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Western Show wrap

January 1991

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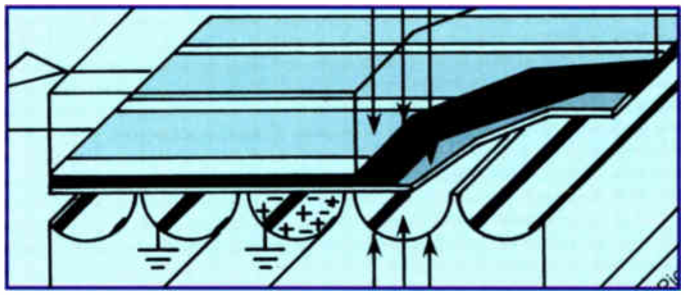
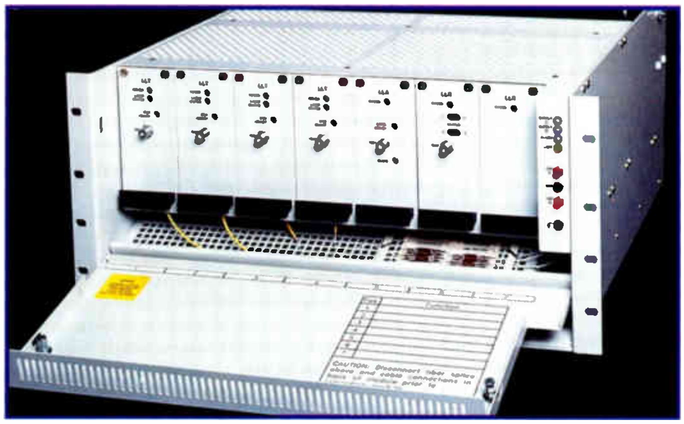


Correspondent's Report 60



Courtesy ONI

CT's Lab Report 80

Geri Saye

Back to Basics 85

Features

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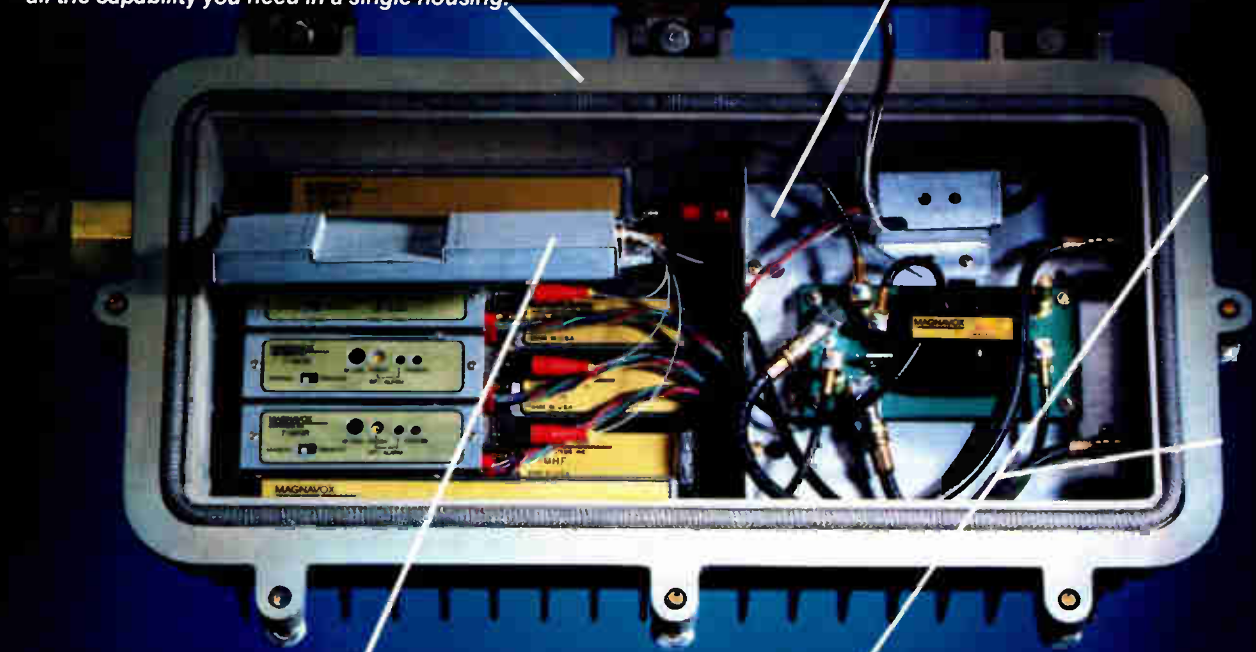

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EDITOR'S LETTER

New Year inspirations

We often think of January as the time to make a list of New Year resolutions (most of which are soon forgotten anyway). Instead, why not reflect on those individuals or events that have been an inspiration in your job—or maybe even your life—and think about ways to give back? Well, I've done just that:

When I look back on my more than 18 years in cable, much of my career inspiration has come from some of the people I've had the opportunity to work with. In 1972, I started in a northern Idaho Teleprompter system, where several of my co-workers had been since the 1950s! I was fortunate that they all were willing to share what they had learned over the years, and that inspired me to give back and share with others by writing in *CT* and speaking at SCTE seminars and other industry gatherings. Dee Miller, Walt McCall, Wes Scoles, Bob Simmons and Jack Milligan have since retired; Bob Munden and Steve Nagel are still there; Del Hallberg moved on to another job (construction, I think); Jeff Tarbet is managing the Colorado Springs, Colo., system; and the guy who hired me for my first job in cable—Bill Raschka—was managing a TCI system in Puerto Rico last I heard.

In later years I again benefited from working with people in the industry who were inspirations in various ways: Ron Schmitt, Richard Covell, Al Kernes, Bob Luff and Glenn Jones. And while we've never actually met, Bill Daniels has set a pretty good example of giving back to the industry.

As I look at events that have shaped my life, there's no question that becoming an Eagle Scout at age 15 is near the top of the list. I was a member of three different troops over five years, and my favorite was one in Tumwater, Wash. Of course, having a scoutmaster who also was a ham operator probably biases my opinion a bit. Today I remain active in the Boy Scout program as an assistant scoutmaster—giving back the skills I learned.

