COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers

Tests and measurements...

...facing the new FCC rules

Fiber restoration and splicing

Lifting the commercial insertion fog

July 1992

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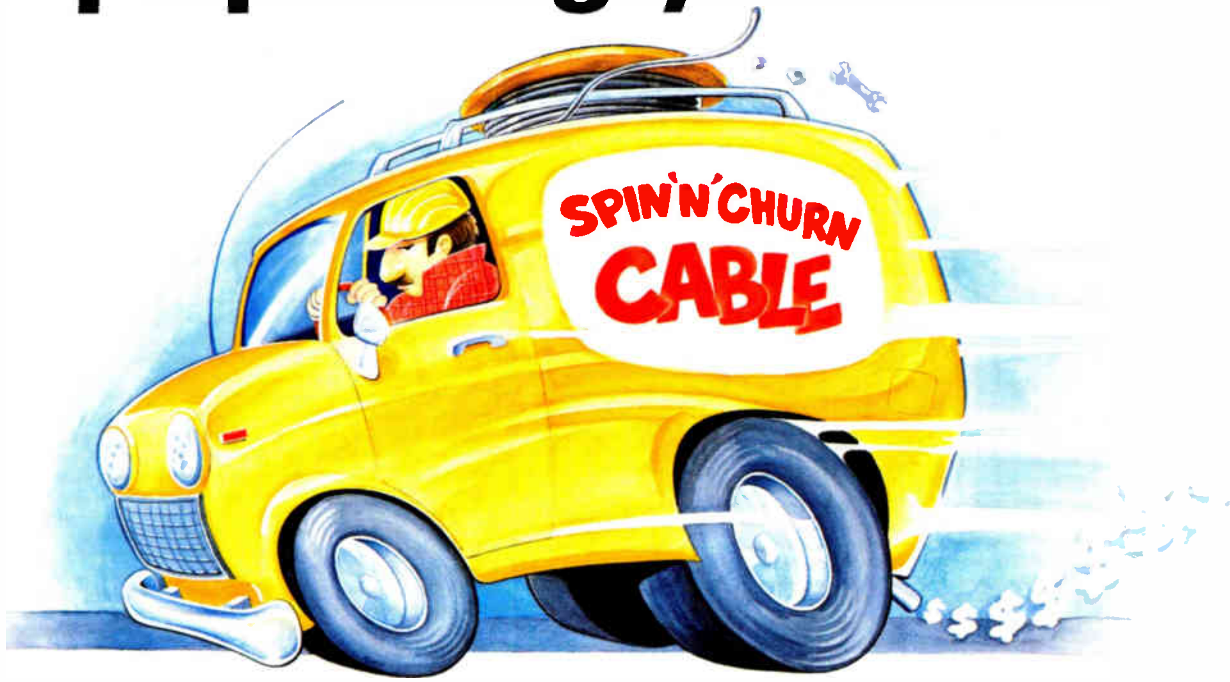

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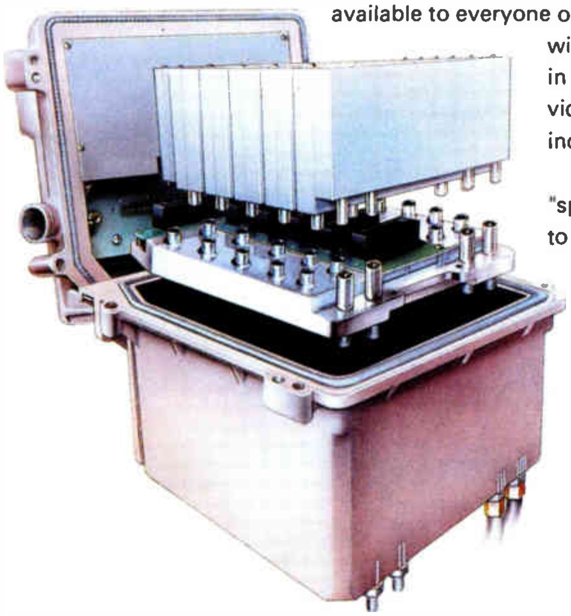

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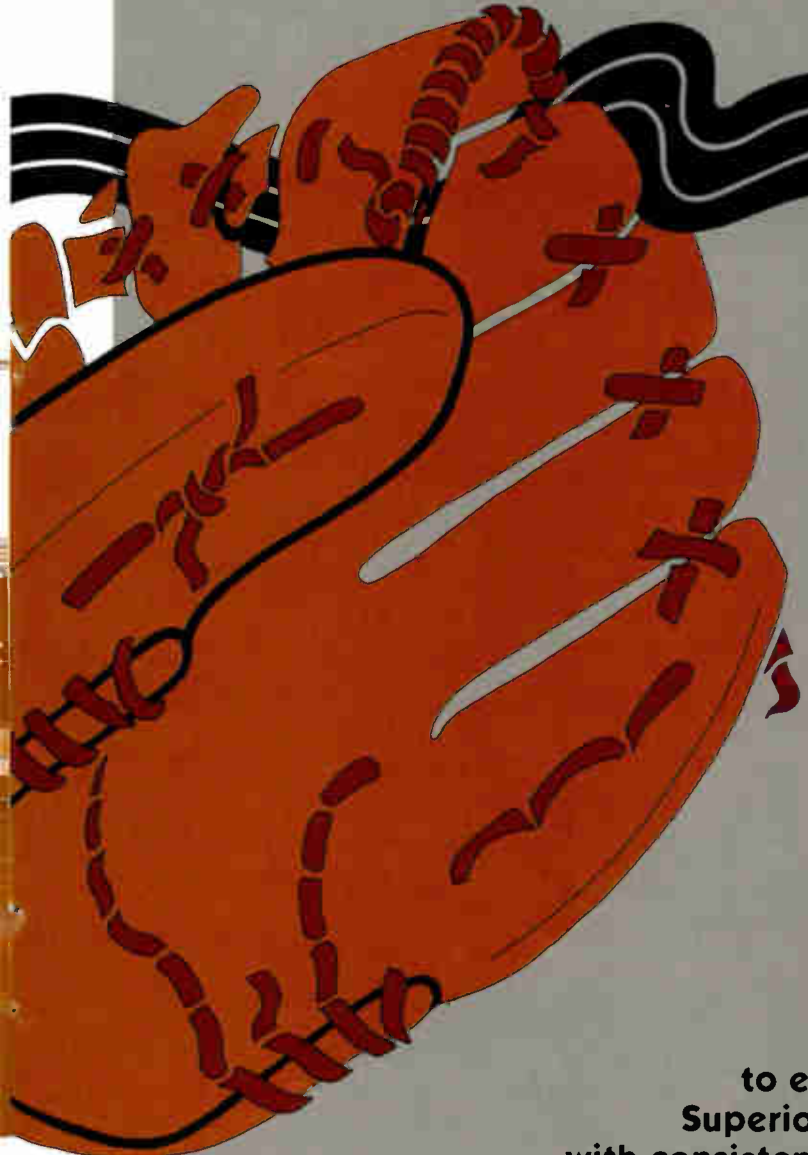

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Reader Service Number 3

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ONI
OPTICAL NETWORKS INTERNATIONAL

Optical Network News

The following highlights are from Optical Networks International's quarterly newsletter.

■ Suburban Cablevision activates YAGLink

April 30, 1992 marked the second YAGLink activation at Suburban Cablevision's East Orange, New Jersey system. The Harmonic Lightwaves' transmitter feeds two hub sites, each at 12 dB optical loss, with performance specifications of 54 dB C/N and 69 dB CSO/CTB, says Bob Ritchie, Vice President of Engineering for Suburban Cablevision.
(See related story in the Summer issue of ONN.)

■ New addition gives operators flexibility

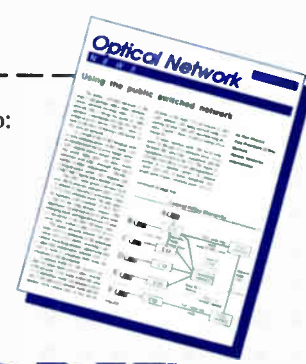
ONI's newest addition to the RESTORPAK™ restoration line incorporates AT&T's UCB1 enclosure. The RESTOR-C-PAK™ gives operators added flexibility during an emergency restoration by enabling a technician to secure and protect the restored splice in the field until a permanent fix can be completed. The UCB1 enclosure also gives the option to make the restoration a permanent fixture.
(For more information, contact a member of the TM&R group at 1-800-FIBER-ME.)

■ Supervising the cable network

As cable networks increase in complexity, so too does the need for network surveillance. The Harmonic Lightwaves' SMS 5000 Network Management System, used in conjunction with the YAGLink system, provides a method of detecting network problems, displaying the status on a PC, and storing appropriate data—without operator intervention.
(To obtain literature on the SMS 5000 System, call 1-800-FIBER-ME.)

■ Mark your calendars

ONI is offering its Digital Networks Training Course during the weeks of July 20-24 and August 24-28, 1992. Held at ONI's Denver Training Center, the course covers digital basics, multiplexing methods, network architectures, telephony applications and digital equipment.
(For more information, contact a member of the TM&R group at 1-800-FIBER-ME.)



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EDITOR'S LETTER

Expo is best yet

I don't know how it's possible, but another SCTE Cable-Tec Expo has surpassed all previous ones. Each year we wonder how the next year's gathering can be better — yet every year it is. The Society, and in particular its national staff in Exton, Pa., are to be commended for a truly outstanding job!

How good was it? The number of exhibit booths was way up, attendance was up (the final figure was about 2,000 regular attendees plus another 1,600 exhibitor personnel), and enthusiasm was as good or better than I've seen at any show. To top it off, it was announced during the awards luncheon that SCTE's national membership has surpassed the 10,000 mark. Join us next month for the only complete wrap-up of Cable-Tec Expo.

The only downside to the whole show was a copy of a petition I saw while there. It's apparently being circulated in California, and is proposing to amend the Society's bylaws. You should understand that I'm not opposed to the petition process, nor any individual exercising his or her right to make use of that process. SCTE's bylaws provide a way for the general membership to petition for a national vote to amend those bylaws. But frankly, this particular effort is nothing more than a nuisance petition: Do the bylaws really need to be changed *again*? I don't think so, especially the way this petition proposes. If you are approached to sign it, I suggest that you decline. Here's why.

The proposed changes appear at first glance to be relatively straightforward. But they are actually very misleading, by virtue of what they don't say. Furthermore, the cost to hold a special national election will be several thousand dollars, which I find hard to justify spending for such things. The petition consists of the following seven items (shown in italics), most of which are simple yes/no questions. My comments follow each one.

• *Should the president of the SCTE be elected by the voting membership?*

This, of course, refers to the current position of chairman (it used to be called president). As stated, this question seems to make sense. After all, shouldn't the voting membership of an organization elect its president? That depends. Do the shareholders of a corporation elect its officers? In most cases, no. That task is

taken care of by a shareholder-elected board, the same as is done in the Society. In SCTE's case, the "shareholders" are the national members, which put their confidence in the directors they elect to choose the Society's leadership.

• *Should the eastern and western vice presidents be elected by the voting membership?*

That's the eastern and western vice chairmen. See previous comments.

• *Should the secretary of the SCTE be elected by the voting membership?*

Also see above.

• *Should the treasurer of the SCTE be elected by the voting membership?*

Ditto.

• *The term of the above officers shall be: 1 year___ 2 years___*

Right now it's one year.

• *Should all eligible voting members of the SCTE be eligible to seek the above positions?*

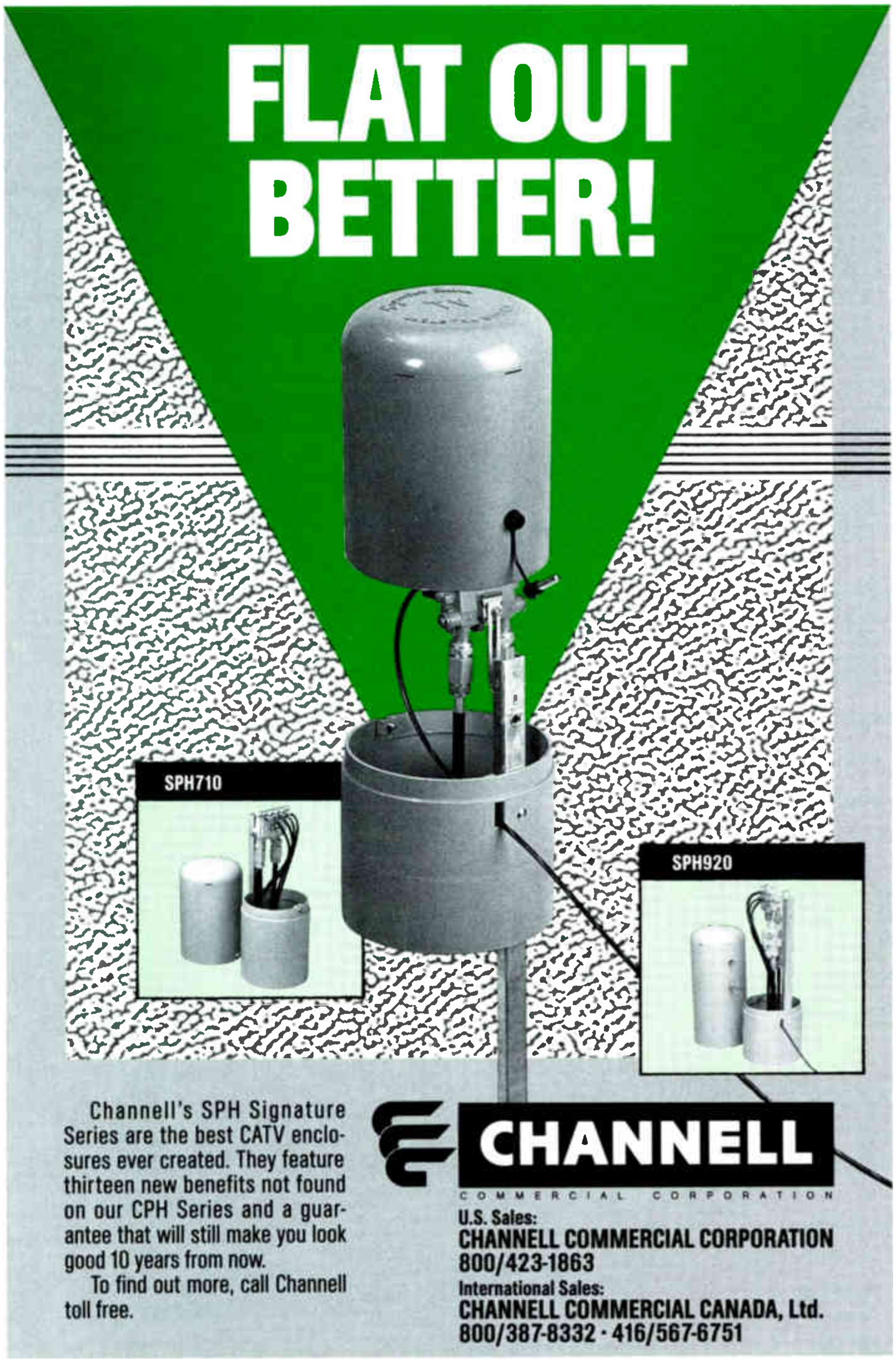
Just what would define a voting member as "eligible"? Presently any Active, Senior or Fellow member can run for the board, and if elected, seek office.

• *Should the title of the highest paid position of the SCTE staff be the executive director?*

Formerly called executive vice president, the membership voted to amend the bylaws to change this position to president. This appears to be nothing more than an attempt to slam Bill Riker, who is doing a damn good job.

That's my opinion. Let's hear yours.

Ronald J. Hranac
Senior Technical Editor



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

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

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

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CT 7/92

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The SCTE Installer Certification Program was created to establish minimum skill requirements for CATV installers and installer/technicians. Participants in the program must successfully complete practical examinations in the areas of cable preparation and meter reading, as well as a written examination on general installation practice. The program is being administered by local SCTE chapters and meeting groups under the guidance of SCTE national headquarters. All candidates for certification in the program are recognized as SCTE members at the Installer level, and receive a copy of the SCTE Installer Manual.

☐ Please send me information and an application for the SCTE Installer Program.

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Bulletin boards

You may be interested that there is a BBS network called Cable-Net. It is currently carried on the following BBSs:

- LANTA Systems BBS, Atlanta, (404) 451-0202
- Tech-Net BBS, Birmingham, Ala., (205) 853-8134
- Broadcasters BBS, Phoenix, Ariz., (602) 872-9148
- MediaLine BBS, San Diego, (619) 298-4027
- VideoPro BBS, Washington, D.C., area (703) 455-1873
- Programmers Exchange BBS, St. Petersburg, Fla., (813) 527-5666
- Radio Daze, Mishawaka, Ind., (219) 256-2255

Most of these boards have cable-related files. There are lively discussions via messages in various conferences. Subjects and contributors range from MSO engineers typing about cable and fiber systems, manufacturers' representatives about their R&D and customer service, customers about cable problems, satellite engineers about dish-related problems and hints, and a staff member of a trade weekly (*MCN*) about cable finances and industry news.

Many of the boards are free of charge; therefore, the only cost is a long distance call. Please try them and report back in your column what your impressions are. Because Atlanta is a local call for me, I am most familiar with the LANTA Systems BBS.

Lothar Merker
Broadcast Engineer

Editor's note: So many BBSs, so little time. I recently joined the Tech-Net BBS (Birmingham) and give it a definite "thumbs up," although I haven't participated in any of the conferences yet. The whole subject of electronic communications via BBSs might find its way into an upcoming "Communications Technology" article. Stay tuned.

Somewhat curious

I have reviewed the "Lab Report" dated January 1992 on the EXFO FOT92XE fiber test set. I find it somewhat curious that a magazine such as *Communications Technology* would write such an article. If the purpose of this column is to inform the readers on updated technology, it would seem to me that a thorough investigation of all competing products would take place prior to an article such as this.

Although I am sure the EXFO FOT-92XE is a good instrument, there are far more economical products on the market that your customers should be aware of. We, for instance, manufacture the OPM1-4 fiber-optic power meter specific to the cable TV market that costs considerably less. We believe it to be a more commonsense solution to what your readers need.

I would be most interested in learning more about this column and its true benefits for your readers, and would strongly urge that any future fiber-optic test equipment articles include evaluation by all of the manufacturers, not just one company who might be more financially capable of advertising in your magazine.

Michael E. Schneider
V.P., Marketing & Sales
Noyes Fiber Systems

Editor's note: While we would like to be able to present competitive evaluations of similar products from all manufacturers in each month's "Lab Report," editorial space restrictions preclude that. The column was created a little over two years ago to provide a useful service to our readers, especially those who do not have the capability to perform in-depth lab tests. The intent hasn't necessarily been to inform readers of updated technology but rather to objectively evaluate products in a laboratory environment and report the test results to our readers. We choose equipment that may be representative of what's available on the market or is unique in terms of features or capabilities.

Tech update a success in New York

Lake George, N.Y. — The focus was on digitization, fiber and training as more than 350 engineers and technicians were here for the 18th Annual Technology Update sponsored by the New York State Commission on Cable Television and the Society of Cable Television Engineers.

According to Alan Richards, NYSCC coordinator of the event, interest in the program was even stronger than usual. The three-day conference, held for the sixth year at the Roaring Brook Ranch, was supported by 48 suppliers providing table-top exhibits and sponsoring the annual Lake George evening cruise.

SCTE Director of Training Ralph Haimowitz again served in his multiple role as tutor and provocateur stressing the importance of installers as the most critical contact with the customer. His message with regard to setting up training programs: Don't waste time reinventing the wheel.

Haimowitz noted most MSOs already have training courses or send their installers to someone else's such as the ATC Training Center in Denver. He mentioned the National Cable Television Institute's installer correspondence course and also reminded attendees interested in setting up or upgrading their training programs of SCTE's recently updated training manual.

"But don't just limit the training to your own installers," he cautioned. "Make sure your contractors have their people take it, too."

Haimowitz also stressed the importance of prudent purchasing, and cited numerous examples of how the quality of drop cable and fittings can make all the difference in system performance and customer satisfaction.

"The difference in quality that sometimes can cost just a few pennies more must be communicated from installers and technicians in the field to the business office," he said.

This will become even more important as Walt Ciciora, ATC vice president of engineering, noted in terms of increased digitization. Ciciora outlined different digital techniques and potential scenarios for their application to cable TV technology, including fundamental difference for film, video and data transmission. He said multiplexing and movies- or video-on-demand would come first. Real-time compression is still "very hard." And, he said, tiering will be a headache because basic nets are ad-supported and that the compression for ad insertion is not yet the same as compression for video. And, digitization and compression cannot be considered as a substitute for rebuilding and upgrade, Ciciora said.

Ways in which NewChannels Corp. is beginning to apply digital technology with fiber according to Chief Engineer Tom Stanic is connecting headends in larger systems and replacing microwave, regionalizing systems and merging support services, providing fail-safe divergent routing and for ancillary business for commercial and private applications. →

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For more information write to DX Communications Inc., 10 Skyline Drive, Hawthorne, NY, 10532 or call (914) 347-4040.

DX ANTENNA

Reader Service Number 12

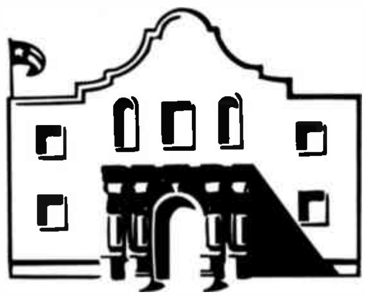
SCTE has 10,000 members!

The national membership of the Society of Cable Television Engineers has passed the 10,000 mark. This represents an increase from 1991's year-end membership count of 9,000, which represented an increase of 1,500 members over the 1990 year-end figure of 7,500 members.

The historic figure of 10,000 members takes into account the Society's 8,500 active members, as well as the more than 1,500 members that have joined the SCTE at the installer level since the introduction of the Installer Certification Program in 1989.

This growth can be partially attributed to the popularity and success of the SCTE's numerous programs and services, including the Chapter Development Program, Broadband Communications Technician/Engineer (BCT/E) and Installer Certification Programs, annual Cable-Tec Expo, annual Fiber-Optics conference and the Technology for Technicians national training seminar program.

Reaching the 10,000 mark is an important event in the Society's history. This figure indicates the broadband industry's technical community's ongoing appreciation and support of the training and services provided by the Society. The SCTE looks forward to continuing its efforts to serve the industry.



Society presents awards at Cable-Tec Expo '92 luncheon

The Society of Cable Television Engineers held its Annual Awards Luncheon June 14, the opening day of Cable-Tec Expo '92, at the San Antonio Convention Center in San Antonio, Texas. The following members and organizations were recognized at the luncheon:

- Expo Program Subcommittee members William Riker and Dan Pike (co-chairmen), Bill Arnold, Richard Clevenger, M.J. Jackson, Paul Levine and Leslie Read received awards for their efforts for Cable-Tec Expo '92.
- The Program Subcommittee of the "Fiber Optics Plus 1992" conference was recognized for its efforts in the planning of the successful January 1992 conference. Receiving awards were Alex Best (chairman), Edward Callahan, James Chiddix, David Fellows, Bill Riker, David Robinson and David Willis.
- The following were recognized for their contributions as technical program coordinators at regional cable shows: Wendell Woody (Texas Cable Show); Diana Riley (Atlantic

Cable Show); Vic Gates and Ralph Haimowitz (Great Lakes Show); William Riker (Western Show) and Richard Henkemeyer (North Central Cable Show).