But my life inspiration has been my maternal grandfather. He had only an eighth grade education and literally was self-taught after that. "Grandpa Charlie" had an IQ over 190 and could discuss anything from the theory of relativity to genetic mutations in plants. In fact, his life-long pursuit was horticulture; 60 years ago he was creating new variations in fruit using chemically induced genetic mutations instead of the conventional crossbreeding and grafting techniques. Polio complicated things when he was 35, but he still managed to enter plants in an international competition; the Stark-Burbank Institute of Horticulture awarded him the event's top three prizes! And in spite of being told he'd never walk again ("The hell I won't," he reportedly told his doctor), he managed to lead a fairly active life after that—on both feet.

He passed away about a year ago, but I'm fortunate to have had a chance before then to tell him thanks for being the inspiration that he was. He taught me to be persistent and to not give up when the road gets rough. The best way I've been able to give back the principles I learned from my grandfather is to set similar examples and encourage others to give back.

We take for granted so much in our day-to-day lives and activities, but have you ever stopped to think about the people and events that have been an inspiration to you? Now that it's a New Year, forget the usual resolutions. Make up your mind to give back in some fashion. Be a teacher and share what you've learned. Set an example for the new hires and be willing to answer their questions. Become involved in the community. Be a volunteer. And if you have a chance, say thank you to the people who have been your mentors. It'll make for a much happier New Year!

Ronald J. Hranac
Senior Technical Editor

The TVM450...

Full featured status indicator panel with automatic FCC offset and RF mute/PLL lock LED's.

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Inside the TVM450 is a non-volatile microprocessor tuning circuit which allows the utilization of a standard set-top converter channel format, while the optional PROM permits the installation of a custom set-top converter channel format. The TVM450 is frequency agile through Low VHF (2-6, Mid VHF (A-1), High VHF (7-13, Superband (J-W) and Hyperband (AA-ZZ). The front panel LED display indicates your real-life channel number, eliminating the need for look-up charts.

When the optional OAP450 off-air processor is added, the TVM450 becomes a internally phased-locked frequency agile off-air processor meeting all FCC offset and stability requirements.

Ground straps

This letter is in response to your article, "How to install ground straps," which appeared in *CT*'s August 1990 issue.

The article was well-written, photographed and informative. It did however, have one serious flaw—it read like an advertisement. A "how-to" article such as this should attempt to be even handed, showing the basic points of assembling *any* manufacturer's copper ground strap.

This article would leave the reader with the impression that one clamp is the industry standard, much like the days when AT&T set the standards for Bell Telephone. There are several types of copper ground straps all of which have their merits. Otherwise, they would disappear from the marketplace.

The primary manufacturers are Blackburn, Diamond, Reliable, Sachs, Senior and Viewsonics. Each of these could have been shown to make the article unbiased. If you would consider a follow-up article I would be glad to contribute and presumably so would other manufacturers.

Gene Coll
Engineering Sales Manager
Diamond Communications Products

Editor's note: The very nature of "how-to" articles often makes them product/manufacturer-specific. I chose Sachs because it has a well-equipped training facility nearby, which made it convenient to photograph the installation procedure. Furthermore, there is only so much editorial space in any magazine and had I shown procedures for all the ground straps available, the article would have been six times the size it was. Besides, it did state that "the procedure for other brands will vary from what is shown here; you should contact the specific manufacturer of the straps you use if you have questions."

Hot chassis help

This letter is an extended thanks for sending me the article "Hot chassis condition" (*Installer Technician*, November 1989). Recently, we have been experiencing a rash of malfunctioning TV sets during installation due to hot chassis and your article immediately came to mind.

It is my hope that this will help our situation, and that we can stay in touch for future reference. Thank you once again.

Ken Shepard
Installation/Audit Supervisor
Staten Island Cable

Getting training

I enjoy your full monthly issues very much and was hoping you could answer some questions I have.

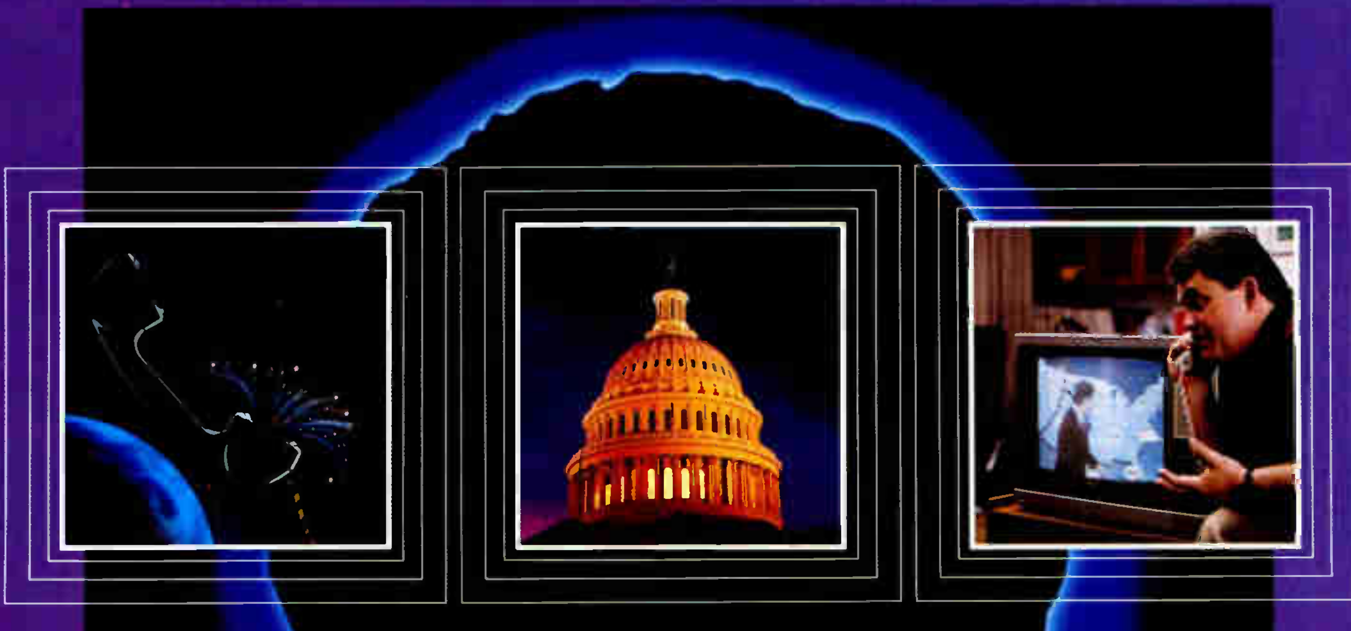
I've been in the cable business for approximately seven years from installer to service tech to technician. I am very eager to learn all I can. I've just moved to Wilmington, N.C., with Vision Cable. I have taken a small course in fiber optics but I need more headend experience. I am aware of the National Cable Television Institute but I'm with a new company and on six months probation, so Vision can't help with the course.