• The former Magnolia Meeting Group of Brandon, Miss., was elevated to full chapter status in the Society.

• Outgoing members of the SCTE board of directors were: Ted Chesley (Region 3), Vic Gates (Region 7), Les Read (Region 4) and Wendell Woody (Region 5).

• Frederick Baker of Viacom, Robert Baker of TCA Cable TV, Richard Beard of Continental Cablevision, Paul Biederman of ComSonics Inc., William Cohn of Zenith Electronics, David Devereaux-Weber of American Communications Consultants Inc., Darrell Eichelberger of Cablevision of Shreveport, Sydney Fluck of CaLan Inc., Donald Gall of American Cablevision, Joseph Gregory of Cablevision Systems Corp., Lawrence Lockwood of TeleResources, Jon Ludi of Continental Cablevision, Pamela Nobles of Jones Intercable, Edward Parsen of Spirit Lake Cable TV, Thomas Prichard of Engineering Technologies Group, Peter Rumble of TCI Cablevision of Washington, David Slabaugh of Cencom Cable Associates Inc., Alan Tschirner of American Cablevision, John Vartanian of Home Box Office, Norman Weinhouse of Weinhouse Associates, and Gary Wesa and Ronald Wolfe of American Television & Communications were elevated to senior member status.

• American Television & Communications Corp. was the recipient of the 1992 President's Award in recognition of its support of the Society.

• Jack Gobbo of United Artists Cable of Santa Cruz, Calif., received first place in SCTE's second annual Field Operations Award competition. He won for his presentation on "The Jack Knife." Fred Hall of Cablevision in Hauppage, N.Y., and William Gorecki of MetroVision in Detroit were the second and third place winners respectively.

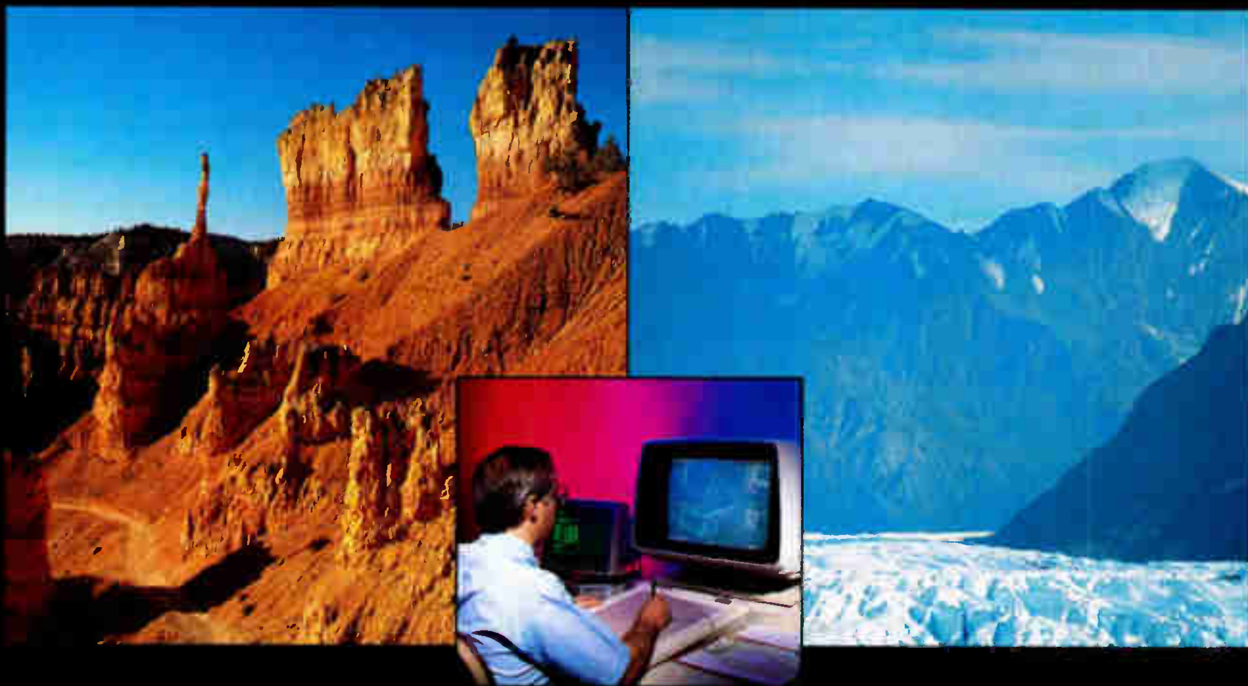
• SCTE Personal Achievement Awards, which were established (based on the SCTE Outstanding Achievement Award) to recognize technical personnel in our industry for outstanding job performance, were presented to Pierre Cubbage of Mega Hertz Sales, James Fronk of Multimedia, Don Gall of American Television & Communications, Mark Graalman of Buckeye Cablevision and Mark Wuller of Continental Cablevision.

• SCTE At-Large Director Tom Elliot of Tele-Communications Inc. received a Special Recognition Award in honor of his active participation in the Society's Engineering Subcommittees.

• Rex Porter, Jim Stilwell and Dave Willis were inducted into the SCTE Hall of Fame. In 1988, SCTE created its Hall of Fame and honored Cliff Paul as its first inductee. The second inductee, Len Ecker, was honored at Cable-Tec Expo '91 in Reno, Nev.

• Ron Wolfe of American Television & Communications was the 1992 recipient of the Society's Member of the Year Award in recognition of his service to the SCTE. Among his SCTE activities are serving as chairman of the Society's Cable-Tec Games Subcommittee and Career Path Working Group, as well as serving on the SCTE Publications and Videotape Development and Scholarship Subcommittees.

WE GO TO EXTREMES.



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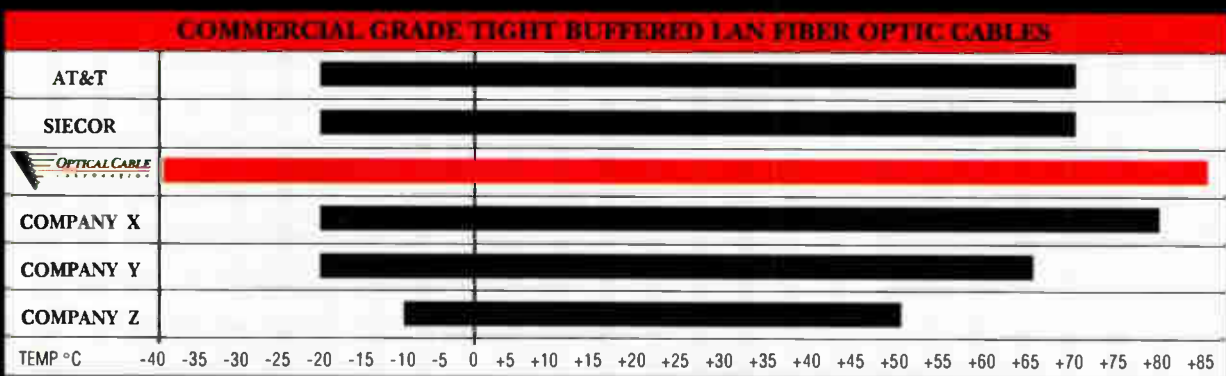

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Facing the new FCC technical standards

By David Willis
Technical Consultant, Tele-Communications Inc.

They're here. They're now. Let's grab the bull by the horns and instead of getting gored, let's make some steaks out of this deal. It was my feeling that the original technical standards did the industry a lot of good. It made us do a lot of testing and a lot of maintenance that would have been real easy to skip. In my estimation, it also made us significantly more aware of the benefits of good maintenance (especially when it was routinely tested and documented). Don't look at the new rules as a burdensome imposition. Instead, look at them as an opportunity to take our systems to the next level of performance and to clearly document that performance. Let's take a brief look at the history of technical standards and then quickly go through the new testing requirements.

The initial Part 76 Technical Standards promulgated by the Federal Communications Commission were adopted in 1972. These standards were applicable to Class I or "broadcast" channels only. Also at that time, franchising authorities were permitted to establish and enforce their own technical standards. In 1974 the Commission pre-empted this right. Then, in February 1985 it elected to terminate its enforcement of Part 76 standards (except signal leakage) although retaining them as guidelines for franchising authorities. In February 1992 the FCC re-established technical standards for the CATV industry. The new rules reflect substantial input from both the CATV industry and cable regulators at the franchise level.

There are, however, some significant differences between the original standards and the new ones. The differences are not onerous but simply reflect the advancements in technology that have occurred in the 20-year span separating the two sets of standards. The new standards are applicable to all NTSC channels on the system. This, then, extends the performance standards to all satellite channels as well as the broadcast channels. This is certainly logical and reasonable.

Bob Sullivan

The new rules are comprehensive, address the normal "problem" areas encountered in CATV, and really define the kind of performance that modern CATV systems should be providing. While compliance with the new technical standards is required for all cable systems, those systems with fewer than 1,000 subscribers are exempted from the testing requirements, which is another example of the logical and practical effort that has resulted in the new rules.

Let's look at the specific requirements and what they mean to the operating CATV system. For our purposes here, we will not go into the specified number of test locations, data retention, test frequency, public file, etc. Rather, we will look at the performance standards.

Aural carrier frequency

Aural carrier frequency must be maintained at 4.5 MHz ±5 kHz above the frequency of the associated visual carrier. This frequency must be maintained at the subscriber terminals and at the output of the modulating and processing equipment.

This requirement is very similar to the original rules. It is easily met with reasonably modern equipment.

Visual signal level

Visual signal level must be 1,000 µV (0 dBmV) across 75 ohms at the subscribers' terminals. It shall not be less than 3 dBmV at the end of a 100-foot simulated drop. (Appropriate calculations must be made for impedances other than 75 ohms.)

The initial requirement is the same as the original specification. The 3 dBmV requirement places little burden on the system.

The visual signal level on each channel cannot vary more than 8 dB over any six-month interval. The measurement of this variation shall include four tests in six-hour increments, during a 24-hour period in July or August and a 24-hour period in January or February.

It must be maintained within 3 dB of any other visual carrier within a 6 MHz nominal frequency separation (adjacent channel). Also, it must be maintained within 10 dB of any other channel on any system up to a 300 MHz upper frequency limit. For each 100 MHz above 300, the requirement is relaxed by 1 dB.

Visual signal level must be maintained at a level that will not cause signal deterioration due to receiver overload.

The requirements of this rule are reasonable and the testing straightforward and relatively easy, although larger systems with numerous test points will find the requirement time-consuming.

Aural signal level

Aural signal level must be maintained between 10 and 17 dB below the associated video carrier level. This requirement must be met at the output of the modulation and processing equipment and at the subscriber terminals.

This is actually a slight relaxation of the old rules.

Amplitude characteristic

The amplitude of each channel shall be ±2 dB from 0.75 MHz to 5 MHz above the lower boundary of the specific channel.

This parameter is primarily a function of the headend equipment, although system frequency response problems could affect it. The FCC took note that the real problem here would be caused by the use of traps. In order to permit the continued use of traps, the commission ruled that these measurements can be made prior to the traps, thus eliminating any impact they might have on in-channel frequency response.

Carrier-to-noise

The ratio of RF carrier level-to-system noise rises gradually. It is 36 dB 15 months following publication of the new rules in the Federal Register, 40 dB one year later and 43 dB at that point in time that is 90 days and three years after publication. It should be noted that for Class I channels, these requirements are applicable only to those channels that are delivered in the Grade B of the station by a cable TV system, those channels that are picked up in the grade B of the station or those that the cable TV system receives via direct video interconnect.

As we move to larger screens and better all-around video reproduction by the TV receivers, all signal impairments are going to become more obvious in the picture. The current ultimate target of 43 dB is generally quite achievable and given the grace period of three years, it appears to be a practical path to superior performance.

"Look at (the new technical standards) as an opportunity to take our systems to the next level of performance and to clearly document that performance."

Carrier-to-coherent disturbances

Carrier-to-coherent disturbances include intermod, second- and third-order, and discrete-frequency interference.

For non-coherent (i.e., HRC) CATV systems the ratio of carrier-to-coherent disturbances shall be 51 dB and for coherent systems the ratio of 47 dB shall be required for frequency-coincident disturbances. These parameters are to be measured using modulated carriers and time-averaged.

Once again the numbers are quite reasonable and the testing processes are not burdensome.

Terminal isolation

Terminal isolation shall not be less than 18 dB. The rule further states that the isolation must be adequate to prevent any subscriber terminal from causing visual impairments at any other subscriber's terminal. The commission allows the use of manufacturers' specifications to illustrate the isolation provided by their specific equipment in lieu of actual testing.

Hum or repetitive transients

Low frequency disturbances (hum or repetitive transients) shall not exceed 3 percent of the visual signal level. Again, this is a reasonable level and quite easily tested using well-known processes.

A three-year implementation

This next part of the technical standards has a three-year implementation time frame and is then to be tested on three-year cycles. This rather long implementation time and the liberal test requirement is a very practical approach that will result in very good compliance. These parameters, which are baseband video distortion measurements, are not routinely tested and cause some consternation simply because they are not familiar to many in the industry. It should be noted that while these tests require some fairly exotic test equipment, the tests are required only every third year. Thus, many systems will elect to lease such test equipment. In the case of MSOs, they will buy a minimal amount of such equipment and share it among numerous systems.

Chrominance-luminance delay

The delay in time of the chrominance component of the signal relative to the luminance component shall be within 170 nanoseconds. The equipment used here is normally a video signal generator precision demodulator and a video waveform monitor. Using the 12.5 T pulse, the measurement is done at the output of the headend.

Differential gain

The difference in amplitude between the largest and smallest segments of the chrominance signal (divided by the largest and expressed in percent) shall not be more than 20 percent.

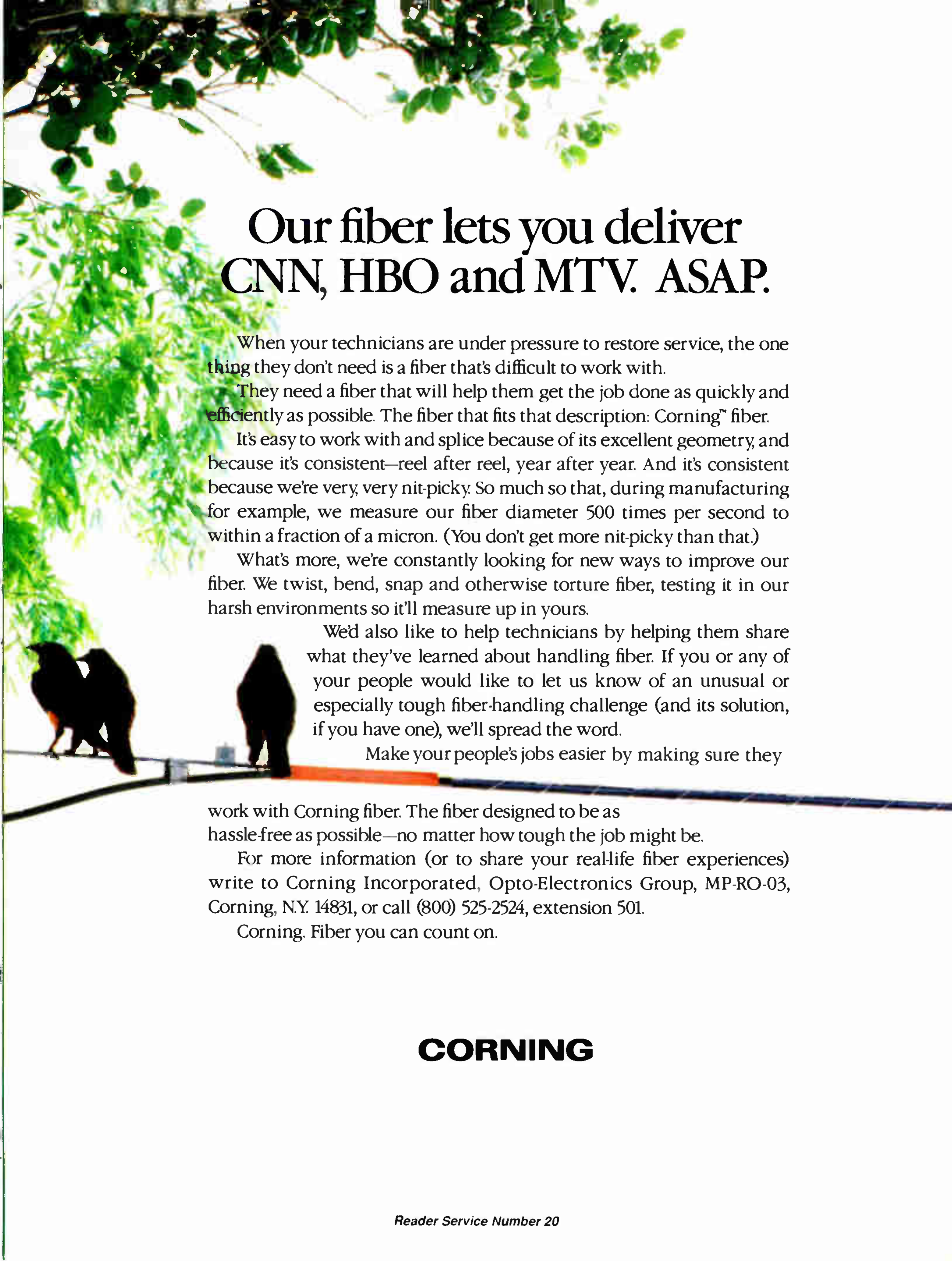
This test also is made using a video signal generator precision demodulator and waveform monitor. A vectorscope may be used in place of the waveform monitor. Video buffs will tell you that 20 percent is relatively easy to achieve.

Differential phase

The difference in degrees between each segment of the chrominance signal and the reference segment at blanking level shall not exceed ±10°. The same equipment is used here with the substitution of a vectorscope for the waveform monitor.

Additional accessories will be required for these last three tests such as filters, attenuators, and test modulators and demodulators. The FCC has validated the measurement techniques put forth in the *NCTA Recommended Practices for Measurement on Cable Television Systems*, Second Edition, November 1989. I recommend that these practices be used. Regardless of the testing techniques used, it will be incumbent on the system operator to demonstrate the veracity of test procedures.

We have touched here only on the testing required by the new rules. You must review the rules in their entirety to assure your understanding of them and to be sure that all documentation and all procedural requirements are not only clear but that you achieve complete compliance with them. The bottom line is: Don't fight it, go with it aggressively and you may find to your surprise that it's not all that painful and yet it assures that your system is delivering the best service it possibly can. **CT**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Reader Service Number 20

Taking the pain out of the 24-hour test

By Rex Bullinger
R&D Project Manager
Microwave Instrument Division
Hewlett-Packard Co.

Twice a year, during the two most extreme weather conditions in the region, cable TV technicians will soon be experiencing the dreaded 24-hour test. In the hottest part of summer and the coldest part of winter, they will have to measure each channel's visual carrier level every six hours over 24 hours. In addition, they must do this at six or more points in the system. If the system consists of multiple AML hubs, the new Federal Communications Commission rules require that these six or more test points be chosen for each hub. The number of required measurements adds up fast.

Theoretically, one technician could test one set of six test points by traveling to and testing each of the six test points in turn, one per hour. Four cycles of this process would cover the required 24-hour period. Unfortunately, many systems will require more than six test points because they have more than 12,500 subscribers. Our technician could still complete the job if he or she could test more than six test points in each six-hour period. However, the reality of the testing environment makes our theory look conservative and reveals the significant cost of the 24-hour test. It is more likely that a crew of technicians will be assigned the job and overtime and extra duty compensation will be unavoidable.

Human beings were not designed for this type of work. A 52-channel system with no AML hubs will need a minimum of 52 channels x 6 test points x 4 per 24-hour period = 1,248 measurements. Errors in testing and data recording will happen. An excessive error rate might even require retesting.

Figure 1: System monitor measurements printout

HP85716A CATV SYSTEM MONITOR MEASUREMENT on 5/13/92 at 13:34
LOCATION CODE = 1234567
ENTERED TEMPERATURE = 105
SERIAL # = 58
SYNTHESIZED TUNING = YES
OVEN REFERENCE = YES

STD Ch #	Visual FREQ. (MHz)	Diff. Vis-Aur FREQ. (MHz)	Visual LEVEL (dBmV)	Diff Vis-Aur LEVEL (-dBc)	Depth of MOD (%)	NCTA Hum (%)	C/N (dB)
2	55.2598	4.5000	14.1	14.2	88.5	1.4	45.5
3	61.2504	4.5000	15.9	14.8	87.1	0.8	43.7
4	67.2401	4.5000	16.0	17.2	91.3	1.2	43.2
5	77.2601	4.5000	14.7	15.1	89.7	1.5	45.4
6	83.2476	4.5000	13.8	14.8	80.3	1.4	44.4
*99	115.2776	4.5000	13.1	14.6	80.0	-	45.6
14	121.2620	4.5000	10.4	13.0	90.3	2.6	43.2
15	127.2620	4.5000	10.9	14.8	89.3	1.6	43.2
16	133.2620	4.5000	11.4	15.3	86.6	1.4	44.4
17	139.2466	4.5000	12.2	16.3	86.7	1.2	43.5
18	145.2636	4.5000	13.1	23.2	72.5	1.1	46.7
*19	151.2501	4.5000	13.4	14.1	73.2	-	47.1
20	157.2533	4.4997	12.7	15.3	90.1	2.8	45.7
*21	163.2479	4.5000	11.6	11.8	78.3	-	44.0
*22	169.2490	4.5000	11.9	13.7	83.7	-	44.5
7	175.2402	4.5000	10.8	14.5	87.9	1.6	45.3
8	181.2489	4.5000	11.2	13.8	79.2	3.1	45.5
9	187.2601	4.5000	11.8	14.2	90.1	1.4	44.2
10	193.2468	4.5000	11.3	17.7	89.7	1.9	43.5
11	199.2489	4.5000	9.9	15.8	97.9	1.8	46.3
12	205.2472	4.5000	8.2	15.4	91.1	2.7	45.0
13	211.2490	4.5000	9.1	15.2	70.6	2.0	43.9
*23	217.2627	4.5000	10.1	14.0	79.2	-	45.4
24	223.2641	4.5000	8.2	14.7	93.5	1.7	43.9
25	229.2609	4.5000	10.3	15.9	88.8	1.5	42.9
26	235.2646	4.5000	8.9	14.8	84.0	1.4	44.8
*27	241.2619	4.5000	9.3	14.5	72.9	-	42.6
*28	247.2646	4.5000	6.7	13.8	76.4	-	43.4
29	253.2616	4.5000	7.1	14.7	90.7	1.6	44.4
30	259.2625	4.5000	6.2	14.4	86.3	2.0	44.0
31	265.2640	4.5000	6.8	13.8	85.3	2.0	44.1
32	271.2626	4.5000	6.7	12.8	89.8	2.3	43.5
33	277.2614	4.5000	7.3	13.7	90.6	1.5	43.9
34	283.2595	4.4999	6.1	16.0	67.0	2.0	39.8
35	289.2582	4.5000	5.6	13.6	85.9	1.8	41.0
36	295.2631	4.5000	4.0	13.6	85.1	1.8	39.3
37	301.2623	4.5000	6.7	15.3	85.3	1.8	43.6
38	307.2623	4.5001	5.8	14.6	87.9	1.9	43.7
39	313.2623	4.4999	6.6	14.8	81.8	2.0	43.5
40	319.2623	4.4998	6.1	17.9	85.9	2.5	42.9
41	325.2623	4.4999	1.9	16.6	87.4	2.8	39.7

Using automatic instrumentation

The HP 85716A CATV system monitor measurement personality makes and records all these measurements using a companion HP 8590B or HP 8591A spectrum analyzer quickly, accurately and repeatedly. After testing, it prints a report directly on a printer in a table format. This printout can easily be used to check the data against the new FCC rules. Minimum level and adjacent carrier level differences of greater than 3 dB are easily seen, as are overall system differences of greater than 10 dB. (See Figure 1, note shaded areas.) Also, channel level variations greater than 8 dB over the measurement period are easily seen.