What I'm asking is: Are there any training seminars in the Wilmington area? or are there any videotapes available on headend training?

The July 1990 issue of *CT* had an article by Ronald Wolfe about a training facility. I would like the address and more information on this facility.

James Holliday III
Vision Cable

Editor's note: Contact SCTE's Piedmont Chapter, P.O. Box 476, Granite Quarry, N.C. 28072, for its schedule of training seminars in your area. Most chapters and meeting groups conduct training seminars every other month and try to emphasize local training for a reasonable cost. SCTE's national headquarters may be able to help out too. They have a fairly comprehensive library of technical publications and videotapes from which you may be able to purchase what you need (check "The Interval" in February 1990 "CT" for a full listing). As well, SCTE's tuition assistance program is available to fund NCTI courses and other CATV-related training. Contact the SCTE at 669 Exton Commons, Exton, Pa. 19341, (215) 363-6888. You can contact Ron Wolfe at the ATC National Training Center, 2180 S. Hudson St., Denver, Colo. 80222, (303) 753-9711.



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NEWS

Vyvx to upgrade fiber-optic network

TULSA, Okla.—**Vyvx National Video Network** (*CT*, Oct. 1990, page 26) plans to upgrade its nationwide fiber-optic TV transmission network. A $10 million contract was awarded to **Grass Valley Group** for the purchase of video equipment required for the upgrade.

The equipment will raise the specifications of Vyvx NVN's system to meet the broadcast-quality standards for digital TV transmission proposed by Committee T-1, an ANSI approved standards organization. In addition, the GVG Excalibur codec allows the Vyvx NVN system to deliver CD-quality uncompressed digital audio at 20 kHz, which meets the T1-505 audio transmission standard.

Installation of the equipment will begin in February and be completed in more than 57 cities in May.

ONI gets Canadian headquarters, two systems activated

ANAHEIM, Calif.—**Optical Networks International** (ONI) has established Canadian headquarters in Mississauga. The new ONI Canada will consolidate all Canadian fiber-optic development and technical service functions previously performed by Anixter Cable TV.

ONI Canada will focus on international fiber-optic resources and their application in Canada. It will pursue joint ventures with established companies, as well as investigate new technologies to expand and complement the Laser Link product line.

MEI's interactive training videos are now available

ENGLEWOOD, Colo.—**Mind Extension Institute's** two interactive video training courses (*CT*, July 1990, pages 20 and 32) have been released. *General Safety* and *Installer Training*, which use SCTE recommended practices, NEC and OSHA regulations as guidelines, are the latest additions to MEI's library of training programs designed for the cable TV industry. Additional programs include *Sales Through Service* and *Customer Service: Your Key to Success.*

Sponsors of the training programs received "laser disc" recognition plaques at the 1990 Western Show. Those sponsors include (clockwise from top) Yvonne Jordan, Magnavox CATV Systems Inc.; Pamela McGregor, Gilbert Engineering Co.; William Channell Jr., Channell Commercial Corp.; Mike Sparkman, Anixter Cable TV; Jeff Geer, Alpha Technologies; Don White, AT&T. Greg Liptak of MEI's parent Jones International Ltd. is at center.

Additional sponsors of the courses include CaLan, Comm/Scope Inc., Eagle Comtronics Inc., Integral, Scientific-Atlanta Inc. and Trilithic Inc.

ONI Canada also has activated two systems: Northern Cable Services of Sudbury, Ontario, has installed the first satellite antenna fiber-optic link in Canada, using six Laser Link transmitters and three dual receivers over 8,000 feet of single-mode fiber-optic cable; and a Laser Link system for Telecable-Laurentian in Hull, Quebec, was activated.

ALS, ATC's FTF concept is up and running

ANAHEIM, Calif.—**American Lightwave Systems** and **American Television and Communications** successfully have installed the first fiber-optic CATV system designed for fiber-trunk-feeder architecture in ATC's Marion, Ind., franchise area.

This was ATC's first design to prove the FTF concept and show that it can be built for equal or less than the cost of a traditional coaxial cable plant. The application uses ALS's LiteAMp transmitters to transmit 60 channels on a single fiber. They're optically split to serve multiple remote node locations.

Two HDTV pacts announced

GLENVIEW, Ill., and TOKYO—**Zenith Electronics** and **AT&T** are developing a high-performance, all-digital HDTV system that could solve the fundamental problems of digital simulcast HDTV, Zenith says. Based on 18 months of research by the two companies, the system will expand the capabilities of Zenith's original spectrum compatible HDTV approach.

In the first joint development of HDTV components between Japanese and U.S. companies, **Toshiba** and **Motorola** will develop a new type of integrated circuit used in MUSE decoders for NHK's HDTV service.

Jerrold reduces Cableoptics prices

HATBORO, Pa.—Economies of scale from increased production levels have allowed **Jerrold Communications** to cut prices of its Cableoptics AM-550R optoelectronic receivers by up to 25 percent.

The new price schedule covers all Starlite Cableoptics modules used for fiber-to-feeder, backbone and other new cable TV trunking architectures. It also includes fiber-to-feeder link configurations for single- and dual-fiber applications.

Expo '91 packages to be mailed

Packages containing registration materials and information for the SCTE Cable-Tec Expo '91, to be held June 13-16 at the Reno-Sparks Convention Center in Reno, Nev., will be mailed to all active national SCTE members in February.

Upon receipt of the packet, national members will be able to register for the expo, the premier training and CATV hardware conference presented annually by SCTE. This packet also will contain a schedule of events planned for the expo and information on accommodations and services available to expo attendees.

SCTE has coordinated the event to make it comfortable to attendees. Registration rates for the expo have not changed since 1986, while sleeping room rates at the headquarters hotel, Bally's Resort, are $76 for single and double occupancy. Bus service to expo events will be available at nearby official expo hotels. The expo promises to be a well-attended event, and the exhibit floor is rapidly selling out.

Cable-Tec Expo '91 is being planned by this year's Program Committee, which includes Bill Riker of SCTE and Steve Allen of Jones Intercable as co-chairmen, Ted Chesley of CDA Cablevision Inc., Dennis Forer of Viacom, Sally Kinsman of Kinsman Design Associates, Paul Levine of CT Publications, B.J. Toner of Toner Cable Equipment and Dave Willis of TCI.

Nominations opened for Member of the Year Award

The Society is currently seeking nominations for its 1991 Member of the Year Award. Presented each year at the Cable-Tec Expo, this award is given by the SCTE board of directors to recognize a member for outstanding contributions to the goals and purposes of the Society.

All persons nominated for the award must be active members of the Society. Nominations must be received in writing by SCTE national headquarters no later than March 1. All nominations will be presented to the board of directors for consideration, and the selected person will receive a plaque recognizing this honor at the 1991 Cable-Tec Expo, to be held June 13-16 in Reno, Nev.

"Technology for Technicians II" to be held in February

SCTE is proud to announce a new series of four "Technology for Technicians II" technical training seminars to be held in 1991. This is an advanced three-day, hands-on technical training program for the broadband industry's maintenance technicians, chief technicians and system engineers. The first "Technology for Technicians II" seminar for 1991 will be held Feb. 11-13 at the Howard Johnson Hotel in Sacramento, Calif.

Subsequent 1991 seminars are tentatively being scheduled to be held in May (Philadelphia), August (Illinois) and November (Phoenix).

Like the original "Technology for Technicians" program, which premiered in September 1988, the "Technology for Technicians II" seminar will be conducted by SCTE Director of Chapter Development and Training Ralph Haimowitz. This seminar offers a combination of comprehensive technical theory and actual hands-on training presented in a laboratory environment.

•The first portion of the seminar will deal with mathematics and measurement and include information on ratios, cable-applicable mathematics, decibels, the decibel-millivolt and logarithms.

•The period on amplifier systems will cover unity gain concepts, equipment specifications, attenuation and equalization, and automatic system controls.

•The section on powering will cover equipment power supplies, system powering, calculating voltage drops and determining power requirements.

•The next area of concentration, coaxial cable, will include material on the types and uses, connectors, cable properties, loss calculation and cable faults associated with this type of cable.

•When covering system operation and maintenance concepts, the seminar will focus on calculating system noise, calculating system intermod, system tests and measurements, and deregulating amplifiers.

•The section on cumulative leakage index tests and measurements covers 1990 FCC requirements, signal leakage and CLI measurements and calculations.

•The hands-on laboratory sessions will feature demonstrations of spectrum analysis, signal leakage tests and measurements, and system signal level meters.

People interested in attending the "Technology for Technicians II" seminar Feb. 11-13 in Sacramento or those who would like to see the seminar presented in their area can contact SCTE national headquarters. **Reminder: Seating is limited to 40 attendees, so make your reservation early!**

Election packages mailed

SCTE election packages containing voting information on candidates for the five open board of directors positions were mailed to all active national members on Jan. 1.

All national members will have the opportunity to elect two at-large director(s) to the board, while members in five SCTE regions will be voting for directors to represent their areas. The election package will include biographies of all candidates to assist members in the voting process.

Completed ballots must be postmarked by March 15. Members are urged to exercise their ability to direct the Society's future and vote.

For further information on Cable-Tec Expo '91, "Technology for Technicians II," the Member of the Year Award or SCTE elections, please contact SCTE national headquarters at (215) 363-6888.

Figure 1: Hamilton/Toronto/Oshawa fiber network

"To deliver the high quality signals required on the backbone network, capacity was limited to 10 frequency modulated channels per fiber."

A comprehensive backbone system case study

Photo 1: Some of the equipment installed at the 855 York Mills primary hub.

The deployment of fiber-optic systems to enhance the reliable delivery of high quality programming to subscribers is proceeding well at Rogers Cablesystems. A comprehensive backbone system serving Canadian subs in Toronto, Mississauga and Brampton has been constructed and tested. A description of this system, performance measurements and extensions into Oshawa and Hamilton are the subject of this article.

By George Hart
Manager of Advanced Engineering,
Rogers Engineering

The Toronto/Peel fiber backbone network consists of five primary hubs and three drop-and-insert nodes. The primary hubs are located at 855 York Mills (855YM), 2000 Sheppard (SHP), Brampton (BMP) and Wolfedale (WD); the drop-and-insert nodes are located at Tangreen (TAN), CN Tower (CNT) and 25 Adelaide (ADE). A geographical layout of the network is shown in Figure 1.

The critical nature of the primary hubs (they essentially serve 100 percent of all subs) necessitate full redundant routes for all the hub sites. Hence, the hubs are configured as a dual counter-rotating ring. Actually, the network is composed of a ring within a ring: The inner ring includes 855YM,

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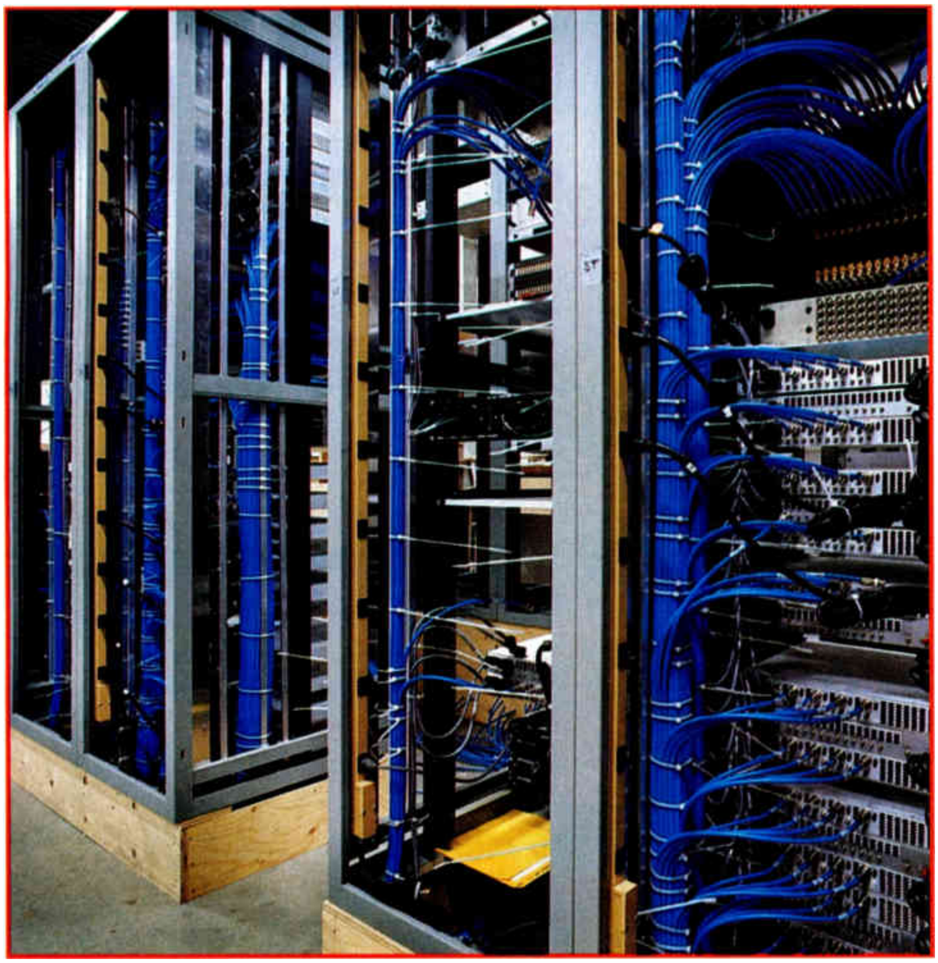
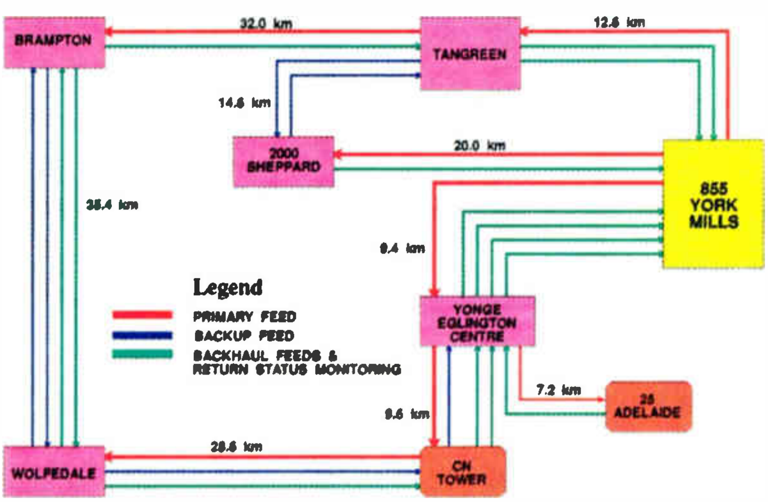