When the system monitor is configured to test only for visual and aural levels, it takes less than 11 seconds to measure each channel. A 99-channel

(Continued on page 34)

FiberTrunk™ 2400 Fiber Optic Analog Video Transceiver

- Plug-in Modules (up to 4 Tx & 2 Rx)
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- For CATV Trunk and Supertrunking (45 to 610 MHz)
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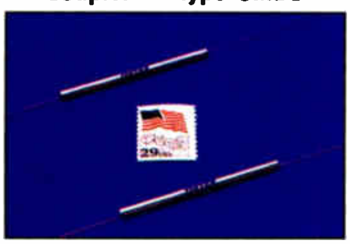

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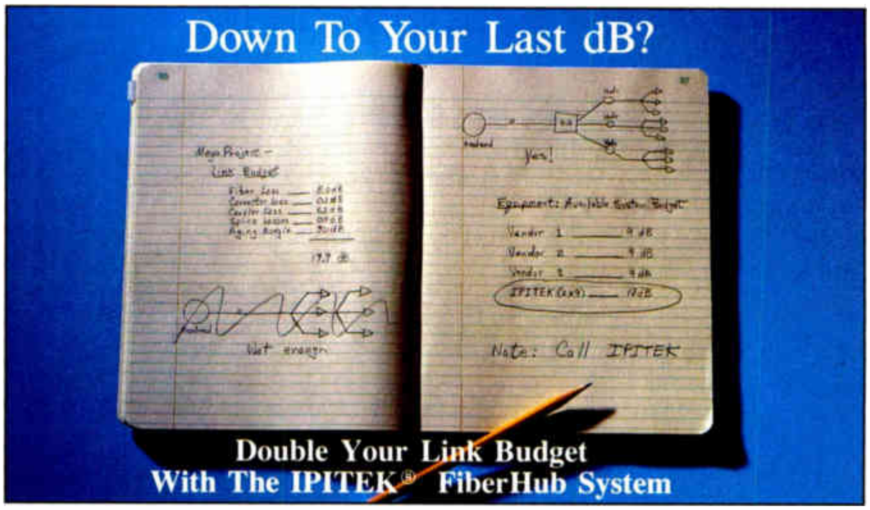

The Unique FiberHub™ System

The system uses a unique SuperTrunk/Star configuration to double the available link budget. You can get all or any part of the system, including the Trunk, the Hub or the Nodes. Completely modular and fully connectorized, the FiberHub network can increase your optical link budget to 18 dB. By installing the FiberHub optical repeater station, multiple 9 dB link budgets are added to the system while minimizing the number of active electronic devices between the source and the subscriber. That means less noise and distortion, improved reliability and lower maintenance costs.

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- Status Monitoring

The FiberHub™ 4800

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- Status Monitoring
- Configurable to Suit Any Architecture
- Emergency Alert

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The FiberNode 600 is a highly linear, wideband optical receiver with AGC and built-in RF amplification, and is enclosed in a weatherproof, RF-tight housing.

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A guide to testing fiber plant in CATV applications

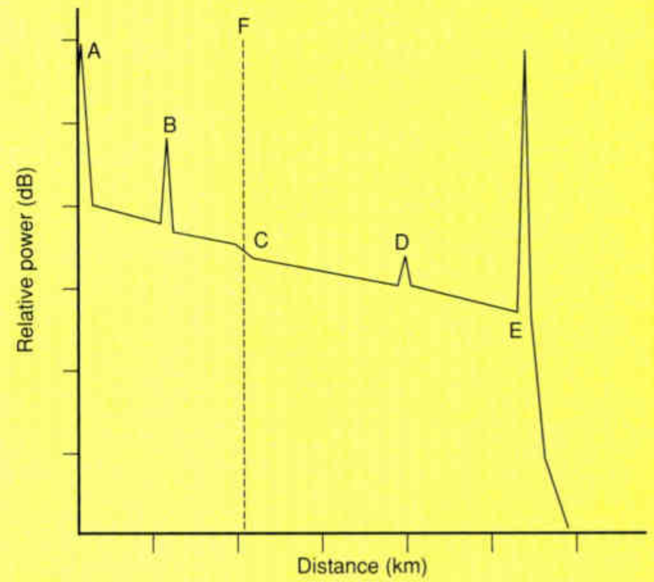
This article will identify a few minimum recommended test practices that will position the prudent system operator to take advantage of a powerful new transport medium — fiber optics — in both the short term and the future.

By Stuart R. Melton
Sales Engineer, Siecor Corp.

As cable TV systems operators realize the benefits of fiber-optic transmission, aggressive plans are underway to deploy this technology deeper into their cable plants. Along with the enhancements to system performance comes a requirement for attention to testing and characterization of optical parameters. This provides an opportunity to "start from scratch" and perform testing and documentation that will enable the cable system operator to better manage one of the most important current investments, as well as to prepare for future opportunities such as PCNs and alternate access services.

In the past, conventional fiber-optic systems were designed based almost completely around optical attenuation, specified as a link loss budget. The recent advancements in high-quality analog systems require attention to additional optical parameters. A thorough testing and documentation regimen will ensure that current performance and future upgrades and enhancements are not compromised. Three fundamental test procedures will provide the basis for managing this important long-term investment: insertion loss (attenuation), optical time domain reflectometer testing and optical return loss.

Typical OTDR display



Key
A — Start pulse, dead zone
B — Connector pair
C — Fusion splice or bend loss
D — Mechanical splice
E — End of fiber, termination point or fiber break
F — Cursor

Insertion loss testing

Insertion loss or end-to-end attenuation testing represents optical power loss and is the key limiting factor in assuring the proper performance of a fiber system. The optical properties of the glass fiber itself as well as splices, connectors, optical couplers and isolators, all contribute to the total attenuation of the cable plant.

Much of the CATV cable plant is installed aerially — by far the most rigorous and physically demanding environment for fiber-optic cable. Yet, properly designed cables can withstand environmental extremes and protect fibers adequately if they are installed and handled correctly. Improper handling and installation techniques may induce attenuation, which can dramatically affect performance over the life of the cable. It is important that every fiber is characterized by testing after installation, splicing and termination are completed.

The level of attenuation acceptable for a given system is determined primarily by the end electronics being used. System designers should plan well within this link loss budget to allow for system upgrades, degradation and aging of the end equipment, and the unfortunate reality of restoration splices. In order that the test and measurement data be accurate and meaningful, several guidelines should be considered:

- The test equipment should mirror the operating wavelengths of the current system and potential upgrades; the fiber should be measured at both the 1,310 and 1,550 nm windows. While the intrinsic attenuation of the fiber is typically higher at 1,310 than at 1,550 nm, the fiber is much more bend-sensitive at the longer wavelength. It would be unfortunate to find that a system operating at 1,310 nm is obsolete at 1,550 nm, prohibiting future enhancements such as wavelength division multiplexing.
- Match the reference and system access jumpers to the system being tested. The fiber type and connectors should be the same as the system being tested.
- Test the system in one direction to obtain documentation that may be required for rerouting or return path applications. (Reference Electronics Industry Association standard EIA-455-171, Method B.)

OTDR testing

While end-to-end attenuation measurements can provide information about the cumulative loss in the cable plant, it provides no data on the loss of individual events or components such as splices or connectors, nor will it reveal and localize losses due to macrobending or microbending. This is extremely important as the life of the fiber can be greatly affected by stress resulting from improper handling; for example, a kink in a fiber caught in the lip of a closure. (Although most optical cable designs are made to protect the fiber from environmental stresses, proper handling and installation of cables and fibers is required to ensure performance is not impaired.)

(Continued on page 36)

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Network telemetry and control — More than just status monitoring

By John Brouse
Senior Project Engineer
Jones Intercable Inc.

Every cable TV system operator has, uses and fully relies upon a network status monitoring system. In fact, nearly all technical activity and workforce schedules revolve around the network monitor. Unfortunately, for the overwhelmingly majority of operators, their system for monitoring the cable network is the *subscriber*. While this arrangement has been an acceptable practice in the past, it has become the industry's leading liability. A subscriber-based monitoring system is inaccurate, unreliable, time-late and obtrusive. A change is needed.

Before considering a different approach toward network management, the forces influencing our industry's future should be examined. Five global trends will impact our future business:

1) Percentage of households without cable is shrinking.

2) Open marketplaces are emerging.

3) Workforce size and skills are declining.

4) Consumer expectations are rising.

5) Digital formats are replacing analog signals.

Reduced growth

It should be generally recognized that cable penetration has reached the 60 percent level; the implication is that the reduced core business growth rate will eventually reach zero. To exemplify this, I've chosen the telephone industry as a business cycle model. The telcos achieved 91 percent penetration of the residential telephone market by 1982 and added only another 2 percent over the entire following nine-year period. In basic terms this translates into having no significant penetration improvement in the past decade nor any real potential for penetration growth in the future. In response, the telcos have created growth in other areas such as additional service offerings like call-waiting, call-conferencing and call-forwarding. As the telco operators have experienced, our current core business growth is not unlimited.

Competition

In recent times, the trend in Washington has generally been a push toward increased competition within the marketplace. Examples of this include deregulation of the airline industry, Judge Greene's divestiture decision against AT&T and, more recently, the ruling for two operators per market in the case of interactive video and data services (IVDS). The Federal Communications Commission and congressional mandates in favor of competitive markets will compound our core business growth declination as new entrants emerge (i.e., the telcos). Competition from MMDS (wireless cable) and DBS (direct broadcast satellite) operators will be strengthened as they develop competitive programming.

Thus, increased competition from MMDS, DBS and the new entrants will tend to reduce our current market share of the residential video entertainment business. The cumulative effect of reduced core business growth and reduced market share will lower our future revenue growth and, in some markets, turn growth into a loss. While the competitive marketplace appears threatening, it promises to open avenues for generating the new revenues needed to sustain our industry's future. Examples of next-generation revenue streams could include competitive access for telephony's interexchange carriers, transport provisioning for the personal communications systems operators, or high-speed data transmission for local, high-volume traffic users.

Workforce 2000

As we enter the 21st century, the workforce will present considerable challenges to our industry and the economy. This next century ushers in an era of declining workforce numbers and an aging of our society. Babyboomers, the bulk of today's workers, will be exiting the workplace and moving toward fixed income. They are being supplanted by a smaller workforce population possessing lesser skills. This is already evidenced by declining academic achievement scores and our growing national agenda to improve the educational system.

The combination of fewer workers and lower job skills will cause operating expenditures to increase as the competition for workers escalates. Additional expenditures also will be incurred as operators develop job skills training programs. These training programs will be required as a means of correcting skill deficiencies within the workforce.

Expectations

The fourth sphere of influence is the consumer's growing level of expectation. Technology has inundated and forever changed our lives. The telephone has moved from the shared "party-line," operator-assisted system of the 1950s to today's touch-tone, direct-dial system that provides nearly instant communications worldwide. We no longer question the telephone circuit availability — we expect it. Likewise, the telephone signal has improved to the point where static or circuit cross-talk is considered objectionable. We now rely on fax transmissions and electronic mail for conducting routine business. We do not question the message reaching its destination; we expect it *and* we expect it to arrive without distortion.

Audio entertainment in the home has moved from the static-laden AM radio broadcasts to clearer sounding FM broadcasts to stereo LP recordings, finally arriving at today's pristine sounds of CD players and laser disc technology. In every example, technology has pushed the quality barrier. The consumer's natural tendency, then, is the expectation that quality will keep improving.

Not only has technology improved signal quality, it has made tremendous

(Continued on page 52)

Commercial insertion: Maximizing revenue with existing technology

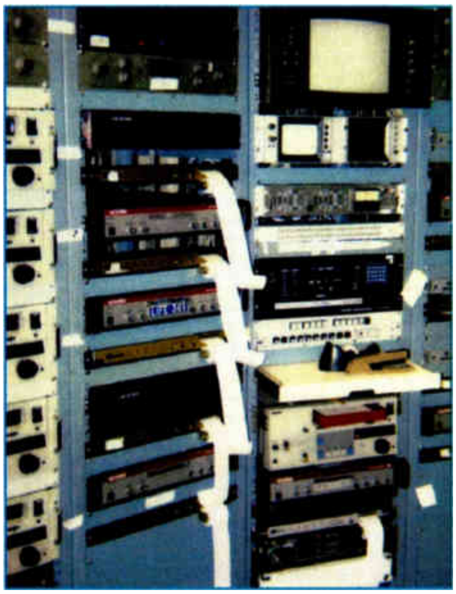
This article provides a brief overview of how Warner Cable's Cincinnati operation uses its existing technology to maximize advertising revenue.

By Edwin M. Eakins
Broadcast/Advertising Operations Manager
Cincinnati Division, Warner Cable Communications

The tremendous value of local advertising capabilities in satellite networks enables the cable operator to maximize revenue with existing technology. The opportunities for revenue, system promotion and community service are vast for those systems capable of utilizing this extensive resource to reach their subscribers. However, the actual process of ad insertion requires a careful balance of information flow, equipment handling, product quality and able staffing.

Warner Cable inserts advertising on 10 cable networks: ESPN, USA, CNN, Headline News, MTV, Lifetime, TNT, TNN, Arts & Entertainment and Nickelodeon. Approximately 30,000 spots are inserted each month, making use of every local avail 24 hours per day.

Accuracy of information and efficiency in tracking orders, schedules and revenue are of great importance. Orders received from advertising sales, sales and marketing, and public relations are processed by Warner Cable's traffic department through a PC-based system called Soft-Link, which schedules priority, rotation and time period. This traffic system also time-certifies spots and provides billing information. Accuracy in identifying spots with ID numbers is essential. Warner Cable identifies multiple cuts on continuity supplied to traffic, which is then passed on to personnel for their handling.



Inserters and spot reel playback units.

The Cincinnati Division began its commitment to sequential insertion in the early 1980s. The system uses Channelmatic Spotmatic Jr. inserters, frame synchronizers and 3/4-inch SP Sony 9000 VCPs on all channels. Daily spot reels are compiled for each channel via a Pegasus compilation unit. The Pegasus receives scheduling information downloaded from traffic. Edit lists are then compiled based on this information. Time-code stripped record tapes are placed in five Sony BVU 850s and a bank reel of commercials in a sixth 850 for playback.

Each of the five record machines is identified as a network and parks at the position where the upcoming spot will be recorded. Pegasus sequences through all active spots on each bank reel needed to complete the daily playback spot reels. When completed, they are toned and quality control checked, ready for the next day's air. As spots air, their IDs and run-times are documented via Channelmatic Logmatic units, which tie back into the traffic system to time-certify spots for billing purposes.

Locally sold and scheduled commercials are received on several tape formats. Warner Cable does not run spots produced or duplicated on VHS. While the majority of spots are on 3/4-inch U-matic, we also can utilize Beta SP and 1-inch. All spots produced locally are shot and edited on Beta SP and transferred to 3/4-inch SP bank reels. Quality of production has been a priority and

Compilation playback recorders.

has steadily improved from 3/4-inch to 3/4-inch SP to Beta SP. The objective is comparative quality with broadcast network-originated breaks, which translates into better playback look. With the sequential system, playback 3/4-inch SP is two generations down from the edited master, or the tape received in-house (original-to-bank reel-to-daily playback reel).

In addition to commercial production, Warner Cable also produces internal sales and marketing promotions and public service announcements. Since Warner Cable utilizes all local avails, consistent quality in production, handling and insertion is very important. Priorities assigned to spots determine scheduling position preference.

Our key to maximizing revenue lies in the hands of our qualified staff. Through cooperative efforts and a team approach, they are able to extract efficiencies beyond equipment capabilities. Lost revenue due to missed spots has remained consistently low, earning the system corporate awards for advertising sales. The following elements are key to the system's success:

(Continued on page 54)

Lifting the digital fog

By Thomas A. Walsh
Vice President, Business Development
Channelmatic Inc.

In the fall of 1991, a dense fog settled into the minds of many able-bodied, technically oriented CATV engineering and management personnel. The fog was created by conflicting reports regarding digital video technology. Some sources reported that digital video transmission and storage systems will soon obsolete VCRs and other analog-based CATV systems. Other reports indicated that digital compressed video was not going to be practical for many years to come.

In reaction to this fog, purchases of analog-based video systems dropped like anchors throughout the CATV industry. Minds were filled with strange new terms like MPEG, JPEG, DVI, discrete cosine transform, vector quantization, spatial transform and selected quantizer-vector-codewords. These were truly strange beasts in a flat analog world. Ships set sail far and wide to learn more about compressed digital video and what it could do for CATV.

The digital video chest of gold

The quest for compressed digital video is in part driven by the desire to eliminate VCRs and videotape from the CATV headend. VCR cleaning, maintenance and repair consume a great deal of time and money. Tapes wear out and must be continually replaced. Local CATV ad insertion operators spend thousands of hours building and rebuilding spotreels. Eliminating these costs is a treasure worth seeking. Also, there is a desire to deliver an ever-increasing quantity and variety of programming to CATV subscribers on existing transmission paths. Going digital could produce a tenfold capacity expansion using existing video paths.

Lifting the fog

Recent advances in computer technology have made the use of high-quality compressed digital video more cost-effective. Previously, digital video was used in high-end broadcast studio applications and lower quality compressed digital video in teleconferencing.

"The quest for compressed digital video is in part driven by the desire to eliminate VCRs and videotape from the CATV headend."

New integrated circuit chip-sets make it possible to decode quality video at a relatively low cost. JPEG (Joint Photographic Experts Group) standard chip-sets are available in production quantities today. MPEG (Motion Picture Experts Group) standard chips are just being released for sale by a few vendors. Many chip manufacturers, such as Intel, have reported that they intend to produce MPEG video decoders in 1993.

Producing quality digital video is no trivial task. High-quality non-compressed digital video requires nearly 250 million bits of information per second. At that rate, a single 30-second advertisement would take up 940 million bytes of disk storage.

Several private technologies and two public standards (JPEG and MPEG) have been developed to compress high-quality video. JPEG was primarily designed for still video, although it can be used for full motion, and MPEG was designed specifically for full motion. The limitation of JPEG is that it compresses each frame of video individually and does not take advantage of frame-to-frame redundancies. MPEG, on the other hand, analyzes each frame and compares them to adjacent frames and eliminates redundancies. MPEG can achieve three times more full motion compression than JPEG at any given quality level.

The MPEG standard in its present form defines a bit stream at a compression ratio that produces VHS-quality video. Studio quality can be achieved by reducing the compression and increasing the transfer data rate. MPEG produces a higher quality picture at a lower data rate than JPEG.

Video encoding (compression) is the most dense component of the digital fog. JPEG circuit boards are now available that can both encode and decode in real-time. U-matic quality can be achieved with standard PC technology, but to achieve Betacam quality, special high-speed computer processing must be used.

MPEG boards are available now for decoding, but the capability to encode at the IC chip level is only in the prototype stage. MPEG compression software is available for use on minicomputers, but requires a high level of technical expertise to operate. MPEG real-time encoding is not far away. Leading chip producers are claiming product in introductory offerings by the fourth quarter of 1992.

Real-time encoding of MPEG is more difficult to achieve than JPEG. The MPEG encoder must not only compress each individual frame, but must also analyze and compare frames to each other. Encoding systems will be sold based upon the speed and quality at which they can compress. Lower cost systems may require minutes per seconds to encode while other multichip set units will encode in real-time.

Charting your course for digital

Choosing the right digital solution is somewhat like buying a PC. If you buy one today, you'll learn about a cheaper, better, faster one tomorrow. If you wait for the best, you'll never buy. The decision should be based upon a two-year return on the investment and an upgradable migration path.

Some VCR-based automation systems sold today are designed to be upgraded for digital video control. Don't be fooled by vendors who say they will have a digital video box that will act just like a VCR and that no changes are required to your existing automation hardware. Current control-track based automation systems require the physical count of control-track pulses to locate video segments. Also, the VCR behavior and timing are carefully monitored for correct operation. If you had a digital video box that acted just like a VCR, it wouldn't be much better than a VCR. It would have to emulate the slow access speed of a VCR in order for the standard controller to control it.

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A digital standard for transmission may not be the best standard for editing, storage or playback. There may be several standards. Low-cost encoding and decoding lessens the need for one universal standard. A closed environment, such as an ad insertion operation, could relate to the world in an analog or digital transmission standard, yet have a different internal digital standard.

VCRs: More than boat anchors

Drawing the conclusion that VCRs will soon go away is not necessarily a correct one. The cost of a digital playback system is proportional to the amount of storage required to perform a task. A digital-based ad insertion system may require the on-line storage of 200 spots. This equates to one hour and 40 minutes of video time. At U-matic SP quality, 3 gigabytes of storage would be required. For the price of 3 gigabytes of hard disk storage and a computer, four U-matic SP videocassette players could be purchased. These four U-matic SP players can store four hours of video. Six S-VHS players could be purchased providing 12 hours of video storage. If three-hour length cassettes were used, 18 hours of video could be stored. In an application that doesn't require high-speed random access, videotape technology may be a more cost-effective approach.

Videotape technology is continuing to improve. Sony has just introduced a new S-VHS VCR that has a very rugged transport and tape control system. This VCR could prove to be three times more reliable than previous U-matic models. Panasonic and JVC have introduced very reliable low-cost S-VHS VCRs. Also, VCR suppliers are talking about lower cost digital videotape machines. These machines will move tape-based systems to a new level of reliability and performance.

Sails and motors: The hybrid approach

Analog and digital, videotape and disk drives can all coexist in a single headend, each technology according to its particular strength in an application. Local programming would be played using VCRs or laserdiscs. Advertisements would be played from computers. If a technology makes economic sense in the short run and can be upgraded in the long run, buy it. **CT**

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Reader Service Number 28

Figure 2: Procedure screen at test point

```
HP85716A CATV SYSTEM MONITOR B.01.02

                  MAIN MENU                              ENTER
                                                      LOCATION
ENTER LOCATION   - Enter Location Code
ENTER TEMP       - Enter Temperature                     ENTER
Measure Now      - Measure Now Menu                       TEMP
Timed Measure    - Timed Measure Menu
Test Plan        - Test Plan Menu                      Measure
Misc             - Miscellaneous Menu                      Now

                                                         Timed
                                                       Measure
Selected --->     2.  3.  4.  5.  6. 99. 14. 15. 16. 17. 18
Channels         19. 20. 21. 22.  7.  8.  9. 10. 11. 12. 13
                 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33    Test
Tune             34. 35. 36. 37. 38. 39. 40. 41                Plan
Config: STD

Location                                                       Misc
Code: 1234567

Temp: 105
```

The 24-hour test

(Continued from page 22)

system can be automatically measured with accurate data recorded to a memory card in under 20 minutes. Smaller systems take even less time, leaving more time to move to the next test point.