Photo 2: Construction activity for the 855YM primary hub installation.

TAN and SHP and the outer ring encompasses 855YM, TAN, BMP, WD, CNT/ADE and Young Eglington Centre (YEC). The network schematic in Figure 2 shows the hub interconnection.

The primary hubs were designed to serve approximately 100,000 to 130,000 subs and consistent with this design objective the primary hubs 855YM, SHP and YEC serve approximately 390,000 subs in Toronto while BMP and WD serve the 200,000 subs in Peel. The TAN hub serves 25,000 subs in Newmarket via an indoor broadband transmitter (IBBT) microwave link.

Figure 2: Toronto/Peel fiber backbone schematic



"Included in each hub is an agile demodulator and high quality video transport system to allow monitoring of signal quality at each hub."

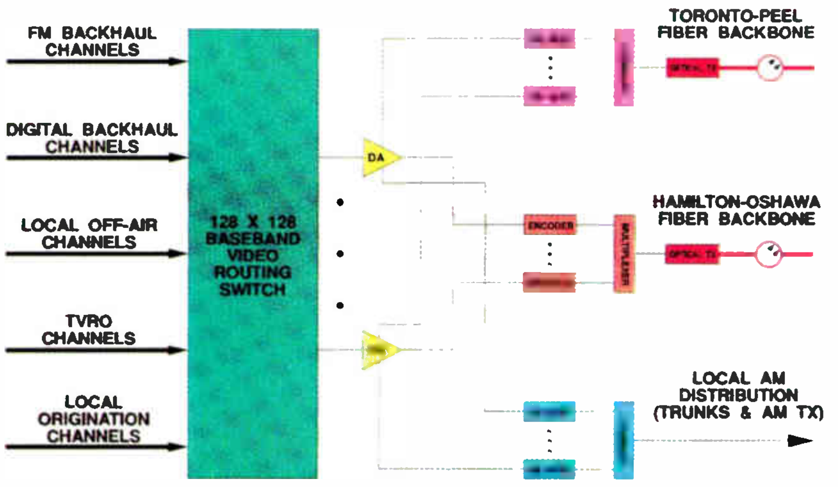
Analog FM system

The backbone employs a frequency modulation/frequency division multiplex (FM/FDM) transport system. The analog FM system was chosen over digital on the basis of economics. The 855YM site serves as the system headend and contains the FM modulation equipment. A disadvantage of the FM system compared to the digital is the signal degradation upon repeating. However, maximum cascade was limited to two optical links and only two primary hubs were affected: BMP link with a repeater at TAN and WD link with repeater at YEC. To deliver the high quality signals required on the backbone network, capacity was limited to 10 frequency modulated channels per fiber. This constraint entailed using eight fibers to deliver the near future anticipated capacity of 77 channels.

The FM modulators at 855YM are fed with separate video and 4.5 MHz BTSC encoded audio signals, which frequency modulates 70 MHz IF carriers. The carriers are then upconverted to RF frequency where each channel occupies a 35 MHz bandwidth. The modulator is capable of translating the IF carrier to any one of the available RF channel assignments with its agile RF tuner assembly, and this can be controlled either manually with front panel switches or remotely via the status monitoring and control network. The RF outputs are passively combined into 10-channel groups and are then split three ways. Each split feeds a 1,310 nm transmitter and three sets of transmitters are required to separately feed the links to TAN, SHP and YEC. Signals are repeated (in electrical domain) at TAN and YEC to feed BMP and WD, respectively. Photo 1 shows some of the equipment installed at 855YM.

All video signals distributed on the

Figure 3: 855 York Mills signal processing



backbone are assembled at the 855YM headend using a combination of high quality FM and digital backhaul links, local off-air and satellite signal reception and local origination. Redundant feeds are available for most signals. A 128 X 128 video routing switcher is used to route available video signals to the transport system as illustrated in Figure 3.

A one-to-one correspondence between each FM modulator and AM modulator channel at all other hubs allows the lineup to be configured at 855YM. Channel lineup changes, substitution switching and diversity selection are all achieved through the routing switcher. The equipment configuration at the primary hubs is shown in Figure 4. Included in each hub is an

"The high quality and reliability of signals at secondary hubs will give subs a noticeable improvement in service."

agile demodulator and high quality video transport system to allow monitoring at 855YM of signal quality at each hub.

Complete testing of all equipment installed on the backbone network has been performed. Representative data for the measured performance is given in Table 1. The various columns show the performance for individual components of the complete system. The transport links deliver video and 4.5 MHz audio to each hub, with performance for the longest cascade being given. The AM modulator performance is given and then total system performance. Finally, the round trip perfor-

Table 1: Analog FM backbone network performance

Parameters	Backhaul	Analog FM transport	Modulator	Combined	Loop back	Test system
S/N weighted (dB)	67	60	(C/N) 67	59	59	84.7
Differential gain (%)	2	2.1	1.8	3	3.6	0.95
Differential phase (°)	0.5	0.5	0.8	1.3	2.5	0.32
Lum non-linearity (%)	1.5	0.8	1.7	3	3.2	0.44
C/L delay (±ns)	5	5	15	20	20	0.8
C/L gain (%)	98.5	97.5	95	93	93	98.5
K-factor (%)	0.3	0.5	1.4	1.4	1.3	0.1
Frequency response (±dB)	0.5	0.5	0.2	0.6	(@ 3.58 MHz)-1	0.1
Audio S/N (dB)	63	61	63	60	60	65.5
Stereo separation (dB)	35	33	35	30	30	37
FM radio	N/A	63.5	N/A	N/A		

Note: Test system includes Tektronix 1910 generator, VM-700 video measurement system. Rohde & Schwarz EMFT receiver used to demodulate RF limits measured S/N to 60 dB. Audio test equipment: Scientific-Atlanta 6380A BTSC encoder, Rohde & Schwarz EMFT, Sound Technologies 3000 series, Modulation Sciences SRD decoder.

Table 2: Digital backbone network performance

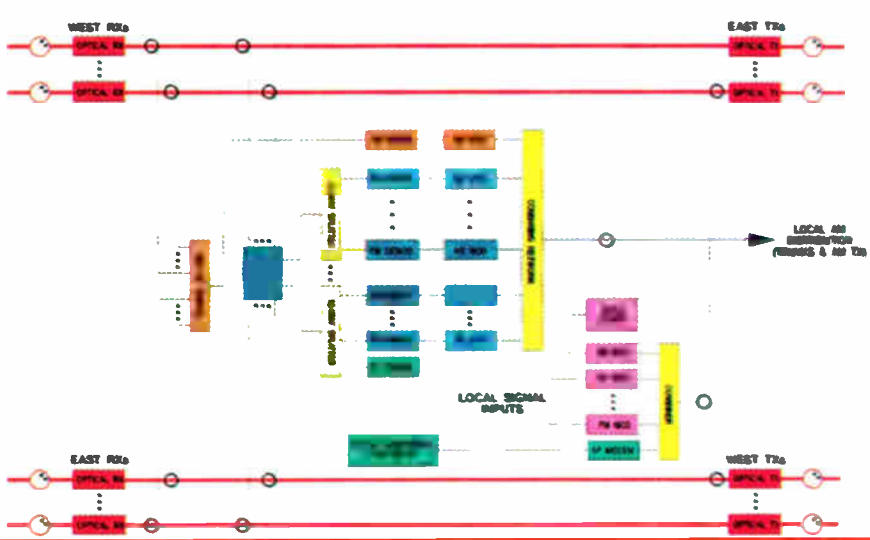
Parameters	Digital transport	Modulator	Combined	Test system
S/N weighted (dB)	61.4	(C/N) 68	60.4	80.5
Differential gain (%)	1.15	1.63	1.29	1.25
Differential phase (°)	0.97	0.52	0.52	0.52
Lum non-linearity (%)	0.81	2.03	2.17	0.65
C/L delay (±ns)	28.4	-15.4	7.5	5.4
C/L gain (%)	97.6	94.3	92.8	98.1
Pulse/bar ratio (%)	95.3	95.5	92	98.5
K-factor (%)	0.9	2.0	2.5	0.5
Sync rise time (ns)	166	165	177	156
Sync fall time (ns)	164	163	175	155
Frequency response (@ 3.85 MHz,±dB)	-0.71	-1.15	-1.39	-0.59
Audio S/N (dB)	62.3	62.6	60.4	64
Stereo Separation (dB)	31	29	27	37

Note: Test system includes S-A 6380A BTSC encoder, Leitch SPG 1300N signal generator, Mathy MBW 420B Brickwall video low pass filter and Tektronix VM-700 video measurement set. Rohde & Schwarz EMFT limits modulator S/N measurement to 60 dB.

Table 3: AM secondary hub performance

	C/N	CTB	CSO
Low band channels	55 dB (min)	68 dB (min)	65 dB (min)
High band channels	58 dB (min)	69 dB (min)	not measurable

Figure 4: Primary hub processing



mance for a channel (leaving 855YM, amplitude modulated at the farthest hub, demodulated and returned to 855YM) is given.

It can be seen from the figures presented that it is possible to ensure the reliable delivery of high quality signals to each primary hub in the Toronto system. At each primary hub, the AM fiber-optic system will feed a network of secondary hubs, each serving 4,000 to 10,000 subs.

Digital backbone

The extension of the Toronto primary hub backbone to surrounding systems in Oshawa, Burlington and Hamilton is being done using digital video transport equipment. The long distance involved makes FM an inferior choice. High speed multiplexers combine eight PCM encoded channels for transmission on each fiber. A composite of video and 4.5 MHz audio is input to the digital video encoder. Decoders located up to 65 km away recover composite signals, which are connected to modulators that have been specifically designed to accommodate composite input. The measured performance for the equipment being installed in Hamilton is summarized in Table 2. The system includes a digital repeater at the Wolfedale primary hub. The 855YM primary hub is the digital video encoding site. The construction activity for this installation is illustrated in Photo 2.

It should be pointed out that the signal-to-noise ratio (S/N) of the digital link is actually quantization noise and not thermal noise. The magnitude of the quantization noise is determined by the number of quantization steps, which in this system is determined by the eight-bit sampling. The S/N remains fixed regardless of the number of optical links in cascade, provided the video remains in a digital format. The S/N due to thermal noise is approximately 70 dB. It is also evident that a high degree of transparency for the BTSC system audio at 4.5 MHz is achieved. A Rohde & Schwarz EMFT receiver was used to allow baseband video measurements to be made. A Modulation Sciences BTSC decoder was used to facilitate the audio measurements.