The date and time of each measurement is automatically recorded. A seven-digit location code for the test point can be entered, as can the ambient temperature. The location code could contain an operator identity code as well. In addition, the serial number of the analyzer performing the test is automatically recorded along with the data.

A large number of tests can be performed and a large amount of data taken with little or no possibility of human error. Since the measurements are automatic, they are always performed the same way, assuring measurement consistency. The measurements are performed faster than could be done by a human, allowing more work to be done with fewer people. The test data can be sent directly from the analyzer to a printer, formatted as an easy-to-read report. Or, the data can be retrieved into a personal computer for incorporation into a spreadsheet or data base program. For example, simple macros in a spreadsheet program could automatically scan the data, compare against limits and identify measurements not in compliance with FCC rules.

While visual and aural levels of each channel can be measured in under 11 seconds, other measurements such as aural and visual carrier frequency, depth of modulation, hum, carrier-to-noise, and system composite second order/composite triple beat also may be selected. If all seven tests are selected, testing takes about one minute per channel.

Grouping the tests

The vast majority of the measurements required under the new rules fall under section 76.605(a) paragraphs (3), (4) and (5). These paragraphs cover the visual and aural carrier levels of all NTSC channels. The visual levels must be monitored and remain within specified limits over 24 hours during specific months. Fortunately, personnel at the headend are not required for these tests.

Paragraphs (2) and (6) through (10) describe tests to be performed on only a minimum of four selected channels. But some of these tests do require coordination with headend personnel to shut off modulation and/or carriers when needed. These are required twice per year, but are not necessarily required to be done at the same time as the 24-hour test.

Grouping the 24-hour level tests (3 and 4) and the aural level test (5) into one group to be done on all channels, and those to be done on four plus channels (2 and 6-10) into a second group, the system monitor can handle the tests in the first group automatically. In the second group of tests, it can measure the aural carrier frequency (2), and low frequency disturbances (10) automatically. This leaves only the amplitude characteristic (6), carrier-to-noise (7), coherent disturbances (8) and, optionally, terminal isolation (9) tests to be done manually. In 1995, the color tests (11-13) will be added in, but they are headend tests. The HP 85716A also can measure visual carrier frequencies for 76.612.

Step-by-step procedures

• *Before going out for the first test*

1) Warm up the analyzer for 30 minutes

2) Make sure the HP 85716A CATV system monitor personality is loaded. This is indicated by the presence of the key {CATV MONITOR} on the screen after power up or instrument preset. (If the key {CATV ANALYZER} is present, this indicates the HP 85711A CATV measurements personality is loaded. There is not enough memory in the analyzer to hold both the HP 85711A and the HP 85716A simultaneously.)

3) Verify the analyzer time and date are set correctly. (See the analyzer's operator's guide.)

4) Connect a cable between the "calibrator output" connector and the analyzer "RF input" connector.

5) Press {CONFIG}, {More}, {CONF TEST}. This confidence test takes about two minutes.

6) Press {CAL}, {CAL FREQ & AMP}. It takes about 10 minutes to completely calibrate the analyzer. When it is finished, press {CAL STORE} (important).

7) Make sure to have enough RAM cards. A maximum of 12 data files can be stored on any one card. A minimum of two HP 82214A cards will be needed for 24 tests. These RAM cards (also available as HP 85700A) are the same as the 32K RAM card used with the HP-48SX scientific calculator (but not the HP-95LX palmtop computer).

(Using a 128K or larger card is possible, but the extra memory is not usable for HP 85716A data files since only 12 of these files can be stored on any one card regardless of card memory size. However, this limit applies only to HP 85716A data files. There is no limit other than RAM card size to how many other types of spectrum analyzer files — traces, states, etc. — can be stored in addition to the 12 HP 85716A files.)

8) Remove the cable between calibrator output and the RF input. The an-

alyzer is now ready to go to work.

• *Procedure at each test point* (See Figure 2.)

1) Turn the analyzer on and connect the drop cable to it.

2) Insert a memory card in the card slot. Press {RECALL}, {INTERNAL/CARD} so {CARD} is underlined, {CATALOG CARD}, {CATALOG ALL}. Note the number of the highest numbered file; if it is 12, the card is full.

3) Press the {CATV MONITOR} key.

4) Press {ENTER LOCATION} and enter a location and/or technician code. Verify the code entered on the screen.

5) Optionally, measure the outside air temperature. Press {ENTER TEMP} and enter the temperature. Verify the number on the screen.

6) Verify the displayed channel plan is correct. If not, see the section below on creating, saving and recalling test plans.

7) Press the {Measure Now} key, the {DUMP TO CARD} key, and enter the next higher file number as determined in Step 2 of this section. (Be careful here since entering a number that is the same as a file number already on the memory card will overwrite the existing file with no warning.)

8) Have a cup of coffee while the analyzer does its job.

• *When ready to print out the data*

1) Connect a printer to the analyzer, turn both on and press (CATV MONITOR). If the printer configuration needs attention, see the operator's guide for the analyzer (not the HP 85716A personality manual).

2) Insert the memory card containing the test data.

3) Press {Misc}, {Recall Data} and {PRINT DATA}.

4) Alternatively, connect a personal computer to the analyzer and follow the instructions in the HP 85716A user's guide to retrieve the data from the memory card to the personal computer.

• *Creating, saving and recalling test plans*

1) Follow the instructions in either the HP 85716A user's guide or the quick reference guide to create and manage test plans. However, for the quickest completion of the 24-hour test, select only test number 2 for visual carrier level and number 4 for aural carrier level. To create a test plan with continuously increasing carrier frequencies, remember to swap the order of the blocks of Channels 7-13 and 14-22. Also account for the channels between the FM band and Channel 14.

2) Turn CSO/CTB testing off.

3) When saving a test plan in the internal memory, write down which test plan is stored under which of the five keys for later reference. (There is no way to examine a test plan without recalling it.)

Conclusion

The HP 85716A CATV system monitor, operating in the HP 8590 series spectrum analyzers, can reduce the complexity of the 24-hour visual and aural level tests from thousands of technician test operations to just connecting the analyzer at each test point, pressing a few keys and watching it do the work. Test time is significantly reduced and the quality of the data taken is greatly improved. This reduces the overall cost of proof testing to a degree that will quickly pay back the investment. In addition, in the months between test periods, the spectrum analyzer still serves daily as a full-fledged general-purpose instrument. **CT**

Testing fiber plant

(Continued from page 24)

An optical time domain reflectometer will not only characterize these events but will accurately reveal their precise location and, unlike insertion loss measurements, only one end of the cable plant (see accompanying figure on page 24).

Like an optical radar, the OTDR sends optical pulses of laser light into the fiber and measures the magnitude and transit time of power reflected back into the unit. The information is displayed on a CRT in the form of optical power (Y-axis) vs. distance (X-axis). Some OTDRs will provide printing and disk storage capabilities for system documentation. The OTDR senses two types of reflective phenomena: 1) Rayleigh backscatter, which occurs throughout the length of the fiber and 2) Fresnel reflections, which are generated at abrupt changes to the index of refraction at connectors, mechanical splices or a break in the fiber.

The multifunction OTDR is an indispensable tool for testing and managing an optical fiber system. The types of testing that can be performed using an OTDR include:

- Incoming acceptance of cable reels and comparison with test results provided by quality cable manufacturers. Loss values in dB/km can be compared with cable data sheets and point discontinuities can be detected before the cable has been placed.
- Verification of proper placement can be ascertained by comparing before and after installation traces.
- Splice and connector loss can be measured not only in terms of magnitude, but the precise location in terms of optical path also can be pinpointed. This is important since the fiber length in the widely accepted loose-tube cable design is typically greater than the cable sheath length and an "overlength factor" can be established for the different cable constructions. The fiber overlength feature allows the cable to expand and contract in temperature changes without placing additional stress on the fibers.
- Documentation of the as-built system in the form of printed traces and those stored on disk provides the most useful information for maintenance and upgrades.
- The OTDR can locate and identify faults in the cable plant to expedite the restoration process by comparison with the as-built records.

Like end-to-end attenuation measurements, the OTDR should reflect the wavelengths of the actual system electronics. For example, dual-wavelength single-mode fibers can be tested at both 1,550 and 1,300 nm wavelengths for a picture of the optical performance. You can test the system at 1,310 nm only since this will be a more conservative reading. (Reference EIA/TIA-455-61.)

OTDR vs. system return loss

Return loss testing measures the light reflected back toward the source compared to the light transmitted down the fiber; the larger the return loss magnitude, the better. This measurement is very important to CATV applications because of the sensitive nature of wide bandwidth analog transmission schemes employed. Significant degradation of signal quality can occur when optical power is reflected back into the laser cavity causing interference that affects the output power and spectral distribution and linearity. The resulting noise will introduce power penalties and reduce the system signal-to-noise ratio. Fresnel reflections are the largest contributor of back reflections and lower the return loss.

A single large reflection can degrade the signal in some of today's systems to unacceptable levels for CATV use. As a result, designers are careful to specify components with low reflectance and minimize the number of reflective components in the system. Optical connectors, couplers and mechanical splices are typical sources of reflectance that must be limited. However, by specifying components with high return loss values, most concerns associated with reflections can be prevented.

Once installed, connectors and mechanical splices can be tested with an OTDR to determine both the relative magnitude of return loss as well as the location of each reflective component. In this manner, excessively high reflections can be isolated and targeted for corrective action. The equation used to calculate optical return loss from the OTDR is:

$$ORL = B - 10\log_{10}[(10^{P/5} - 1)D]$$

Where:
B = Fiber backscatter level in dBs below the incident power level at the refractive index discontinuity (-79 dB for single-mode fiber)
P = Pulse height (in dB)
D = Pulse width (in ns)

Conclusion

End-to-end insertion loss measurements, OTDR testing and return loss characterization provide the foundation for a well-documented fiber-optic cable plant. Investing in quality test equipment and performing these three evaluations up-front can save time down the road and lead to a system that is easy to manage. As well, maintenance and emergency restorations are simplified, and future enhancements and upgrades can be evaluated and implemented quickly, without worry that the cable plant is obsolete. **CT**

July 1992

BACK TO BASICS

The training and educational supplement to Communications Technology magazine.

Table of Contents

Understanding and using a fusion splicer

This article will address issues critical to understanding a fusion splicer: the different types of alignment systems; proper operating parameters and procedures; cleaning and maintenance; and fiber preparation for splicing.

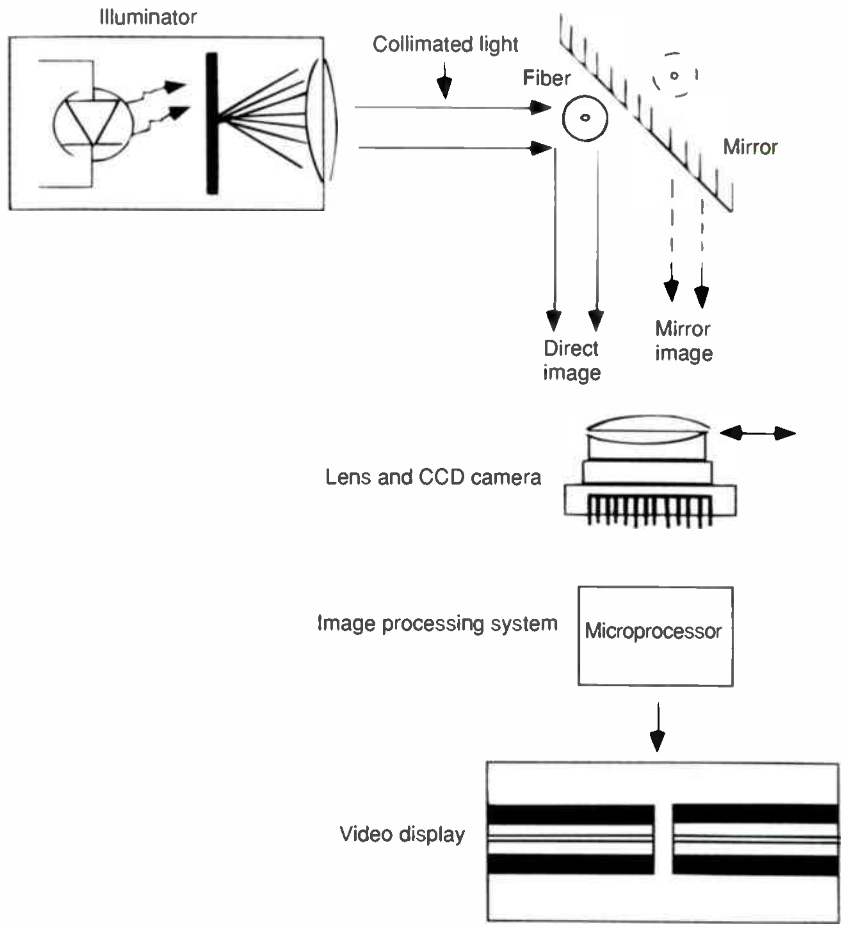
By Tom Schatz
Engineering Product Manager
Test, Measures & Restoration Group
Optical Networks International

Preferred by many engineers, fusion splicing is the process of welding the ends of two optical fibers together, forming a continuous glass fiber with very little signal loss and no fresnel reflections. (A fresnel reflection occurs whenever light passes between two materials with different refractive indexes.) In contrast, mechanical splicing joins two fiber ends together by clamping them within a structure, constructing a splice with potentially higher losses and fresnel reflections.

Although mechanical splices or connectors are typically recommended for splicing a transmitter or receiver to the fiber-optic cable, fusion splicing is used for most outside plant applications because of its potential for lower splice loss specifications and excellent mechanical integrity. Whereas mechanical splices may produce as much as 0.5 dB splice losses in field conditions, fusion splicing yields worst-case losses of 0.2 dB in the same conditions. Even if the same loss performance is achieved, mechanical splices still run the risk of fresnel reflections due to the air/glass interface.

Because of the improved performance possibilities and lack of fresnel reflections, fusion splicing is quickly gaining acceptance by the cable technical community. However, this acceptance requires that technicians and installers be proficient in the workings of a fusion splicer.

Figure 1: Direct core monitoring



Aligning the fiber

There are two main fusion splicer alignment systems used today — those using direct core monitoring (DCM) and those using local injection detection (LID) systems. Although most fusion splicers operate the same and perform low loss splices, it is the alignment systems that differentiate the products.

The DCM process (see Figure 1) uses a collimated light source that transmits a light perpendicularly across the two fibers to be spliced. The light goes through the fibers and is reflected against a mirror and down into a charge coupled device (CCD) camera. Because of the different indices of refraction at the air/cladding and cladding/core interfaces, it is possible for the camera to see the cladding and core regions.

From the camera, the information is analyzed by a microprocessor (to control the process) and displayed on a screen where a splicing technician can monitor the procedure. Splice loss estimations are based on the actual alignment of the fiber cores as seen by the microprocessor through the camera and optics system. The DCM system actually inspects the splice region and estimates the splice loss.

DCM also allows a technician to visually identify a bad splice immediately, without the use of an optical time domain reflectometer (OTDR). Bad splices include those that have air bubbles or unfused portions in the splice region. On the fusion splicer display screen, these bubbles will appear in the core region, at the point where the fibers were fused; unfused or partly fused regions appear as dark, fuzzy lines on the surface of the fibers.

This kind of detail allows a technician using the DCM system to produce splice losses of 0.01 to 0.2 dB, with no measurable reflections. It is important to know that manufacturers

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Figure 2: LID system

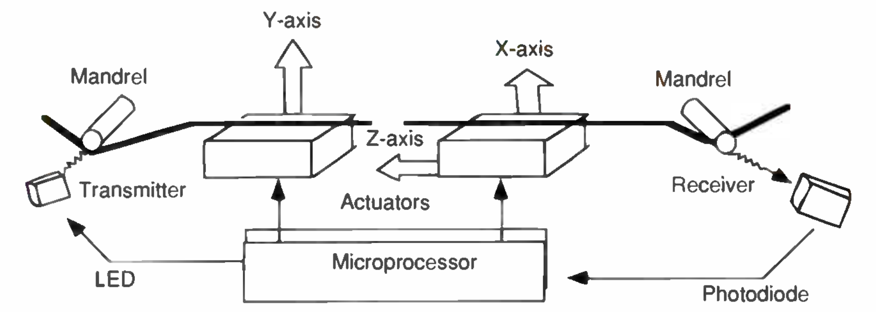


Figure 3: Fiber cleave angles

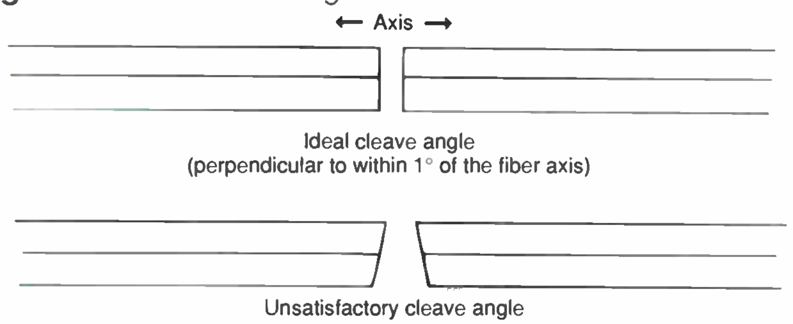
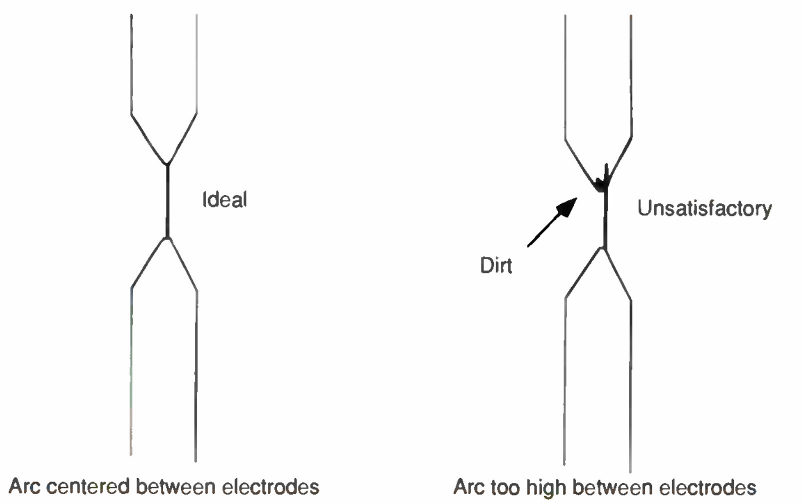


Figure 4: Location of arc between electrodes



of fusion splicers typically print spec sheets with splice losses specified at less than 0.05 dB. However, those specifications are based on laboratory conditions with identical fibers. Realistically, operators should expect to consistently achieve splice losses of less than 0.2 dB for field conditions with dissimilar fibers.

Unlike the DCM process, the LID system bends each fiber to be spliced (a macrobend), and injects light into the first macrobend (Figure 2). The LID system then does a rough alignment of the fibers, and fine tunes the X- and Y-axes for the maximum detected power on the second fiber. The LID system allows the unit's alignment system to "see" the fiber's core, while the operator is limited to a view of the fiber's surface.

Even though low-loss splices are achievable through this method, the problem is in measuring the loss of the splice. Because a macrobend is inconsistent, it's difficult to get the same amount of light coupled into the macrobend for every splice. This variable factor dictates that the optical measurement system must have a large dynamic measurement range that is facilitated by a logarithmic amplifier in the detector portion of the system. Accuracy of log amps are best in the mid-range, decreasing in accuracy as the extreme low- or high-range is approached.

Since splice loss estimation is based on the detected power through the aligned fibers before and after fusion takes place, it is sensitive to the cleave angle of the fiber end face. Ideally, the fiber end faces need to be perpendicular to the axis of the fiber and parallel to each other (Figure 3). If the cleave angles are bad, the measured light coupled from one fiber to the next will reflect off the angled face and yield unsatisfactory results.

Another factor to consider when using a LID system is the incompatibility of the LID mandrels with 900 µm or larger buffered fiber pigtails. This is directly due to the fact that the mandrel (the metal rod around which the fiber is bent) is designed for use with 250 µm coated fiber. You will need to remove enough of the coated fiber on each side of the splice to reach the injector and detector.

Operating procedures and parameters

Regardless of the alignment system chosen, many of the procedures for using a fusion splicer are the same. One of the most important considerations when using a fusion splicer is a clean working environment. To fully understand the importance of this statement, the inner workings of a fusion splicer should be examined.

Fusion splicing works on a very precise process of melting two precision-aligned fibers together by applying a voltage across two electrodes. When the voltage gets high enough, it creates an electric arc that jumps between the two electrode tips, the temperature increases, and it melts the fibers together as one fiber is fed into the other.

This process is tied very closely to the environment because the resistance between the electrode tips is defined by their air gap. It is the properties of air (temperature, humidity, contaminants and atmospheric pressure) that affect its conductivity. Splicing parameters can be set (and changed) by the technician to com-

"Whereas mechanical splices may produce as much as 0.5 dB splice losses in field conditions, fusion splicing yields worst-case losses of 0.2 dB in the same conditions."

pensate for the properties of air. Dust also can be a factor in the splicing procedure. Dirt or dust on the electrodes causes the resistance to change and also can change the location of the arc between the electrodes. Instead of its ideal placement centered between the two electrodes tips, the arc occurs higher. (See Figure 4.) A simple rule of thumb to remember: clean electrodes produce the correct arc.

By working in a clean, stable environment where temperature and humidity are controlled, the parameters of the fusion splicer are not a constant worry. Another important aspect of the work area is the technician's comfort. Because splicing can be a long, tedious process, it is important that installers be comfortable. Comfort includes proper lighting for splicing, the correct size work table, and if needed, a larger monitor to view the splice.

Other considerations that impact the operation of a fusion splicer are the operating parameters. For instance, the temperature of the electric arc should always be the same, with the heat of the arc dependent on the amount of current. The arc current is determined by the atmospheric conditions and the voltage applied across the electrodes. In high altitudes, the air is less dense, which means more voltage is necessary to arc the electrodes. In other words, increased resistance of air necessitates more voltage.

Operating parameters include arc power, prefusion, fusion time, arc gap and overlap. Since each of these parameters is important, and in many cases are controlled by the technician, it is necessary to understand the operating considerations of each. (In some cases, the fusion splicer may have programs that automatically compensate for changes in operating parameters.) Let's consider each parameter separately:

- *Arc power* represents the voltage across the two electrodes. The arc power parameters need only be changed to compensate for changes in electrode air gap resistance.
- *Prefusion* refers to the length of time the fusion arc is on before the fibers are driven together. This parameter changes to compensate for various manufacturers' melting point specifications of different fibers. It is seldom changed by technical personnel.
- *Fusion time* is the length of time the fusion arc remains on while fibers are being driven together. Fusion times change when subjected to extremely cold temperatures or when fibers larger than 125 µm are used.
- *Arc gap* is the distance between the fiber end faces when the prefusion/fusion process begins. This parameter needs to be adjusted when using the fusion splicer in a manual control mode.
- *Overlap* is the actual distance fibers are driven into each other after the molten end faces make contact. This parameter changes when the

fiber diameter changes: the smaller the diameter, the more overlap and a larger diameter equals less overlap.

Cleaning the fusion splicer

It is important to remember that dust, dirt and lint can be larger than 5 µm, while the fiber's single-mode core size is 8.3 to 9 µm. Therefore, keeping the fusion splicer clean and well-maintained is essential to ensure good splices. Maintenance is usually nothing more than cleaning the machine two to three times during an eight-hour period, or when needed. Since temperature and humidity change, it also is necessary to check the parameters as environmental conditions change. Most technicians see splicing problems begin to occur between 11 a.m. and noon. This is the time when outside temperatures begin to dramatically change and personnel are frequently leaving or entering the splicing environment.

One simple step will prepare the fusion splicer for splicing. That is, use reagent-grade alcohol to wipe down any surface the fiber comes in contact with: fiber chucks (bottom and upper surfaces), V-grooves and clamps. As well, make sure the cleaning extends to the splicer's optics system. With LID ones this means the injectors and detectors, and in DCM splicers it's the mirror and camera lens.

Do not use canned air for cleaning since it contains impurities. These impurities will get on the electrodes and cause problems. If it is necessary to use canned air, arc the electrodes 10 to 15 times before attempting a splice. Most manufacturers do not recommend canned air under any circumstances.

Once the fusion splicer is clean, it also is important to maintain the cleaver that will be used for splicing. If bad cleaves are consistently being produced, chances are the cleaver simply needs to be cleaned. As with the fusion splicer, use reagent-grade alcohol and wipe anything that comes in contact with the fiber, including the blade.

Fiber preparation

Splicing is a very repetitive process. Following the ensuing steps every single time will yield the best splice results:

1) Clean the fiber thoroughly with reagent-grade alcohol.

2) Place splice protection sleeves on all fibers to be spliced.

3) Use a good coating stripper that takes the glass fiber from 250 µm down to 125 µm.

4) Clean the fiber again with reagent-grade alcohol.

5) Use a good precision cleaver. (Investment in a high-quality cleaver will make or break the fusion splice.) A cleaver should produce cut fibers with smooth, flat end faces perpendicular to within 1° of the fiber axis.

6) Take the fiber out of the cleaver and place the fiber directly into the fiber-optic chuck. (The fiber will never be as clean as it is after being cleaved.) Be careful not to allow the end of the fiber to touch on anything, since it could become chipped or pick up dirt.

If the procedures of cleaning the splicer, cleaver and fiber are followed, the chance of completing a low-loss fusion splice is extremely good. Regardless of the investment in equipment or the experience of the technician, if these steps are not adhered to, the chance of obtaining a good splice is rare. In many cases, the fusion splicer won't even perform the splice. **BTB**

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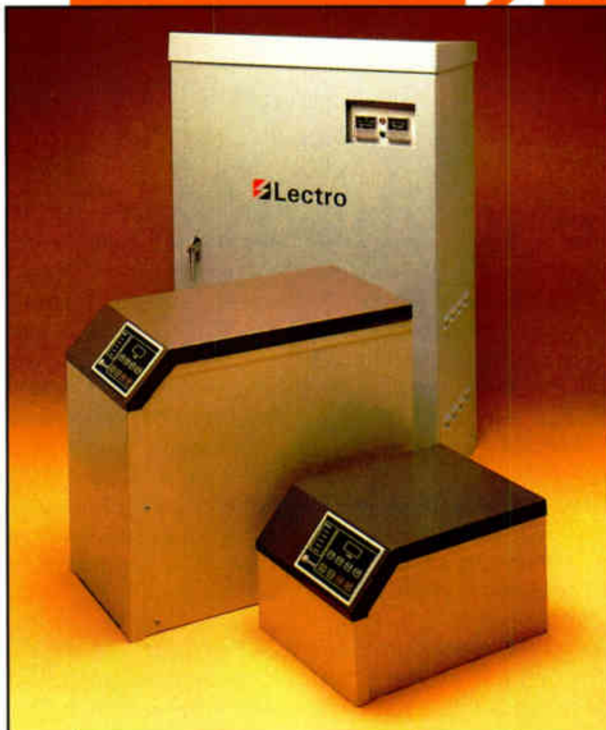

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Finding the break

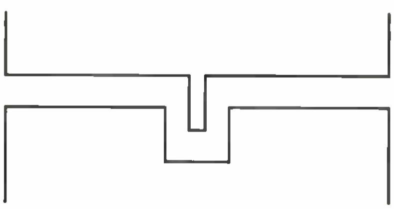
This article describes what equipment you need, how to set it up and how to make the measurement to the end of a fiber-optic cable to find a break.

By Janet H. Lunde
Product Marketing Manager
Photon Kinetics Inc.

If you've got service to restore, the first step is finding the break. Sometimes this can be easier said than done. Of course, if your fiber-optic link is short and you can see a backhoe, you probably won't need any help finding the break. But it's not always that easy.

You can determine the distance to a break in optical fiber cable using an optical time domain reflectometer (OTDR). An OTDR is the fiber-optic version of a TDR. It can do a one-ended measurement, shooting light into one end of a fiber and interpreting the reflections that come back down the fiber. The OTDR constructs a waveform showing how the light is traveling down the fiber. By looking at the waveform, you can measure the distance to a break.

Figure 1: Keys on FC connectors



What you need

- An optical time domain reflectometer
- Jumper cable (check connectors)
- Spare jumper cable
- Plot of original installation
- Cleaning kit: can of air, isopropyl alcohol, swabs, wipes

When you pick up the OTDR, be sure to get the necessary optical jumper cable. If there's a spare cable available, pick it up, too. You'll need a jumper cable with the appropriate connector for the patch panel on one end and the right kind of connector for the OTDR on the other. It's likely that your entire system uses one type of connector, so this shouldn't be a problem.

It's also a good idea to pick up an optical cleaning kit. And, if possible, get a copy of the measurement that was taken when the link was installed. This may be a printout, or it may be a disk file that you can recall on the OTDR.

Setting up

Make sure all the connectors are clean before connecting the OTDR to the patch panel. If any of them are dirty, it will lower your signal level and make the break harder to find. To clean the connectors on the OTDR and patch panel, blow them off with a clean precision duster (canned compressed air) and wipe off the jumper cable connectors with a lint-free wipe dampened with electronics-grade isopropyl alcohol. If you have special lint-free swabs for the connectors, gently wipe out the OTDR and patch panel connectors with a swab moistened with alcohol. If the swab or wipe comes away looking dirty, it's wise to clean the connector again to make sure you've removed all the dust or debris.

Attach the jumper cable. Many connectors are "keyed," and the two keys must be lined up. On an FC connector, align the small tab on the jumper cable end with the notch on the connector of

Figure 2: A sample OTDR waveform

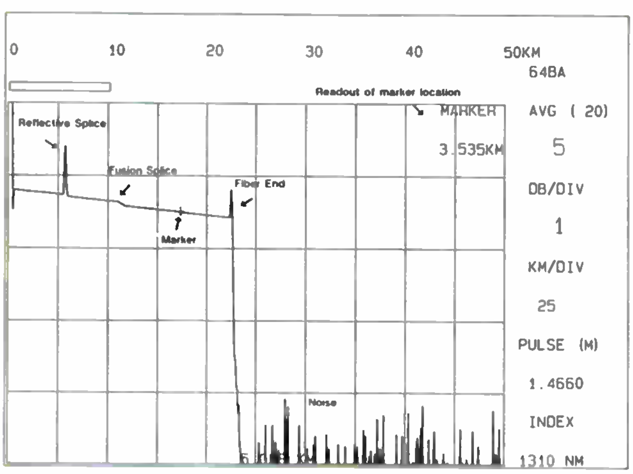
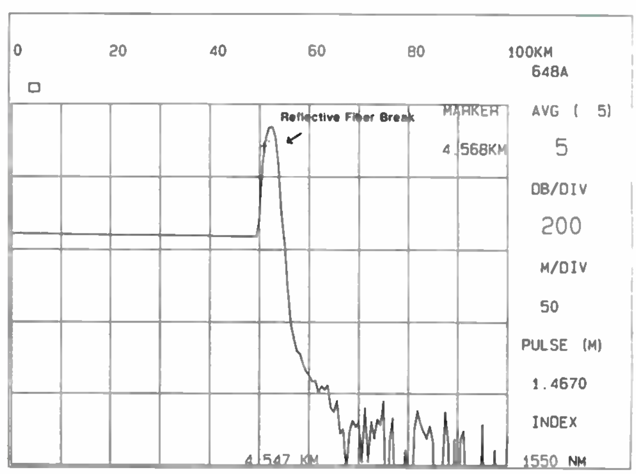


Figure 3: A reflective fiber break



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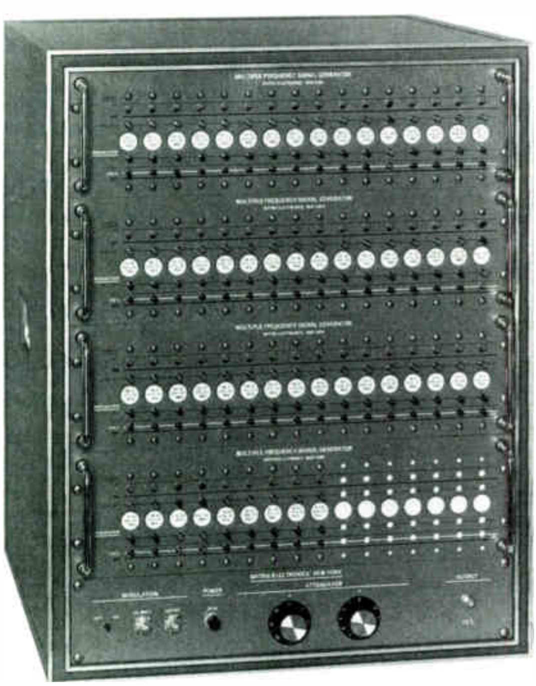

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Figure 4: A non-reflective fiber break

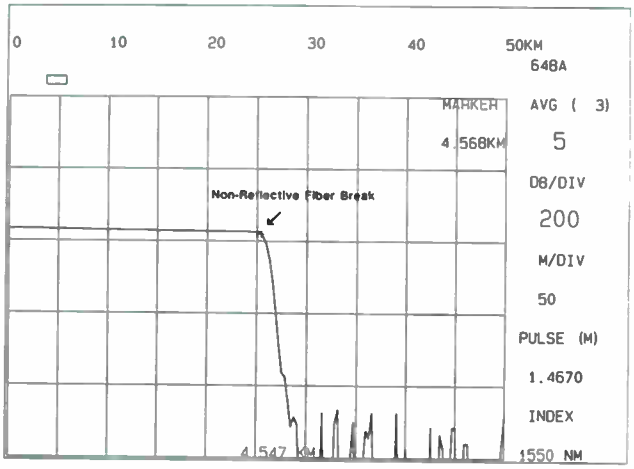
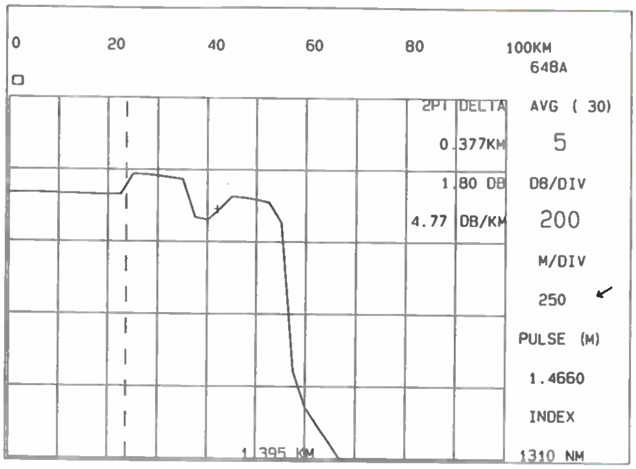


Figure 5: Too long a pulse width



the OTDR or patch panel (Figure 1 on page 46). Finger-tighten the connectors.

Visually check that you've got a good signal level. If you looked at the OTDR when it was first powered on, before you had attached the fiber, then you know what that looks like. If it doesn't look much different after the fiber is attached, then you may have a bad connection. Verify that the connectors are attached properly. You could try your backup jumper cable or re-clean the connectors.

If you cannot see a fiber signature with either of the jumper cables or after cleaning the connectors, it is possible that the break you're trying to find is close to the patch panel. All OTDRs have what is known as a "dead zone" — an area that cannot be seen after a reflection. If a break is within that dead zone, then you won't be able to see it on the OTDR waveform. Try attaching to a different fiber in the cable, since the connector on the patch panel could be the problem.

If you know the original length of the link, set the OTDR's "range" setting to a value longer than the link length. If your OTDR's range is stated in kilometers and you know the link length in miles, simply multiply the miles by 1.6 to find the length in kilometers. The range setting limits how long a fiber the OTDR will measure. Using too long a range may slow the OTDR's operation, but you should still be able to make a good measurement. More important, using a range shorter than the link can prevent you from finding the break.

Set the "pulse width" to the OTDR's medium value. The pulse width may be described in meters or in seconds (nanoseconds or microseconds). Don't select the shortest or longest value, but pick one in about the middle of the choices. Too short a pulse width may prevent the OTDR from seeing to the end of the fiber. Too long a pulse width may make it difficult to measure closely spaced features.

The OTDR may have both 1,310 nm and 1,550 nm wavelengths available. Unless the link is intended to operate at 1,550 nm, you'll probably want to use 1,310 nm for testing it.

Once your OTDR is set up, you can average the trace. Averaging is very important, because it reduces the random noise on the OTDR's waveform. When the OTDR was in free-run mode the waveform was probably wavy. Averaging should make the signature even out into a fairly straight line, with occasional steps down. These steps mark the locations of fusion splices.

If you were able to get a copy of the original OTDR measurements made on the cable, all you need to do is set up the OTDR the same way, and average. Then check to see how the new waveform differs from the original one. If it

Figure 6: After changing to a shorter pulse width and re-averaging

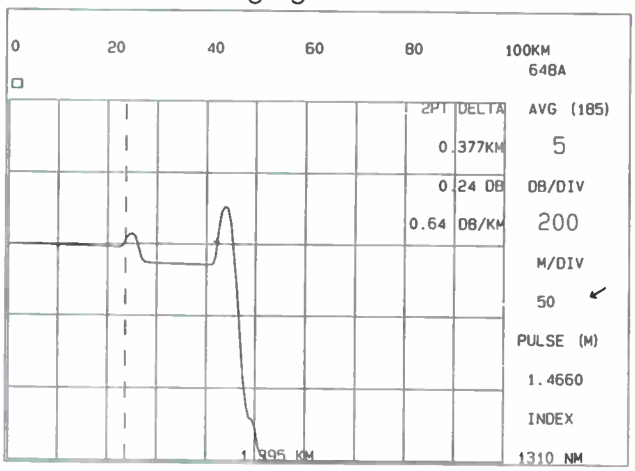


Figure 7: Too short a pulse width

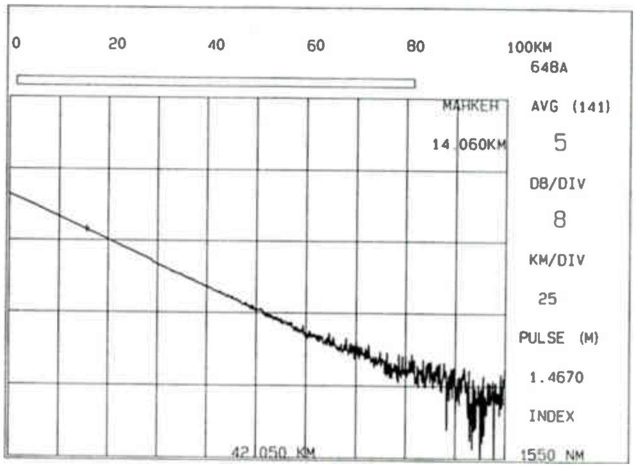


Figure 8: Same fiber with longer pulse width

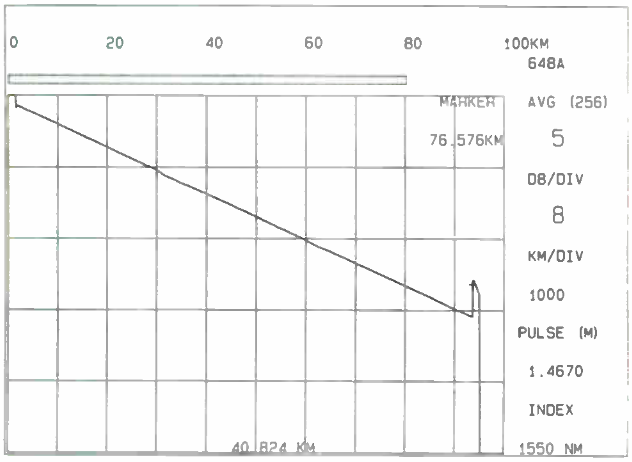
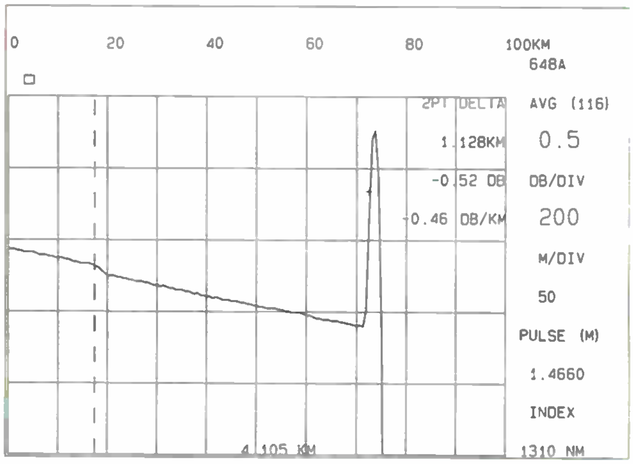


Figure 9: 2-point measurement from a splice to the break



looks noisier, then the connection may be weaker, so try cleaning your connectors. It should look much the same, up to the point of the break.

Finding the break

Finding a break with an OTDR involves looking at the waveform and interpreting the picture. First, we'll define the terms used in describing an OTDR waveform.

An OTDR fiber signature is made up of reflective spikes, backscatter, fusion splices and the noise after the end of the fiber (Figure 2 on page 46). Backscatter is the signal returned by sections of fiber. Backscatter shows a steady downward slope because the light is gradually attenuating (weakening) as it travels through the fiber. Fusion splices show a loss, but since they aren't reflective, there is no spike. A reflective splice or connector shows up as a spike. Your link may not have any reflective splices or connectors in it. The end of the fiber may or may not be a spike, depending on the condition of the glass at the end. After the end of the fiber, you see the background noise of the instrument. This is like the white noise you hear from a radio when it is not tuned to a radio station.

To find the break, you'll need to see the entire fiber on the OTDR screen. Some OTDRs show you the entire range when they're powered on, so you won't need to change anything. Look for the noise, sometimes described as "grass," after the end of the fiber. If you can see that, then the entire fiber is already on screen. If you can't see to the end of the fiber, change the OTDR's km/division and dB/division values until you can.

When a cable is broken, the fiber ends may be broken cleanly. In that case, the ends are reflective and will show up as a spike on the OTDR (Figure 3 on page 46). At other times, the fiber ends are crushed or submerged in water and they won't reflect (Figure 4 on page 48).

Fine-tuning your OTDR setup

If your fiber waveform doesn't look like either Figure 3 or 4, then you may need to change the OTDR's settings. The range may not be set to a long enough value, so increase it. You also may need to change the pulse width. Pulse width determines two things:

1) Measurement range — How far down the fiber the OTDR can see.

2) Resolution — How close together the OTDR can see things.

The longer the pulse width, the farther down the fiber you can measure, but you'll have trouble seeing splices that are close together (Figure 5 on page 48). The shorter the pulse width, the less distance you'll be able to see, but you'll be able to see splices that are closer together. If a break is close to a splice or connector, you'll want to go to a shorter pulse width (Figure 6 on page 48) to be able to see the break separately from the previous feature. If the link is long and the break appears to be near the end, then you'll want to go to a longer pulse width to be able to see it.

If the pulse width is too short (Figure 7 on page 48), you won't be able to see to the end of the fiber. If the fiber declines gradually into the noise, then you need to try a longer pulse width (Figure 8) and re-average. If it still flattens into the noise at the OTDR's longest pulse width, then try changing the wavelength to 1,550 nm. On a long fiber you also should let the OTDR average for longer than a minute.

Fiber attenuation is typically lower at 1,550 nm than it is at 1,310 nm. For example, a fiber might have an average attenuation of 0.40 dB/km at 1,310 nm and an attenuation rate of 0.20 dB/km at 1,550 nm. Therefore, when traveling down that fiber, the light weakens twice as fast at 1,310 nm as it does at 1,550 nm. That's why an OTDR may be able to see further down a fiber at 1,550 nm than at 1,310 nm.

Making the distance measurement

When your OTDR waveform is correctly set up, you can measure the distance to the break. The OTDR's "marker" is typically moved along the fiber by a knob and reads out the distance to a point on the waveform. Move the marker to the end of the fiber, position it as instructed in your OTDR's user's manual and you've got the distance from the OTDR to the break.

After following these steps, the waveform will let you clearly see the entire fiber. Sometimes this makes it difficult to fine-tune the position of the marker. To get a closer look, change the dB/division and km/division settings to zoom in on the fiber end. Be careful not to zoom in too close, though. You want to keep both the previous splice and the fiber end on-screen.

The previous splice is a useful reference. If the break is 32,000 feet (9.75 km) from the OTDR, it's difficult to judge where that is above ground. A better approach is to measure the distance from the closest splice. Then you can reference a splice enclosure or vault, and measure from there to find the break.

Most OTDR's have a "2-point" or "delta" measurement for measuring distance between two features (Figure 9). Place one marker on the previous splice, the second marker on the fiber end and read off the distance between the two.

This article has described making a manual distance measurement. Your OTDR may have some type of automatic measurement function. If it does, use it. But take a close look at the results. An automatic measurement is a big help in interpreting the fiber waveform, but your OTDR can only work with what it sees. To get an accurate measurement, you have to have it set up appropriately.

Gotchas

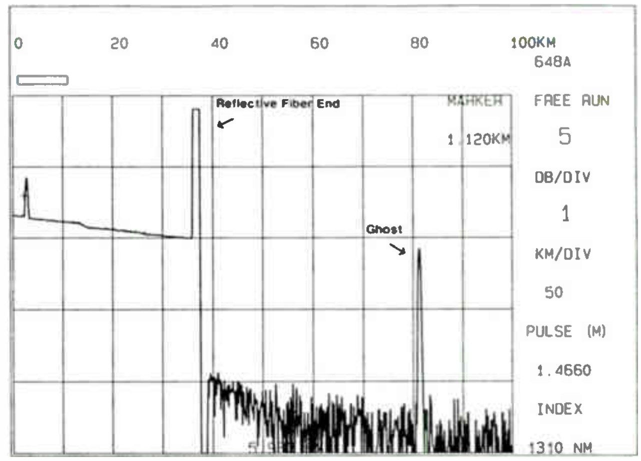
There are a few things to keep in mind when measuring distance with an OTDR.