Similar performance is anticipated for the digital primary hub backbone network being installed in the Kitchener/Waterloo/Cambridge area in south-

(Continued on page 49)

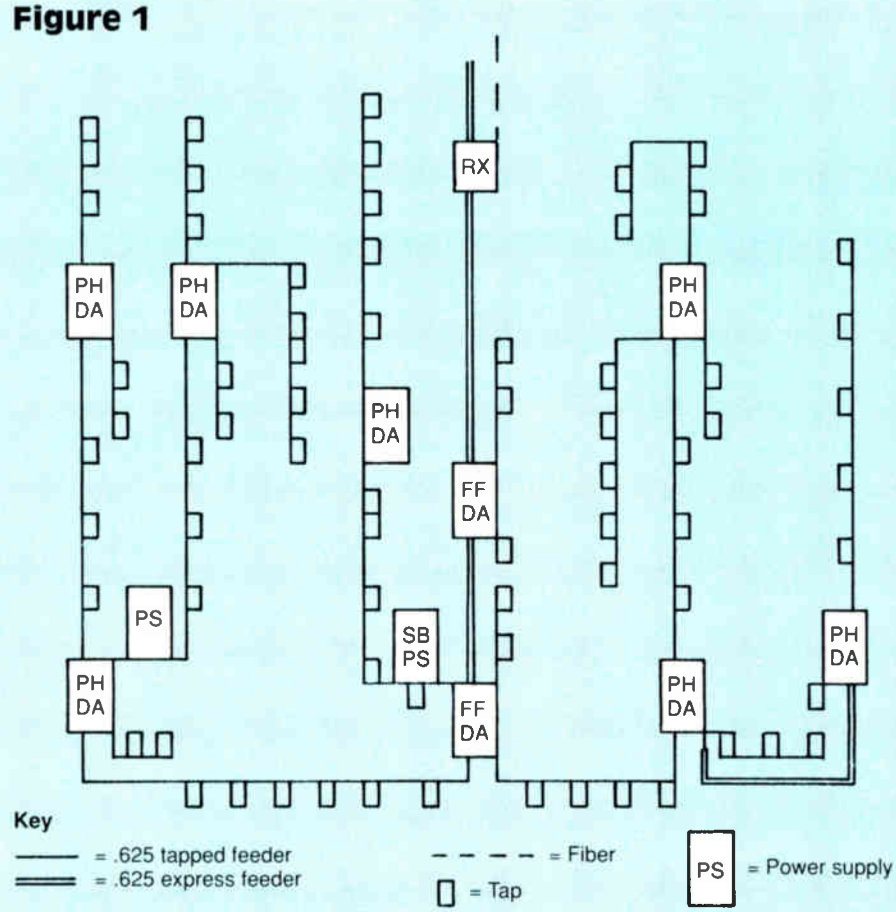
Fiber to the feeder: A case study

By Eugene M. White
Vice President Engineering
Paragon Cable/Tampa Bay Division

Fiber to the feeder (FTTF) architecture offers unique opportunities over conventional trunk and feeder. The coaxial trunk is replaced by fiber, eliminating the undesirable artifacts generated by the long trunk cascades and increasing reliability. This, in turn, offers opportunity in the feeder design.

To clarify our St. Petersburg, Fla., design, it's best to analyze the two major components (fiber and feeder) separately then put them together to complete the picture. For this article, we will use the southern-most 75 miles of plant in St. Petersburg as an example. This area would have had the longest trunk cascade (32 trunk amplifiers using coaxial cable) typifying the system in part, and features unusual areas.

Figure 1



Feeder considerations

The first rule of designing is to have an end product in mind. In cable systems, this is the permissible distortion and noise parameters for the longest cascade. Having already set these specifications for conventional design, all that's needed is to maintain or, if possible, improve them.

To calculate the distortion parameters, the equipment types and specifications are essential. All the fiber and RF equipment needed for this project is produced by various manufacturers with approximately the same specifications, and should approximate the same results. We will use Scientific-Atlanta (S-A) specifications for our calculations throughout this article because the project uses its equipment.

The S-A 6450 optoelectronic transmitter and 6901 optoelectronic bridging amplifier (receiver) specified for 10 dB power budget at 450 MHz loading are being used. The line equipment is S-A's 550 MHz distribution amplifiers (DAs), model numbers 376368 (feedfoward) and 370697 (parallel hybrid). The design calls for a maximum of four DAs in cascade; the first two are normally feedfoward followed by two parallel hybrids. The output level for feedfoward is 48 dBmV, and 45 dBmV for the parallel hybrids. All output levels

"The first rule of designing is to have an end product in mind. In cable systems, this is the permissible distortion and noise parameters for the longest cascade."

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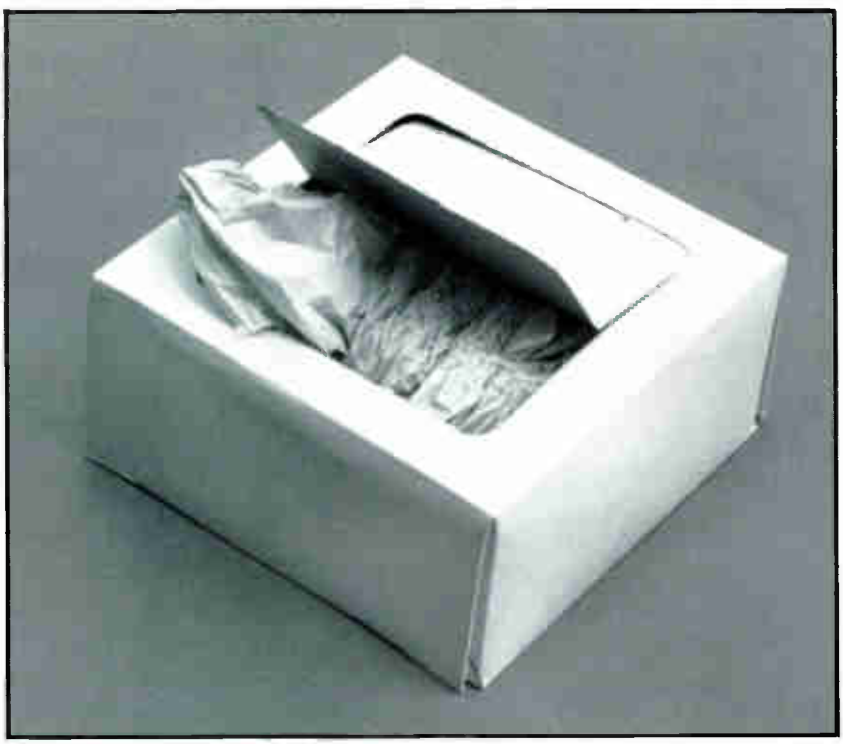