• *Ghosts* — These are echoes of reflections on the fiber. They don't cause any real problems, but since they appear to be a feature in the fiber, they can be worrisome. Light is actually traveling in two directions on the fiber. The OTDR launches a light pulse into the fiber that travels away from it. Some of that light is reflected back toward the OTDR from connectors and from the fiber end. Some of the light scatters in the fiber and a portion of the scattered light travels back down the fiber toward the OTDR (backscatter). With all this going on, echoes can show up. On a typical CATV link with just a reflection at the end of the fiber, the only ghost that will appear will be in the noise after the end of the fiber (Figure 10).

If there's a reflection on the backscatter that you think is really a ghost, change the OTDR's range setting. If it is a ghost, it will change position. Changing an OTDR's range setting changes how fast the laser fires, which affects echoes.

• *Wavelength* — If your fiber is to be operated at 1,550 nm, then you should test it and check it for breaks at 1,550 nm. A link could look fine at 1,310 nm and look terrible at 1,550 nm. The attenuation of optical fiber can be affected by pressure on it or by being tightly coiled, and these effects vary with wavelength. If the fiber has been coiled too tightly in splice trays it may have large splice losses at 1,550 nm yet look fine at 1,310 nm. The high "splice" losses at 1,550 nm would be due to the coils in the splice trays, not to the actual fusion splices, but the OTDR would just see the total loss over those few meters of fiber. Also, if a buried cable has been subjected to pressure from vehicle traffic or the ground shifting, then it might have a high loss at 1,550 nm and be fine at 1,310 nm.

Figure 10: Ghost after the fiber end



• *Optical distance vs. cable length* — An OTDR measures optical distance; that is, the distance that the light travels in the single glass fiber. That light path is generally longer than the length of the cable because the fiber is slack inside the cable sheath and may be coiled. At each splice location some fiber is coiled into splice trays, again making the fiber light path longer than the actual physical distance that the link follows. These are two more reasons why it's a good idea to measure to a break from the previous splice, instead of from the beginning of the cable.

• *Refractive index* — An OTDR cannot actually measure distance. It measures the time that the light took to travel down the fiber and back, then it converts time into distance. The refractive index setting tells the OTDR how fast the light travels inside an optical fiber and, therefore, calibrates the distance accuracy of the OTDR. If the refractive index is set incorrectly on your OTDR, then your distance measurements will be off. Fortunately, the error is related to how long a distance you're measuring. Again, measuring distance from the previous splice will minimize this error.

Example: Suppose the correct refractive index is 1.47, but the OTDR is set to 1.499. The fiber is actually 6,000 feet long. The measured value will be off by 116 feet:

$$6{,}000 \times (1.47/1.499) = 5{,}884 \text{ ft}$$

If you've got a plot of the cable that was done when it was first installed, look to see what value the refractive index was set to. Confirm that your OTDR is set to the same value. Your cable manufacturer can tell you what the correct refractive index value is for your cables.

Conclusion

These are the basic steps to follow in locating a break with an OTDR. You just need to get a good signal level averaged and look for where the waveform drops into the noise. To improve the accuracy of the measurement, measure the distance from the last splice before the break. Then you're ready for the fun part — fixing it. **BTB**

Network telemetry

(Continued from page 26)

strides in component and system reliability. The vacuum and gas-filled tube technology prevalent in the '50s was replaced by transistor technology in the '60s. Development of the integrated circuit moved electronics manufacturers away from transistors. This movement through miniaturization and large-scale integration reduced component powering requirements, which directly translated into significantly extended component life expectancies. Again, the consumer's reaction is an expectation that things must perform better and last longer. In essence, today's consumer places high value on reliability and weighs the cost of reliability during the decision-making process.

Digital technology

The last trend to examine is the electronic media's transition from analog formats to digital technology. In addition to the music industry's use of digital formats for CDs and the like, other industries have moved toward digital signals. Today's interexchange telephony carriers boast crystal clear reception. This is largely due to their use of digital technology. For the most part, local telephone exchange operators interconnect their central offices through digital signaling, and nearly all of today's operating telephone switches are digital. All computers are based on digital technology. Wristwatches, radio tuners and electronic test equipment are now digital.

Soon, TV sets will incorporate digital receivers for decoding digital format programs. The dramatic benefit of digital formatting is the ability to transmit a signal, reconstitute the signal, then retransmit it error-free. This process of transmission, reconstitution and retransmission with no signal degradation can be repeated virtually forever. Because a digital signal is extremely robust, it can be transmitted unscathed (to a point) by a degrading transport network.

Consider our current analog transmission network: As the transport system weakens, increased noise and/or distortions become visible to the subscriber. As the system further degrades, the picture quality worsens, the subscribers notify the cable operator, service calls are issued and technicians are dispatched. Under the same scenario, but using a digital format signal, the subscribers notice no real change in picture quality as the transport system performance begins degrading. At some level of continued degradation, the digital system's bit error rate (BER) limit is exceeded. (BER is a measure of erroneous bits per unit time and is directly related to the transport network's performance). Once the system's BER is exceeded, the signal is virtually lost and cannot be decoded. From the subscriber's perspective, an outage has occurred. For this reason, the use of digital formats will render the consumer ineffective as a system performance monitor.

A macroperspective of the five global trends shaping our industry's future implies that:

- Cash flow will decline as our core business growth erodes and the cost of labor escalates.
- Next-generation revenue streams can be developed only through a strategy of combined competitive pricing, a quality delivery system and superior reliability.
- The network employed to transport services must be transparent to the

customer. These are the principle considerations driving the need for an automated network telemetry and control (NT&C) system.

So what is NT&C?

The function of the network telemetry and control system is, as the name suggests, twofold. First, the design objectives of the telemetry segment of NT&C are to test, analyze, evaluate and document the network's performance. The control segment's design objectives are to correct any network performance deficiency and document the corrective actions taken. NT&C differs from a conventional status monitoring system in two respects: 1) It is an integrated network, or systems, approach rather than a component/device approach, and 2) a strategic rather than tactical deployment of technology. NT&C will be mandated for successful entrance into the $200 billion a year telecommunications marketplace, and for the operation of advanced network architectures.

The NT&C platform will be modular, which provides the operator with an opportunity to define the NT&C operating requirements. In this manner, the operator determines the level of NT&C to deploy according to business plans and operational needs. As additional business requirements come to fruition, more options can be added. The cost of deploying the NT&C system can therefore be financed as requirements arise. Several portions of the telemetry segment are already available through various vendors. What is lacking is the engine to put them together. Other portions are currently in the development stage and should be available within the next 12 months.

One NT&C scenario that could be played out now would be to integrate automated headend test equipment, trunk and distribution amplifier station performance monitoring equipment, standby battery power supply performance monitoring, and fiber-optic node status and performance monitoring. A PC-based controller with some resident artificial intelligence could consolidate the data from each of these units and, when performance boundaries are exceeded, command an auto-dialer to initiate an outbound call via a pre-established calling matrix until a positive response is received. When notified by the NT&C system, the technician on call connects to the controller via a modem and laptop, or notebook computer, and receives the diagnosis. The system has completed the technical troubleshooting, all the technician need do is affect the repair.

Addressing the issues

With NT&C, network testing can be initiated from a central location and requires, at most, one technician. This is in stark contrast to the number of technicians and time required to just sweep existing coaxial plant. Under today's preventative maintenance schemes, technicians visit properly operating equipment more often than not. The improved maintenance efficiencies will not only reduce manpower requirements, they will also tend to improve the network's reliability. As reliability improves, perception of the industry will improve. This will create for us the opportunity to successfully compete in new market areas. NT&C will result in problems being identified and corrected without the customer having to endure degraded service. Network telemetry and control is not just status monitoring, it's a systematic approach to address the trends influencing our future. **CT**

Commercial insertion

(Continued from page 28)

- Accuracy in processing contracts through traffic.
- Accuracy in spot handling and labeling.
- Accuracy in compiling and QCing daily spot reels.
- Accuracy in spot production with attention to client copy, graphics and audio levels.
- Attention to insertion and checking as-run logs regularly for missed breaks.
- Preventive maintenance of insertion equipment including a two-hour per week deck and inserter checkout for the entire inserter compliment.
- Daily head cleaning of all playback and record decks.
- Resolution of missed spots with make-goods scheduled within 24 hours.
- Cooperative traffic-master control scheduling "work arounds" when equipment malfunctions occur.
- Manual editing expertise to cover compiler failures or last minute orders.
- Spot checks of insertion window for clean in-out transitions to and from networks.

"Through cooperative efforts and a team approach, (staff members) are able to extract efficiencies beyond equipment capabilities."

This kind of attention to detail has clearly paid off for Warner Cable. With comparable quality to network TV, local insertion becomes transparent to the viewer. Client information is delivered as promised — when promised. Thus, client satisfaction translates into increased revenue.

Other insertion systems, particularly random access and hybrids, are currently being used in other markets with some success. New traffic systems and technologies such as laser disc and digital will most certainly raise the level of efficiency of local insertion, and will be new options to consider. Until then, however, Warner Cable is confident that its staff can continue to maximize revenue using the existing technology. **CT**

The face of OSHA

The following is the premiere column of a new "CT" department.

By Michael H. Morris
President, Taylor Morris and Associates Inc.

Is "OSHA" a four-letter word in the businessman's vocabulary? To some, the mere mention of the acronym brings on a bout of gritting and grinding teeth, clenched fists and a tirade that raises the blood pressure a minimum of 50 points. However unpleasant OSHA may be, it's a fact of life, like death and taxes. A little background about OSHA's birth and reason for existence might relieve the agony.

In 1970, Congress enacted the Occupational Safety and Health Act, which is administered by the Occupational Safety and Health Administration (OSHA), a division of the Department of Labor. The purpose of the act's creation was to impose rules and regulations on employers in order to curb escalating injuries, illnesses and deaths in the workplace. Apparently it helped matters, because there was a reduction in the rate of occupational injuries and illnesses.

At its inception, OSHA couldn't inspect the majority of businesses because of a lack of inspectors. Employers were therefore required to conduct self-inspections (or employ the "honor system.") Then in 1984, OSHA inspections slowed due to a reduction in the number of available inspectors. With OSHA's effectiveness greatly hampered, occupational illness and injury rates again began to climb. As a result, history has demonstrated that a cause and effect relationship exists between OSHA enforcement and injuries and illnesses in the workplace.

As boring as statistics are to read and digest, they are relevant to the issue. As the accompanying table shows, even though there were fewer occupational illnesses and injuries in subsequent years than in 1975, many more workdays were lost. Is the workplace really safer, or are the injuries and illnesses more severe?

Injuries/illnesses in the workplace

Year	Injuries/ illnesses*	Lost workdays*
1975	9.1	56.1
1980	8.7	65.2
1985	7.9	64.9
1990	8.8	84.0

*All statistics are based per 100 full-time employees. Source: Department of Labor, Bureau of Labor Statistics.

With OSHA clamping down on states that have approved OSHA programs, 22 of 23 states have been given six months to comply with federal standards or be subjected to federal OSHA regulation once again. In addition, in order to improve compliance with the federal standards, a record number of inspections and fines was set in 1991. In 1990, fines issued by OSHA were $66.6 million, but in 1991, the figure jumped to $91.7 million. Why? OSHA is growing teeth, largely due to industry's indifference to the health and safety of its employees.

Unfortunately, it's all too common to

read articles in newspapers or magazines that begin with "OSHA rules to protect workers from AIDS, hepatitis ... Workers must fight workplace hazards ... Death on the shop floor ... Workplace injuries set record in 1990." Both headlines and statistics give the appearance that industry isn't as safe as it should be.

How's cable faring?

What does all of this mean to the cable TV industry? Is it a safe industry? Is safety a viable and working issue in this industry or is it given mere lip service? Based on statistics, the cable industry has serious problems that are just beginning to be addressed. Consider the following:

Twenty-eight deaths were reported in 1991 in the cable TV industry alone due to accidents. However, if the total employment for the telephone and electric industries is combined and compared to the number of employees in the cable industry, the ratio is a whopping 10.67-to-1. (This does not include contractors.) A valid expectation would be that there are more injuries and lost workdays per 100 full-time employees in the telephone and electric industries combined than in cable.

However, this isn't the case. The cable industry has more incidents of illnesses and injuries (11.7 per 100 full-time employees) and lost workdays (96.2 per 100 full-time employees) than both the telephone and electric industries combined, even though these two industries have more than 10 times as many employees as cable TV!

Based on the most recent federal statistics derived from employer accident and injury reports, the cable TV industry lost 122,232 man-days in 1990. And cable operators wonder why customers complain about service and rising costs?

How does the future appear for this industry as far as safety is concerned? Some cable companies are looking at improving safety in the workplace but many times, "how safe" will depend on the cost of programs and equipment. Some people follow an outdated philosophy: "I'm not having problems now and OSHA has never inspected me, so why be concerned?" All too often, by the time OSHA gets around to inspecting that business, someone has been injured or died. The cost of a good safety program and equipment is nothing compared to what that employer will be facing then.

More teeth for OSHA

As far as OSHA is concerned, it's going to continue hiring and training compliance officers. Senators Kennedy and Metzenbaum have a bill in process that will beef up OSHA, require mandatory safety committees with a specific mix of management and employees, and further increase the compliance inspection force, rates of inspection, citations and fines.

Already, OSHA is showing evidence of its new image. In 1991, a new fine structure (civil penalty policy) was developed. Fines were increased and a seven times multiplier was added. Example: A failure to post the OSHA 2203 poster is a $1,000 fine. However, that fine can be increased to $7,000. Under certain circumstances, that $7,000 fine can become $70,000 if the cited problem isn't corrected. Other fines can reach as much as $500,000, with potential imprisonment as a "bonus."

In order to maintain a safe and healthy work environment, businesses have an obligation to comply with the federal or state standards in addition to their moral obligation to their employees and their economic obligation to their stockholders. However badly government regulation is abhorred, evidence indicates that OSHA is here to stay — not because it wants to be here, but because industry refuses to fulfill its obligations of its own free will. Until utopia evolves in the workplace, OSHA or some other government entity will regulate safety. **CT** source book intended to give MSOs information they will need as they set their own priorities and implement programs for solving intrapremises wiring problems, or continue programs they already have begun.

This source book, like the intrapremises wiring project in general, draws much of its inspiration from the telephone industry, Bachman says. In the 1980s, the post-divestiture telcos formed a non-profit group — Building Industry Consulting Services International (BICSI), based in Tampa, Fla. — to educate people in the telecommunications and building industries about proper procedures for telephone installation. The group conducts a continuing education and professional registration program for telecommunications designers, who can become certified as registered communication distribution design (RCDD) consultants. The program is similar to, but more extensive than, the cable industry's own certification program conducted by the Society of Cable Television Engineers.

CableLabs' intent, says Bachman, is not to dictate priorities, but to provide general information that supports individual system's efforts, which in turn are influenced by cable operating company policies as well as by strictly local factors such as building codes. When a home builder comes to a cable operator with questions like "How do you want prewires done?" and "What product specification should I be using for prewire box outlets and knockout plates?" some cable companies already have installation manuals to give them. The source book, customized as needed, can play that role for those who don't, Bachman says.

The source book is now circulating in topical outline form to member companies' chief technicians. (As with the final report, copies of the outline are available to the same group.) As planned, it brings together into one book "resource handbooks" for installers, builders, electrical contractors, home-video customizers and telecommunications professionals. The finished document is scheduled to be available by year's end.

In addition to specific information about intrapremises cabling techniques, the document "will have information on how system operators can set up a BICSI-like outreach program in their own community," says Bachman.

One obvious target for information dissemination is BICSI's own widely used *Telecommunications Distribution*

Methods Manual, in which the topic of cable TV installation is addressed in only a few pages. The hope is to encourage BICSI to make the section much more extensive, especially in view of the growing role of telecommunications professionals in drawing up specifications for integrated voice/data systems in commercial buildings, Bachman said.

Liaison to other industries

At the national level, CableLabs plans to reach out to key industry groups — including BICSI, the Electronic Industries Association, the National Association of Home Builders, the American Institute of Architects and the Telecommunications Industry Association. This effort will include such elements as attendance at standards meetings and trade shows, trade press articles and seminar packets.

Paralleling the efforts focused on in-home wiring, CableLabs also is looking into the perils of wiring consumer electronics retail stores for cable. Specifically, in May a CableLabs team began wiring a large retail store in Boulder. The result of this project will be a document tracing step-by-step how the job was done, complete with design layout and bill of materials.

The plan is for the store-wiring account, together with a retailer manual written by CableLabs in 1990 (which addressed some retail store cabling considerations), to be sent to the same 2,800-name chief technician mailing list receiving the final report and the source book. This also would occur by the end of 1992, Bachman says.

A big problem that Bachman would like to pursue — subject to members setting priorities — is to open up communications with big retail stores that today are selling items like splitters and cabling that are of such low quality that they can visibly degrade signals.

The CableLabs consultants' formal report contends that manufacturers and sellers of these after-market products "exhibit a 'commodity, high-margin' attitude. The result is often shoddy product, limited consumer instructions and scant attention to CATV distribution requirements." How can the retailers be convinced to go with higher quality gear? One idea proposed in the new study is developing some kind of "CATV-approved" label that could be displayed on items produced by manufacturers of good-quality components. But, so far, that's just one of many possible tactics, Bachman notes. **CT**

Automated A/V Playback and Coffee-Making

By John Gerstenberg
Applications Engineer
And Wesley Brown
Customer Service Engineer

More Than Just Ad Insertion

Best known for its random access ad insertion capabilities, the Adcart Channel Control Unit may be overlooked when it comes to some of its other useful applications, like automated program playback on LO channels, or Pay-Per-View/Barker channels.

In fact, any television application that requires local or remote control of A/V sources for automatic playback on selected channels, can definitely use an Adcart.

Program Playback

Playback of programming from an A/V source, e.g. VCRs, laserdisc players, or digital file servers, is the same as inserting commercials...the programs are just longer. An Adcart Channel Control Unit (CCU) provides all the necessary audio and video switching and VCR control required to play back programs from up to four VCRs, plus four auxiliary inputs, into one or two satellite networks. All of the switching is performed automatically, according to a schedule that is preprogrammed using a terminal or PC.

A typical Local Origination channel might use an Adcart CCU as illustrated in Figure 1. Four VCRs can provide up to eight hours of continuous playback, using two-hour Super-VHS tapes. The CCU's four auxiliary inputs can support a variety of peripheral A/V sources, like a character generator with music, a satellite feed, and even a live studio feed.

Switching among these many sources can be activated by a real-time schedule or event, by encoded tones, or manually. Adcart's scheduling flexibility allows you to mix day-parts or repeat schedules, black out programs or delay events, just by keying in simple commands.

Adcart's schedule processor holds 16 schedules per channel, containing up to 2400 events total. And each event can comprise up to eight actions, for example, AVS: AUX 1 (switch to AUX 1), VCR 1: PLAY, VCR 1: STOP. Which means you can schedule two week's worth of complex instructions, and let Adcart do the rest.

Pay-Per-View

Adcart's two-channel support can be a lifesaver in a PPV operation, when the show absolutely must go on. As illustrated in Figure 2, the CCU's second channel can serve as a redundant "fail safe" program source. The same movie is scheduled to play on both sets of VCRs. If Adcart's automatic video quality sampling feature detects any VCR problems or any degradation of video quality, it automatically switches to the back-up source machines, unnoticed by the viewer.

What's more, the CCU's auxiliary inputs are perfect for delivering barker information. A character generator can display pay instructions and movie schedules, while alternating with a VCR running movie trailers.

Even Makes Coffee!

We learned from one customer that the CCU's ability to control external devices is not limited to A/V source machines. He plugged in a coffee maker and scheduled his Adcart to brew a fresh pot just before he arrived each morning!

Automation Solutions

Channelmatic designs, manufactures and installs complete automation systems that improve operating efficiency and on-air signal quality. With a complete line of over 200 modular units and A/V accessories, we can enhance your system with virtually any feature you could want or need.

If you have an automation application that could be simplified by using an Adcart, give us a call. We'll be happy to design a custom solution to your problem...free of charge!

Figure 1: Program Playback on LO Channel

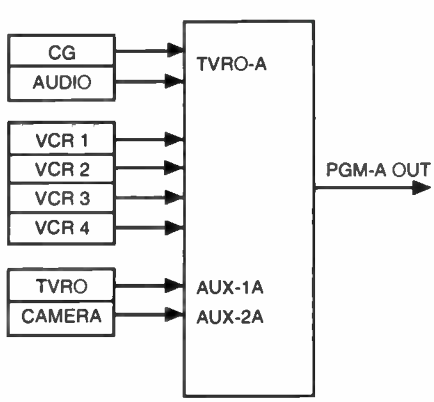
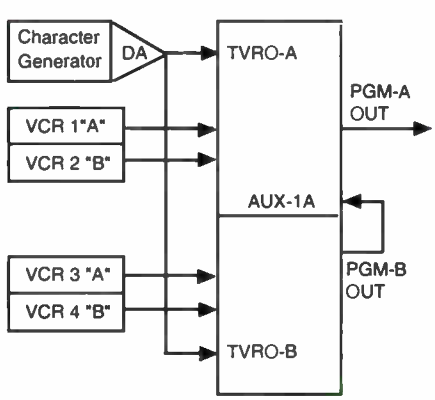


Figure 2: Pay-Per-View/Barker Channel



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Riser-Bond Instruments' Model 1220 TDR

By Ron Hranac
Senior Technical Editor

One of the more useful pieces of test equipment a cable operator can have for routine system maintenance and troubleshooting is a metallic time domain reflectometer (TDR). These instruments have been with us for many years, from companies such as Biddle, Riser-Bond and Tektronix. Metallic TDRs are used to test transmission lines that include coaxial cable, telco twisted pair and local area network wiring.

Time domain reflectometry works on a principle similar to radar, with the instrument sending a pulse of some sort through the medium being tested. An impedance discontinuity or fault in the line will cause all or a portion of the pulse to be reflected back toward the TDR, where the pulse's round trip time is measured and converted to a distance reading. The accuracy of a TDR is a function of, among other things, its "knowledge" of how long it should take the pulse to travel through the line being tested. This generally requires the user to input the line's velocity of propagation (VOP) — the speed at which a signal will travel through a cable or wire, relative to the speed of light in free space. CATV coax usually has a VOP of 78 to 89 percent.

As a maintenance or troubleshooting tool, a TDR can be used to measure the length of a reel of cable, as well as identify open or short circuits. Some of the better TDRs (this also usually means more expensive) can show defective splices, dents, kinks or cuts in the cable, water-damaged dielectric and other impedance problems. This caliber of TDR also has the sensitivity to show the presence of good splices and various in-line components.

For this month's "Lab Report" we obtained one of Riser-Bond's new Model 1220 TDRs, a successor to the popular Model 1210. We looked at it in both lab and simulated field conditions.

The product

The Model 1220 is packaged in an impact-resistant plastic housing that resembles a small briefcase or camera case. It includes a pressure release valve below the handle, since the lid (when closed) forms an airtight seal. Overall dimensions are 5-3/4 (H) x 13-3/8 (W) x 12-2/8 (D) inches, and the complete unit weighs about 9 pounds.

Manufacturer's specs for the 1220

Display	128 x 256 pixel supertwist LCD
Horizontal resolution	
Waveform	Less than 0.25 ft. (0.08 m)
Numeric distance readout	1 ft. (.1 m)
Vertical resolution	
LCD	14 bits with 108 dots displayed
Printer	14 bits with 192 dots displayed
Vertical sensitivity	>65 dB
Maximum range	
at .99 VOP	65,000 feet
at .60 VOP	35,000 feet
Distance accuracy	±0.5 ft. (0.15 m) ±1% of reading
Output pulse	Negative (<-5.1 volts), selectable widths of 2, 10, 100 and 1,000 ns

Operating power is provided by a built-in rechargeable four-cell 4.4 amp-hour NiCad battery pack. You can operate it from the external AC charger, but only if the on-screen battery condition indicator is above the minimum level.

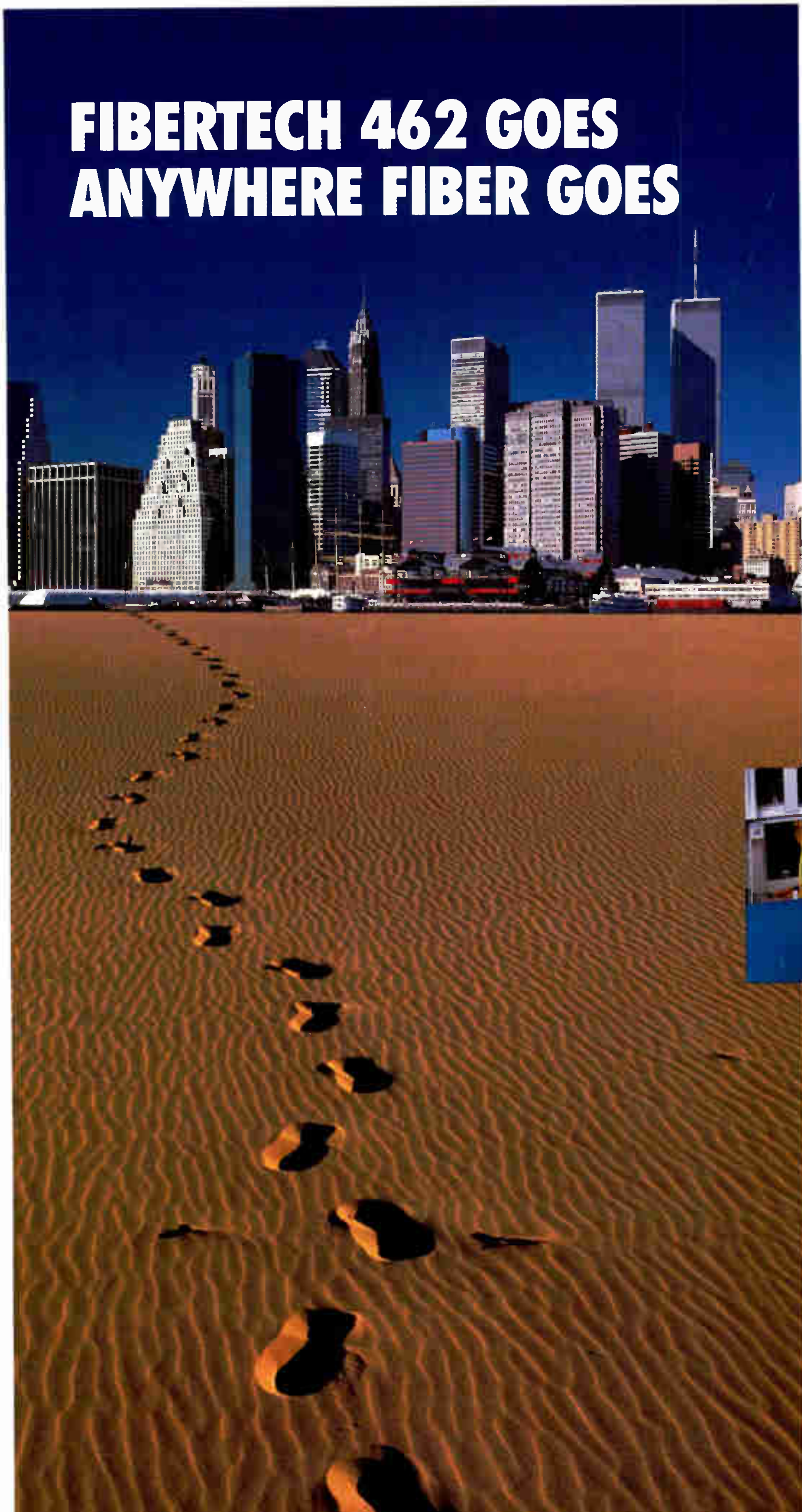
Standard accessories include a custom soft-side carrying case (Cordura nylon) with precut foam inserts, BNC-to-F adapter, BNC-to-N adapter, BNC-to-alligator clips jumper, battery charger, instruction manual, thermal printer and a roll of printer paper. One additional accessory now being shipped with all Model 1220 TDRs is a 20-minute VHS instructional videotape that provides an introduction to the product and how it operates.

The 1220's front panel includes a 2-3/4 x 4-7/8 inch dot-matrix supertwist LCD with electroluminescent backlighting. The backlight switch is next to the power switch, and just below the switches are the charging and power-on LED indicators, charger jack and input/output BNC. To the right of the display is the cover plate to the printer's paper well (accessible by loosening a small thumbscrew). The built-in printer is just below the paper well, along with a paper release lever that is used when loading a new roll of paper. In the event you should forget to turn the 1220 off after use, a small auto-off switch will do that for you when you close the lid.

Below the display is the instrument's membrane keypad. With the exception of backlighting and main power on/off, all TDR functions are controlled with one of the 23 membrane "pushbuttons" (keys). Riser-Bond has attempted to make the 1220's operation as intuitive as possible, and this is reflected in the layout and labeling of the keypad. The *HORIZONTAL ZOOM OUT* and *HORIZONTAL ZOOM IN* controls change the horizontal scale (the zoom range is 1x to 2,048x), while the two *VERT GAIN* keys change the vertical scale (and displayed sensitivity) from 1x to 128x. The four *WAVEFORM POSITION* keys move the displayed waveform in directions corresponding to the arrows on the keys.

Pressing the *AUTO SEARCH* cursor key will cause the TDR to restart the auto-cursor placement routine, which places the two on-screen cursors at the leading edge of the transmitted and first major reflected pulses respectively. The distance between the two are displayed in meters and feet in the LCD's lower right corner. This is handy if you want to quickly check the length of a reel of cable or find the first major fault. The other two cursor keys are labeled *1st* and *2nd*. These will place their respective cursors at the center screen marker and lock them on the waveform (to use this function, you move a point of interest on the waveform to center screen, then depress either the *1st* or *2nd* key, depending on which cursor you want to position at the point of interest).

NOISE FILTER manually selects one of five internal filter



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Reader Service Number 56

functions (Average x4, Average x8, Auto Filter, Median Sort, or Filter Off). The two keys to the right of *NOISE FILTER* are *VOP* up and down. These allow the user to change or specify the velocity of propagation by setting the displayed VOP to any value from 0.30 to 0.99 (30 to 99 percent) in 0.01 increments. Below these keys are *CABLE IMPEDANCE* (which allows a choice of 50, 75, 93 or 125 Ω cables) and *CONTRAST* up and down.

The keypad includes three waveform keys (*STORE*, *RECALL*, and *DISPLAY MODE*). As shipped, the 1220 has the ability to store one waveform in memory, and optionally up to four. When *STORE* is pressed, the displayed waveform is stored; it can be viewed later by pressing *RECALL*. When *RECALL* is pressed, the display switches to a split-screen configuration: The top half is the previously stored waveform and the lower half is the current waveform (real-time). *DISPLAY MODE* will change the display to show the mathematical difference between the displayed and current waveform. Pressing it again will show the stored waveform full screen, and one more push of the key will return to the "live" waveform. As long as the internal batteries are in the TDR and have at least some charge, the memory will retain the most recently stored waveform.

PULSE WIDTH allows the user to select from four available pulse widths, including 2, 10, 100 and 1,000 nanoseconds. Riser-Bond recommends starting with the 2 ns pulse when checking an unknown cable for the first time. The larger pulses would be used when less resolution is required or for high attenuation or very long cables.

The last two keys are printer control keys. *LINE FEED* is used to advance the paper and *PRINT* will print the current on-screen display. All printouts include spaces for the TDR user to write in the date, time, operator (name, tech number, etc.) and location. Besides the waveform, the 1220 prints current instrument settings for VOP, pulse width, vertical gain and impedance. It also prints the distance between the cursors in meters and feet, calculated return loss and type of fault (open or short).

The user-friendly characteristics of the 1220 are carried over to the LCD as well. Besides displaying a real-time waveform of the cable being tested, the LCD shows the chosen impedance setting, VOP, pulse width, battery level, return loss (this is calculated by the TDR and includes cable attenuation), distance between cursors in meters and feet, horizontal units/division, and vertical gain setting. An area in the upper left of the screen called the "message center" provides several TDR and printer status messages.

Many of the 1220's functions are microprocessor-based or controlled. For example, when the batteries reach about one-fourth of their capacity, the printer function is automatically disabled to conserve power, although the TDR will continue to operate otherwise. The microprocessor also detects power or other high level signals on the cable and will activate the noise filter function (the 1220 is protected up to 400 volts AC or DC). At power-up, the impedance and VOP last used are selected and an auto search routine is performed.

Highlights of the manufacturer's specifications are summarized in the accompanying table. Riser-Bond provides a one-year warranty on the 1220, and at the time of our evaluation its list price was $5,195.

Lab test

Perhaps the best way to test a TDR is to connect a variety of known cables to it and see what it tells you. Following this, various simulated faults can be created (at known points along the

Reader Service Number 58

cable) and the resultant display observed. This is precisely what we did.

The first test was a check of the TDR's capability to accurately measure a relatively lossy length of coax. For this we used a new 1,000-foot reel of Comm/Scope RG-6 drop cable. After setting the 1220's impedance to 75 Ω and its VOP to 0.82 (corresponding to Comm/Scope's specification for the particular cable we used), we connected one end of the reel to the TDR. Pressing the *AUTO SEARCH* key resulted in the display shown in Figure 1, and an indicated length of 987 feet. This is a little more than two feet worse than what Riser-Bond's worst-case spec says it should have indicated, assuming the cable under test was exactly 1,000 feet (we didn't measure the actual length, but assume Comm/Scope's printed length and published VOP are each accurate within 1 or 2 percent). The TDR correctly indicated both open and short conditions on the far end of the cable.

Figure 1

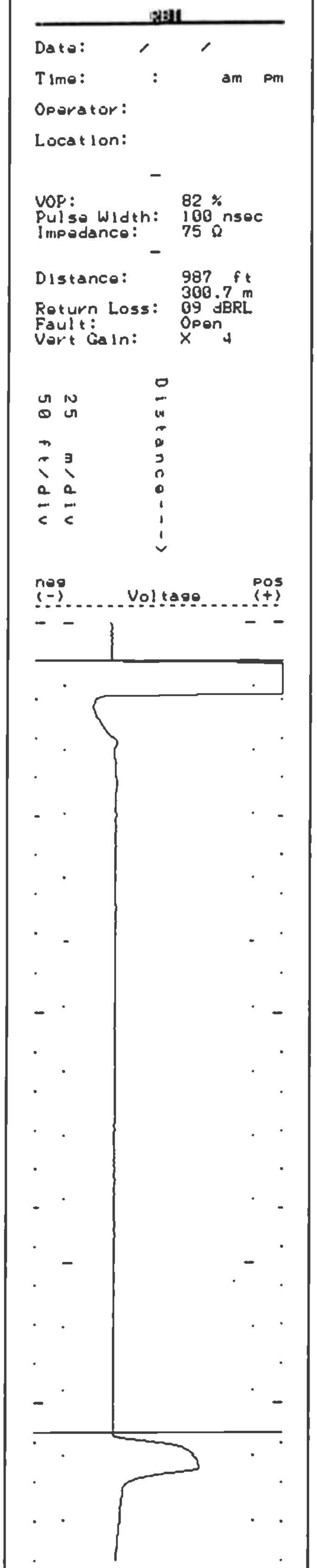
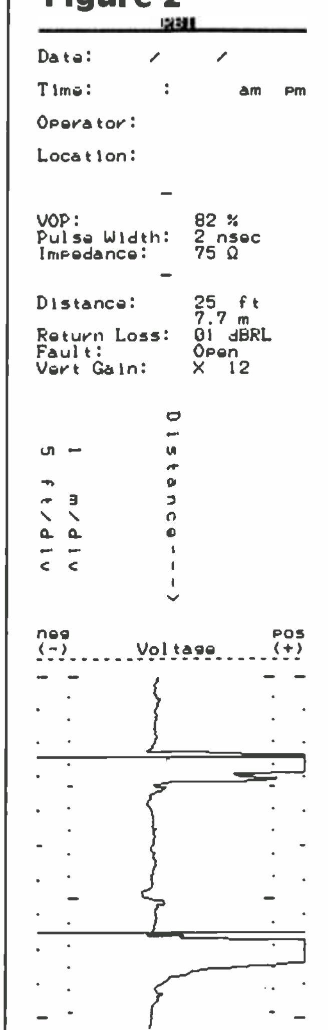


Figure 2



We then carefully measured and cut a length of the same reel to 25 feet and connected it to the 1220. After pressing *AUTO SEARCH*, we got an indicated length of 25 feet. The next step was to cut the cable about six feet from the far end and install F-connectors and a barrel. Figure 2 clearly shows the location of the barrel about three-quarters of the way between the two cursors (after the VERT GAIN was increased to x12). Similar accuracy was noted with other manufacturers' types and sizes of cables (all 75 Ω).

One unusual test was to verify the TDR's ability to detect the presence of voltage on the input connector and operate with it there. We first applied 12 VDC, and the display's message center area indicated "powered cable," and switched the noise filtering on. Next 120 VAC was applied to the connector. The displayed waveform was very noisy until the filtering cleaned it up; the 1220 faithfully indicated "powered cable" and proceeded to operate unharmed.

Several simulated conditions also were tried, including kinked cable, nicked shield and various devices in-line. The 1220 had no problem pinpointing kinks, but we could not detect a small nick in the cable shield (a leakage detector would have probably been better suited for this latter task). Devices installed in the line being tested have a variety of effects, including making the waveform difficult to interpret. In some cases, you may find (as we did) that certain components have an electrical length that is greater than their physical length. While it's easy to accurately tell where the device is, such a component will make the overall cable length beyond the device appear more than it really is. Note, however, that this will occur with any TDR.

We checked all of the TDR's remaining functions and features and found them to work as specified.

Comments

Riser-Bond's replacement for the 1210 is a full-featured TDR that will find use in both CATV and non-CATV industries given its capabilities and performance. The 1220 is accurate and rugged, and is competitive with units costing $1,000 to $2,000 more. It is very easy to use, and the front panel controls are relatively straightforward. If you find yourself avoiding the instruction manual, at least spend a few minutes watching the videotape.

If you do need to refer to the manual, you'll find it among the easiest to understand while still being comprehensive. Riser-Bond did an outstanding job with the manual. It provides an excellent tutorial on general TDR operation, and includes VOP tables for several types of cables used in telephony, CATV, aviation, land mobile and LAN. It also includes several helpful waveform examples for situations that may be encountered in the field. A small luggage tag-size laminated VOP chart was included with our evaluation unit, and was attached to the TDR's handle.

We found only one situation that would really fool the 1220. If a fairly short piece of cable (less than about 19 feet, but greater than the TDR pulse width's blind area) is connected to the instrument during power-up or after pressing *AUTO SEARCH*, it will have difficulty automatically showing the true length of that short piece of cable. We could bypass this problem by zooming in and manually positioning the cursors to get an accurate readout, but it appears that a cable length smaller than one division of the unit's minimum "feet/division" — in this case, 20 feet — can confuse the 1220 in the automatic mode.

For more information, contact Riser-Bond Instruments at 5101 N. 57th St., Lincoln, Neb. 68507; (800) 688-8377. **CT**

Welded towers

Sabre Communications Corp. announced four new solid round welded towers. The 3600 SRWD and 4400 SRWD are designed for use as taller structures with heavier loads, such as tall AM, FM broadcast, HF, VHF, UHF and microwave antennas up to 600 feet.

The 2400 SRWD is a medium weight, high-strength tower for AM/FM and supporting HF, WHF, UHF and microwave antennas up to 400 feet. The 1800 SRWD is a lightweight, high-strength tower for AM/FM, supporting HF, VHF, UHF and light microwave antennas at heights up to 300 feet.

All models are fabricated from structural steel, hot-dip galvanized and meet ASTM specifications. All welding is in accordance with AWS. Sabre's assembly hardware is high-strength SAE grade 5 or A-325 hot-dip galvanized. Member sizes vary with design requirements, and 10 and 20 foot sections are standard.

Reader service #207

Fiber detector

The LFD-10, new from EXFO, is a hand-held live fiber detector that can indicate both the presence and direction of a signal (modulated or CW) or 2 kHz test tone. It can be used to identify spare or marked fibers, compile fiber routing documentation, locate faults, check continuity and avoid cutting active fibers.

Operating at 850, 1,300 and 1,550 nm through a single head, the LFD-10 can detect traffic through the acrylate coating of a fiber (250 µm, single-mode or multimode). It requires no direct connection with the fiber but clips onto it, leaving the signal uninterrupted.

EXFO says the LFD-10 has a high sensitivity of -47 dBm at 1,550 nm and creates very little loss (1 dB typically) when clipping onto the fiber. At power-up, a self-test routine ensures that the instrument functions properly. Single-handed operation of the unit is possible. When a signal is present on the fiber, the unit emits visual and audible indication. The LFD-10 comes with case and battery.

Reader service #206

Power meter

Fiber Instrument Sales introduced a power meter featuring an all-metal case, three-wavelength measurement capability and low power consumption display. A rechargeable NiCad battery system and low power consumption red LED are standard.

Its germanium detector provides measuring capabilities in three wavelengths — 850 nm, 1,300 nm and 1,550 nm, and the unit is said to perform in temperatures of -20 to 55° C. It has a measurement range of -60 to 0 dBm, and each meter comes standard with an interchangeable ST adapter. The following accessories are also available: ST adapter, SMA adapter and FC, D4 and Biconic adapters.

Reader service #204

Voltage detector

Communications Technology Corp.'s C9970 voltage detector is a new high-voltage detection device designed for

use in the testing of various conductive objects that might expose craftspeople to electric shock. It is battery-powered, self-contained and may be hung from a work belt when not in use.

Go/no go safety or warning signals are delivered by means of green or red LED displays that are said to protect the user up to 20,000 VAC RMS or 2,000 VDC. The voltage detector also is available in the C9973 kit that includes a storage bag, temporary bond, ground cord and handbook.

Reader service #203

Converter technology

Anadigics has announced its production of a single gallium arsenide (GaAs) chip for tuners in cable TV set-top converters. The integrated circuit is said to provide all the front-end functions for the double-conversion, 84-channel converter. It was designed and is produced to specifications set forth by Jerrold Communications.

The new chip is said to replace more than 30 discrete components, many of which require hand tuning. Mixer, oscillator, RF amplifier and automatic gain control functions are included in the IC. The component is furnished in a plastic DIP package.

Reader service #202

Utility top

Leggett & Platt introduced its Masterack package, featuring the recently introduced Masterlite pickup utility top. This heavy-duty top features all-aluminum construction for protection from the elements. A fully welded frame, continuous door hinges, heavy-duty latches, stainless steel hardware, tempered safety glass, insulated roof and dome light are all standard. The Masterlite top is available for all pickups and includes a choice of side and rear door configurations.

Reader service #201

Fiber identifier

Noyes Fiber Systems introduced the OFI 200 optical fiber identifier for non-

invasive fiber-optic signal detection. During installations, cut-overs, maintenance and restoration, the OFI 200 is used to identify optical fibers carrying normal traffic, a 2 kHz tone or no signal (dark). Used with the Noyes OLS2-1300 laser source, the OFI 200 is said to be the lowest cost, highest performance optical fiber identification kit available.
Reader service #200

Boring system

Ditch Witch announced the 2/15 Jet Trac directional boring system. Installations made with the compact, dry-bore system are said to result in little soil disturbance and to require minimal restoration. The system is designed to make bores from 1.75 to 2.5 inches in diameter at distances to 150 feet in normal soil conditions. The 2/15 JT package is said to be easily maneuverable and able to be set up faster than wet-bore machines since there is no wait for fluid pressure to build. The drill stem sections snap together and allow a 40-foot bend radius. The power supply is portable and fits inside a standard yard gate. The drilling unit, power pack and drill stem package are modular units.
Reader service #199

Ladder rack

Crown Divisions is now offering a slide-down ladder designed to prevent injuries sustained while reaching for ladders on conventional rooftop carriers. Crown claims its product will help prevent twisted ankles and knee injuries suffered when technicians slip off the rear bumper, and back injuries due to overextension while reaching for rooftop ladders.
Reader service #198

AutoCAD software

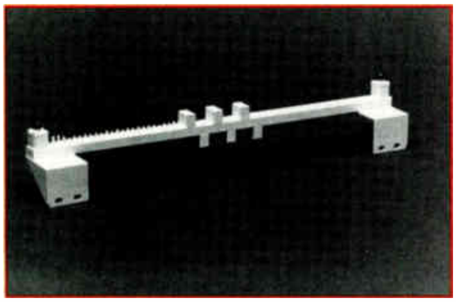
Lode Data Corp. now has available two AutoCAD-based software packages for CATV design and drafting. Lode Drafting, a "drafting-only" software package, provides AutoCAD 11 users with symbol libraries and software for drafting base, routing, design, power and geography.

Lode CADD, a combined design and drafting package, includes tools for both drafting and designing networks as well as importing design directly into AutoCAD maps.

The symbol libraries of both products are National Cable Television Association and Society of Cable Television Engineers compliant. In addition, MSO-specific (such as Times Mirror and Tele-Communications Inc.) symbols are provided, along with other frequently used symbols for coaxial and fiber-optic design. Both packages are capable of importing AutoCAD maps, survey maps and drawings in DXF or IGES format (such as those created from Intergraph). Complete BOM reports may be sent to a printer, a text file or software packages, such as DBase, Paradox, Lotus and other data base and spreadsheet software.

Both packages include complete software tools for map cutting and splicing, automatic and configurable block statistics generation, overnight unattended plotting and project management. Both packages require AutoCAD release 11 or

better running on a PC-compatible 386 or 486 computer. Support is included for both single-monitor and dual-monitor systems.
Reader service #197



Waveguide filter

Delta Microwave has developed a new 18 GHz waveguide filter for the cable TV market that features high-temperature stability to eliminate drift. The unit combines a low-loss bandpass filter to reject lower sideband signals, with a notch filter to provide additional rejection of local oscillator radiation.

Delta says its 18.142 to 18.574 GHz passband features insertion loss of 2.5 dB and VSWR of 1.5:1. Rejection is 51 dB from 0 to 18.033 GHz and 18.874 GHz, and 80 dB at 18.088 GHz. Other features include a temperature range of -40 to +70° C, and coaxial SMA female connectors.
Reader service #196

Digital modulator

Anritsu Wiltron Sales Co. introduced the MN3650A/B/C digital modulators, providing $\pi/4$ DQPSK and GMSK modulated signals covering 800 MHz to 2.7 GHz when used with synthesized signal generators as the RF signal source. They also are said to have a maximum vector error of 3 percent RMS and maximum phase error of 5° (GMSK) when Anritsu's MG3633A synthesized signal generator is used as the RF signal source.

Gaussian filters are incorporated to figure GMSK modulation for constant-amplitude modulation. They also can select a Bbt product of 0.2 to 0.55 in 0.05 steps variable in eight steps. This makes it possible to compare or simulate various types of digital mobile radio equipment.

The MN3650A/B/C can make measurements for digital communication. They have built-in baseband signal sources that Anritsu claims can select nine types of bit rate in a range of 32 kb/s

to 320 kb/s and can generate four types of patterns, including the PN9 and PN15 pseudo-random patterns required for modulation. The MN3650C's baseband signal sources can select 11 types of bit rate in a range of 32 kb/s to 384 kb/s.

These modulators can produce I and Q signals, which are output via I-Q level balance and variable offset functions for use as a standard I-Q signal generator to test and evaluate devices for systems, such as a quadratic modulator. The external I and Q signals can drive the built-in quadratic modulator directly. External I and Q signals can be input to obtain digitally modulated wave over the quasi-microwave bandwidth. The I and Q also are input via I-Q level balance and variable offset functions.
Reader service #205

Reader Service Number 11

The following is a listing of videotapes currently available by mail order through the Society of Cable Television Engineers. The prices listed are for SCTE members only. Non-members must add 20 percent when ordering.

☛ *Category V Review Course: Data Networking and Architecture* — Category V Cirriculum Committee Chairman Ernie Tunmann presents an overview of material covered in this category's BCT/E certification examination. (1 hr.) Order #T-1047, $35. **B-V**

☛ *Category VII Review Course: Engineering Management and Professionalism* — Category VII Cirriculum Committee Chairman Wendell Bailey presents an in-depth discussion of this BCT/E certification category. (This material is similar to that in videotape #T-1041, but has greater detail.) (2 hrs.) Order #T-1048, $45. **B-VII**

☛ *Signal Leakage Detection* — Equipment used in locating leakage problems within a cable system is discussed by ComSonics in this video produced for SCTE's Product-Specific Tele-Seminar Program. (30 min.) Order #T-1050, $30.

☛ *Channel Deletion and Reprocessing Networks* — Microwave Filter Co. explains the construction of RF filters and their applications in cable system headend processing in the video produced by Microwave Filter Co. for the SCTE Product-Specific Tele-Seminar Program. (30 min.) Order #T-1051, $30.

Note: The appearance of the symbol **B-** indicates a videotape relating to a certain category (noted by a Roman numerals **I-VII**) of the BCT/E Certification Program. These tapes have been discounted to aid candidates for certification in their studies. All videotapes are in color and available in the 1/2-inch VHS format only. Videotapes are available in stock and will be delivered approximately three weeks after receipt of order with full payment.

Shipping: Videotapes are shipped UPS. No P.O. boxes, please. SCTE pays surface shipping charges within the continental U.S. only. Orders to Canada or Mexico: Please add $5 (U.S.) for each videotape. Orders to Europe, Africa, Asia or South America: SCTE will invoice the recipient for additional air or surface shipping charges (please specify). "Rush" orders: a $15 surcharge will be collected on all such orders. The surcharge and air shipping cost can be charged to a Visa or MasterCard.

To order: All orders must be prepaid. Shipping and handling costs are included in the continental U.S. All prices are in U.S. dollars. SCTE accepts MasterCard and Visa. To qualify for SCTE member prices, a valid SCTE identification number is required, or a complete membership application with dues payment must accompany your order. Orders without full and proper payment will be returned. Send orders to: SCTE, 669 Exton Commons, Exton, Pa. 19341 or fax with credit card information to (215) 363-5898.

A complete listing of SCTE publications and videotapes is included in the March 1992 issue of the Society newsletter "Interval."

The Society of Cable Television Engineers proudly presents the latest in a series of three-day hands-on technical training seminars:

TECHNOLOGY FOR TECHNICIANS II

June 29 - July 1, 1992

Doubletree at Southcenter, Seattle, Washington

August 10-12, 1992

Holiday Inn, Richmond, Virginia

FUTURE 1992 SEMINARS TO BE HELD IN:
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PLUS in the Hands-On Lab:

- *Signal Leakage Tests and Measurements*

- *Amplifier Systems*
- *Coaxial Cable*
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- *Spectrum Analysis*
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To make hotel reservations call the Doubletree at (206) 575-8220 or the Holiday Inn at (804) 285-9951. Please specify that you will be attending the SCTE Seminar when you call. All reservations must be made at least three weeks prior to the event to ensure guaranteed room and pricing.

If you wish to register, or would like to see TECHNOLOGY FOR TECHNICIANS II presented in you area, please fill out the coupon below and return it to SCTE National Headquarters.

Please send me registration materials for the following **Technology for Technicians II** seminar:

❑ June 29 - July 1, Seattle ❑ Aug. 10-12, Richmond ❑ Sept., Florida ❑ Oct., New York ❑ Dec., Texas

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(215) 363-6888; FAX: (215) 363-5898

Reader Service Number 1

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- Color photo or transparency
- Company logo

Friday, July 24 — Final Deadline

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SEPTEMBER 1992

SHOWCASE

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BUSINESS DIRECTORY/CLASSIFIEDS

AD INDEX

It's so simple! To obtain additional information from any of the display advertisers appearing in this issue of ***Communications Technology,*** please use one of the **Reader Service Cards** on the facing page (pass the others along). The ad index below has been expanded to include not only the page number of each advertiser, but also each corresponding reader service number to be circled on the Reader Service Card.

Back to Basics

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FREE INFORMATION

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July 1992 (Valid until September 1992)

CT 7/92 - 1

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3	22	41	60	79	98	117	136	155	174	193
4	23	42	61	80	99	118	137	156	175	194
5	24	43	62	81	100	119	138	157	176	195
6	25	44	63	82	101	120	139	158	177	196
7	26	45	64	83	102	121	140	159	178	197
8	27	46	65	84	103	122	141	160	179	198
9	28	47	66	85	104	123	142	161	180	199
10	29	48	67	86	105	124	143	162	181	200
11	30	49	68	87	106	125	144	163	182	201
12	31	50	69	88	107	126	145	164	183	202
13	32	51	70	89	108	127	146	165	184	203
14	33	52	71	90	109	128	147	166	185	204
15	34	53	72	91	110	129	148	167	186	205
16	35	54	73	92	111	130	149	168	187	206
17	36	55	74	93	112	131	150	169	188	207
18	37	56	75	94	113	132	151	170	189	208

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3	22	41	60	79	98	117	136	155	174	193
4	23	42	61	80	99	118	137	156	175	194
5	24	43	62	81	100	119	138	157	176	195
6	25	44	63	82	101	120	139	158	177	196
7	26	45	64	83	102	121	140	159	178	197
8	27	46	65	84	103	122	141	160	179	198
9	28	47	66	85	104	123	142	161	180	199
10	29	48	67	86	105	124	143	162	181	200
11	30	49	68	87	106	125	144	163	182	201
12	31	50	69	88	107	126	145	164	183	202
13	32	51	70	89	108	127	146	165	184	203
14	33	52	71	90	109	128	147	166	185	204
15	34	53	72	91	110	129	148	167	186	205
16	35	54	73	92	111	130	149	168	187	206
17	36	55	74	93	112	131	150	169	188	207
18	37	56	75	94	113	132	151	170	189	208

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CT 7/92

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- ☐ 3. Cable TV Program Network
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- ☐ 7. Commercial Television Broadcaster
- ☐ 8. Cable TV Component Manufacturer
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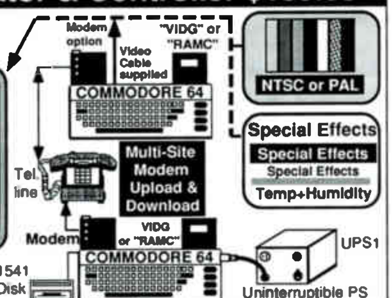

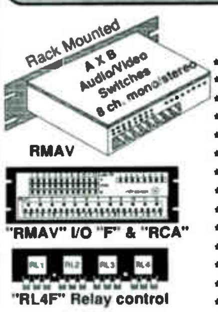

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CALENDAR

July

5-8: Colorado, New Mexico and Wyoming Cable TV Associations' Rocky Mountain Cable Television Expo, Beaver Run Resort, Breckenridge, Colo. Contact (303) 863-0084.
7: SCTE Rocky Mountain Chapter seminar, troubleshooting. Contact Patrick Kelley, (303) 267-4739.
8: SCTE Oklahoma Chapter seminar. Contact Arturo Amaton, (405) 353-2250.
8: SCTE Magnolia Meeting Group seminar, recovering cost of cut cables, locating utilities and safety in underground construction, Ramada Inn Coliseum, Jackson, Miss. Contact Steven Christopher, (601) 992-4461.
8: SCTE Snake River Chapter seminar, installation procedures and troubleshooting, Weston Plaza, Twin Falls, Idaho. Contact Paul Elgethun, (208) 377-2491.
8: SCTE Oahu Meeting Group seminar, basic video measurement and spectrum analysis, and function/relation with CATV interference and resolution questions. Contact Michael Goodish, (800) 836-2888.
9: **SCTE Mid-South Chapter**, BCT/E exams to be administered in all categories at the technician level and Categories III, IV, V and VII at the engineer level, Memphis CATV, Memphis, Tenn. Contact Scott Young, (901) 365-1770, ext. 4150.
9: **SCTE Penn-Ohio Chapter** seminar, fiber restoration and emergency troubleshooting, Sheraton Hotel, Warrendale, Pa. Contact Bernie Czarnecki, (814) 838-1466.
9: **SCTE Satellite Tele-Seminar Program**, *Video and Audio Measurements Part Two* produced by SCTE's Wheat State Chapter. To air from 2 to 3 p.m. ET on Transponder 6 of Galaxy I.
10: SCTE Greater Chicago Chapter, "A Day at the Races" event sponsored by the Greater Chicago Chapter, Women in Cable and NAMIC. Contact Bill Whicher, (708) 362-6110.
11: SCTE Big Sky Chapter seminar, fiber, new technologies, fiber plant tour and hands-on fiber splicing, and Installer and BCT/E Categories IV and VI exams to be administered, Red Lion, Missoula, Mont. Contact Marla DeShaw, (406) 632-4300.
11: SCTE Cascade Range Chapter, BCT/E exams to be administered in all categories, Paragon Cable, Portland, Ore. Contact Cynthia Stokes, (503) 230-2099.
11: SCTE Chaparral Chapter seminar, OSHA and CATV, and BCT/E exams to be administered at both levels in all categories, Albuquerque, N.M. Contact Rita Erickson, (505) 761-6206.
13-15: Space 2000 satellite communications & VSAT seminar, technology, applications and economics, Houston. Contact (800) 933-4540.
13-17: ONI Fiberworks '92 seminar, ONI Training and Product Development Center, Englewood, Colo. Contact Ray Reynard, (800) FIBER ME.
14: SCTE Chattahoochee Chapter seminar, FCC technical standards and measurements, Holiday Inn, Macon, Ga. Contact Hugh McCarley, (404) 843-5517.

14: SCTE Desert Chapter, Installer and BCT/E exams to be administered, Southland Cablevision, Redlands, Calif. Contact Chris Middleton, (619) 340-1312, ext. 258.

14: SCTE New York City Chapter seminar, consumer interface, Time Warner offices, Flushing, N.Y. Contact Rich Fevola, (516) 678-7200.

14: SCTE Delmarva Meeting Group seminar, installer level drop standards and hardline construction, connectorization and drop-related CLI programs, The Hub Steakhouse, Dover, Del. Contact Linc Reed-Nickerson, (215) 825-6400.

14-15: SCTE West Virginia Mountaineer Meeting Group seminar, system performance testing, Ramada Inn, Charleston, W.Va. (14th) and Holiday Inn, Fairmount, W.Va. (15th). Contact Joe Jarrell, (304) 522-8226.

15: SCTE Appalachian Mid-Atlantic Chapter, annual pig roast and golf tournament, Community Center, Scotland, Pa. Contact Richard Ginter, (814) 672-5393.

15: SCTE Dixie Chapter seminar. Contact Scott Peden, (904) 968-6959.

15: SCTE Great Plains Chapter seminar, BCT/E Category I, "Signal Processing Centers," and BCT/E exams to be administered, Courtyard Cafe, Bellevue, Neb. Contact Jennifer Hays, (402) 333-6484.

15: SCTE Mount Rainier Chapter seminar, La Quinta Inn, Tacoma, Wash. Contact Sally Kinsman, (206) 821-7233.

16: SCTE Central Indiana Chapter seminar, BCT/E Category V, "Data Networking and Architecture," Indianapolis. Contact Gregg Nydegger, (317) 362-6161.

16: SCTE New England Chapter seminar. Contact Jeff Piotter, (508) 685-0258.

16: SCTE Wheat State Chapter seminar, Wichita, Kan. Contact Mark Wilson, (316) 262-4270.

18: SCTE Cactus Chapter seminar, Installer Certification class. Contact Harold Mackey, (602) 352-5860, ext. 135.

19-21: SCTE Palmetto and Piedmont Chapters seminar, new FCC technical standards, safety training issues/OSHA requirements, penalties and labor relations, technical training sources and PPV technologies/order entry and delivery, in conjunction with the North Carolina/South Carolina CATV Association joint summer meeting, Hiltonhead, S.C. Contact Tod Dean, (919) 662-1489.

21: SCTE Central Indiana Chapter, BCT/E exams to be administered, Monticello, Ind. Contact Gregg Nydegger, (317) 362-6161.

21: SCTE Southeast Texas Chapter, Installer and BCT/E exams to be administered, Warner Cable office, Houston. Contact Rosa Rosas, (409) 646-5227.

22: SCTE Bluegrass Chapter seminar, BCT/E Category V, "Data Networking and Architecture." Contact Liz Robinson, (606) 299-6288.

22: SCTE Golden Gate Chapter seminar, FCC system proof-of-performance and testing, Viacom headquarters, Pleasanton, Calif. Contact Mark Harrigan, (415) 358-6950.

Planning ahead

Sept. 9-11: Eastern Cable Show, Atlanta. Contact (404) 252-2454.

Sept. 15-17: Great Lakes Cable Expo, Cleveland. Contact (517) 482-9350.

Oct. 6-8: Mid-America Cable Show, Kansas City, Mo. Contact (913) 841-9241.

Oct. 13-14: Atlantic Cable Show, Atlantic City, N.J. Contact (609) 848-1000.

Dec. 2-4: Western Cable Show, Anaheim, Calif. Contact (415) 428-2225.

SCTE

The melting pot

By Wendell Woody
Immediate Past President
Society of Cable Television Engineers

The uniqueness and greatness of our Society is the result of our all-encompassing membership base and the leadership it elects. The organizational structure and procedures detailed by our national bylaws unite the strengths and provide the required direction for our Society to exist and continue to grow stronger.

First, it is the diversity of our membership that makes the Society so unique. We have members from every technical level of knowledge and skill. If we were a school Society, our student membership would encompass kindergarten, elementary school, junior high, high school, college and university students — plus all the professors, book publishers and supporting industry trade people. Likewise, if we were a church, we would have only one Sunday school class that would include all ages. The SCTE is "the melting pot" for our industry technically. We have the integration and support of the other two major technical groups in our industry (the National Cable Television Association's Engineering Committee and Cable Television Laboratories) as well as a strong working relationship with the Federal Communications Commission.

The majority, approximately 75 percent, of our members come from the cable operation ranks. The Society's elected leadership follows near the same pattern. The 1991/92 national board of directors consisted of five vendor representatives, eight operator representatives and one industry representative each from the NCTA and *Communications Technology* magazine, the official SCTE journal. The recent 1992/93 elected board of directors remains unchanged with the mixture of five vendors and 10 operator/industry representatives. There is no mixture dictated by the Society bylaws. Instead, this excellent representative ratio is merely the will of the membership to elect the best candidates to serve the Society.

Size of MSO

Once again the national board of directors is unique and fortunate to have a variety of representatives from the largest operators, medium size operators, as well as small system operators. Each of these directors has special talents and skills that they bring to the Society: leadership skills, management skills, innovation of leading-edge technology, training resources, worldwide interfacing, day-to-day in the field interfacing and some even climbing poles and towers regularly. Therefore, once again the Society is "the melting pot," bringing together all these talents so they can be shared with and beneficial to all our members. This is not merely desired, but reflected in the actual working relationships and contributions of your current SCTE national board.

Elected officers

In the beginning years of the Society, the officers were elected from the floor of the Annual Membership Meeting. At that time those present for the meeting would probably represent 75 percent of the total membership. Today's Annual Membership Meeting is held during Cable-Tec Expo. Even though 25 percent of the Society's members may attend the expo, only 5 percent or less will attend the meeting. Therefore, as the general membership grew, regions were established and representatives from each region were elected to the national board of directors by the members in their respective regions.

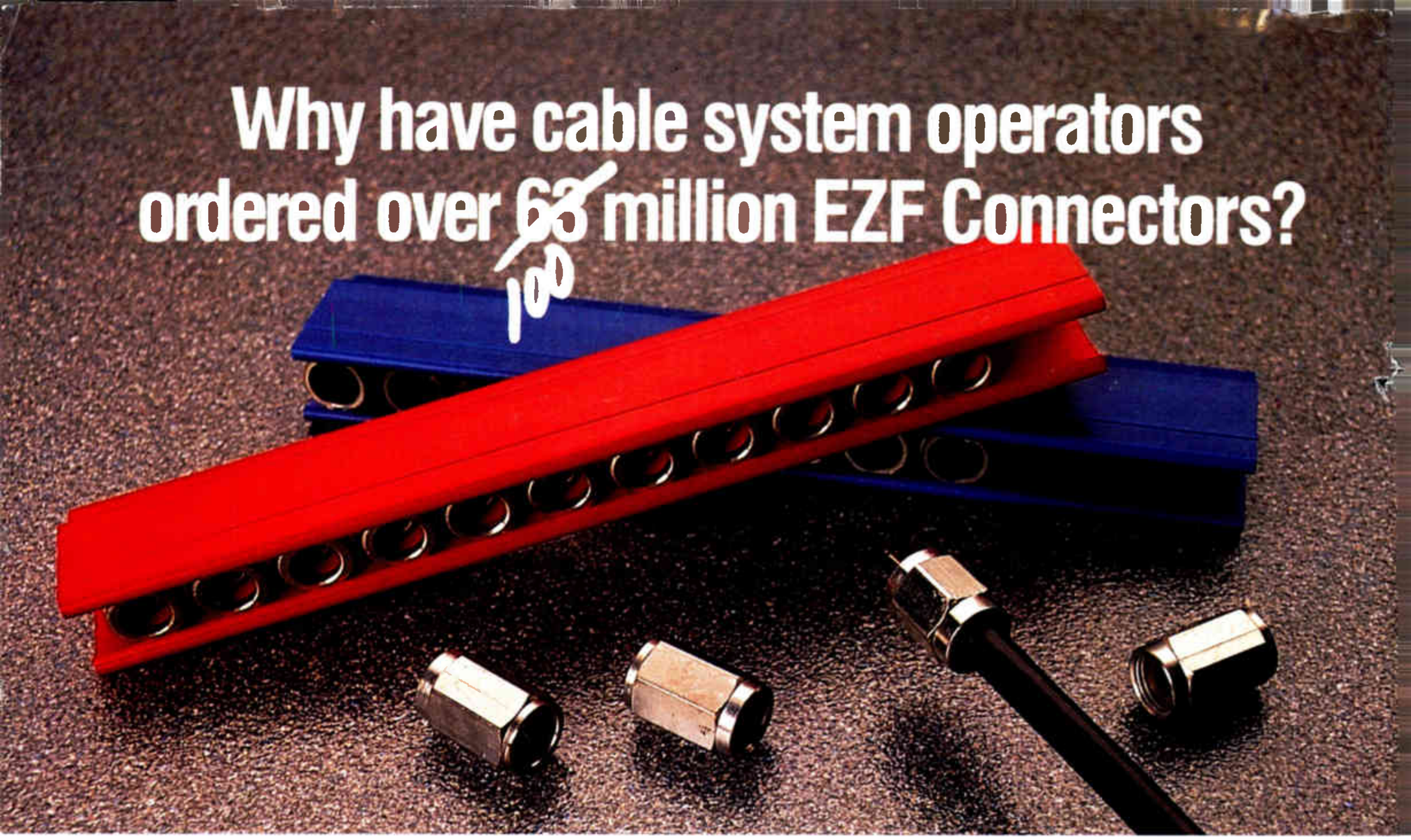
Thereupon, this elected body of representatives would elect among themselves a chairman, vice chairman, secretary, treasurer, etc. Who better knows the capabilities and skills of those who could best serve the Society leadership roles than this small group of colleagues? You are correct, none. Consequently, the Society has been best served by the voting general membership electing its directors and letting the qualified board of directors select the active leadership.

Meeting the members

Fortville, Ind., is its home and its name is the Central Indiana Chapter. Geographical directions for chapter names are perhaps not the most picturesque. However, attending the recent Central Indiana Chapter meeting will remain a picturesque event. The registration fee included the SCTE morning training session, luncheon and tickets for the Indianapolis Speedway Memorial Day time trials, as well as a tour of the garages in "Gasoline Alley" in the afternoon. Over 125 were in attendance, including guests from neighboring chapters. We salute the officers for a good program: Gregg Nydegger, Bob Ralston, Mike Richardson, Deanna Christie, Charles Nydegger and Scott Widaman. How about a distinctive renaming of this chapter, maybe the Indy 500 Chapter?

"The uniqueness and greatness of our Society is the result of our all-encompassing membership base and the leadership it elects."

The Heart-of-America Chapter recently held a coordinated training program with the Gateway Chapter. The same program and speakers were in St. Louis on Wednesday and Kansas City on Friday. The Heart-of-America Chapter also announced its completed board of directors, which includes Don Gall, Ken Covey, Bill George, Larry Stiffleman, Alan Tschimer and Larry Douglas as officers. The remaining directors are Russ Hamilton, David Clark, Tom Schulle, John Giesch and Chris Cooper. **CT**



Lower Maintenance Costs and Improved Customer Satisfaction

In both new builds and rebuilds, users of the EZF connector system are experiencing a dramatic reduction in drop related service calls. RF leakage trouble calls resulting from improper connector installation and corrosion are no longer the single most problem in a CATV system when the EZF connector system is used.

PROVEN: Fewer problems occur during installation

- One color-coded connector for each cable size minimizes connector selection problems.
- The cable is prepared for installation the same way every time with the EZF cable preparation tool.
- Only a 7/16 inch wrench is needed for installation.
- Cassette packaging facilitates proper installation and reduces connector loss.
- Immediate inspection for proper installation by installers and QC inspectors.

PROVEN: Fewer problems occur during service life

- A circumferential, environmental seal is automatically made at the connector/cable interface during installation.
- The EZF sealing sleeve supplied with the connector prevents moisture penetration at the connector/port interface.
- Material compatibility and corrosion resistance are ensured by specially selected and tested materials and platings.
- Rugged connector design and consistent installation quality contribute to reduced RF leakage and reliable performance.

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