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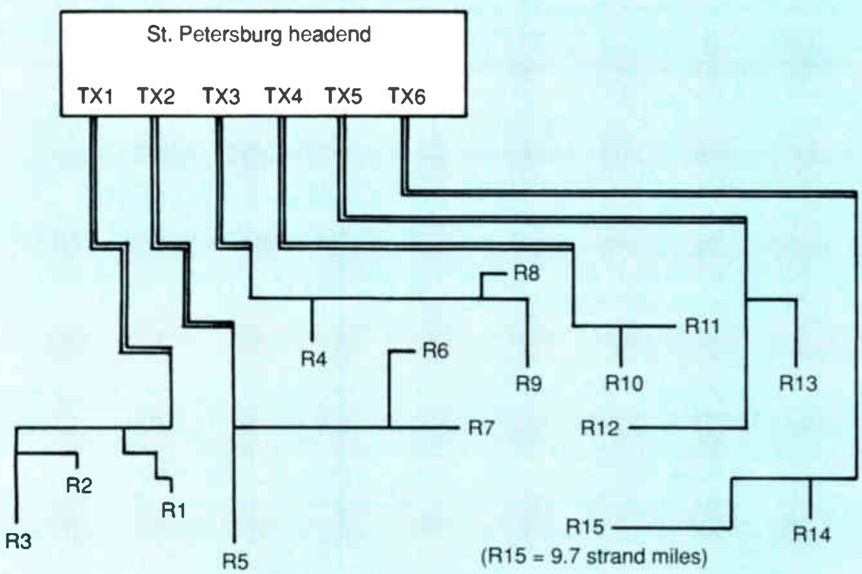
Figure 2



are specified for 550 MHz unless otherwise designated. The tap output is 15 dBmV, and cable is .625 unless otherwise noted.

Tables 1 and 2 contain the specifications for both 450 MHz and 550 MHz loading, comparing conventional trunk and feeder to FTTF. Notice the 550 loading shows some improvement over the 450 loading. This is because we use split frequency 550 loading that involves dual fiber transmitters and receivers. Using split loading and optimizing the transmitter improves the distortion parameters of the fiber equipment while holding noise at a constant.

As we can see from the tables, the system performance is enhanced by using fiber over coax cable. It follows that the reliability of one active (the fiber receiver) over 32 trunk amplifiers will be superior. Having established the specifications for FTTF, we need to maximize the feeder design.

Efficient feeder design is necessary to keep the cost of the project within reason. To maximize the fiber receiver's coverage, we use a concept called express feeder, or if you will, feeder trunk. Using untapped feeder cable and the higher levels of the feedfoward amplifiers, we express the signal out from the receiver before tapping. Using this method, we have achieved as much as 11 miles coverage from one receiver. We used all .625 cable for express feeder, however, in a more rural application the option of lower loss cable is open. Figure 1 more fully illustrates the use of express feeder and the broader coverage it affords us.

"The more complex the system, the more critical is the need to keep good records and use color coding for future maintenance and quick restoration."

The S-A DAs have up to three output ports set up by internal splitter and directional couplers. With the low input requirements needed by the DA, we extend beyond the point we can tap, so we backfeed those spans from the following DA. The backfeed normally is fed from the input side of the amp through an internal DC 8. Figure 1 shows several examples of backfeeding.

Figure 1 only shows one leg out of the fiber receiver in; notice that we are using nine DAs but only two are feedforward. Throughout the 75 miles, we average about 20 percent feedfoward DAs and 80 percent parallel hybrid DAs. This is important in capital cost concentrations and long-term power consumption (operating cost).

The 75 miles of our southern St. Petersburg system is designed for 15 fiber receivers, giving us an average coverage of five miles per receiver. This, however, is not what we expect for the entire system. In the typical areas, we expect to achieve a 10-mile coverage per receiver and as little as one-quarter mile in unique areas. Three of the 15 receivers for southern St. Petersburg are for large apartment complexes, and three more are used to pick up small pockets and isles in and around the beach area. Subtracting these six receivers located in unique areas and the small mileage associated with them, we end up with a seven- to eight-mile average for the remaining nine receivers.

Power is another area in which conventional design must be modified. We no longer have a path between all active devices. Each fiber receiver and its associated plant is an island. We are reusing the existing standby power supplies to power all fiber receivers. This presents a problem due to the power passing capabilities of the taps, which is no more than 6 amps, and standby power supplies are 12 amps. We must carefully locate these power supplies so we pass no more than 6 amps in any one direction and still utilize the full capacity of the power supply. When we get to the end of the lines, we may find we need only 3 to 5 amps to power the remaining few DAs.

This means we need to purchase small amperage power supplies to serve these areas. For this project we increased the number of power supplies needed for this design over conventional design, but we lowered the overall power consumption because they were smaller amperage power supplies. In a few cases the entire node is on standby power and in one area we needed a 2-amp power supply to complete powering.

Fiber considerations

Conventional coaxial systems are often designed in 20-mile phases. Each succeeding phase is an extension of the preceding phase, and this

Table 1: Specifications for 450 MHz loading

	Trunk	Fiber	Delta
C/N	-44.1	-48.2	+4.1
CTB	-53.0	-54.1	+1.1
X-mod	-52.0	-52.0	0
2nd	-61.0	-56.6	-4.6
Hum	-39.1	-56.0	+16.9

process goes on as long as we maintain allowable distortion parameters. If we exceed these parameters, then a supertrunk, microwave hub or new headend is located accordingly, and the process of building outward continues.

Designing with fiber calls for total area design. Look at the concept—fiber from the headend to the farthest reaches of the plant. The first consideration is how much fiber is needed for the total area. We design areas, not 20-mile phases. This is necessary to determine the fiber count originating from the headend required for the total area. It is not cost-effective to build one phase, then go on to the second phase, overlash fiber in the first phase to serve the second phase, and so on.

Next, how much fiber is required for each node? We chose to run three fibers per transmitter, two for forward communications and one for return communications. The distinction here is three fibers per transmitter, not per receiver. We used six transmitters and 15 receivers for this phase, so our fiber count out of the headend is 18 fibers, not 45 as would be the case if we ran three fibers per receiver and 15 transmitters. Cost considerations would come into play if we decided to run three fibers to each receiver, but it may come under consideration depending on future usage.

During the design phase is the time to decide how many spare fibers you want to run and to what point. Should you run redundant routes for self-healing benefits? Do you have possible data business plans? If so, the design phase is the time to consider adding extra fibers. The labor is free if the spare fibers go into the same cable and path you are planning, and the cost of the fiber goes down as the fiber count per cable goes up. Explore the future and consider all possibilities before you make a final decision on the fiber count.

We categorize the fiber into transportation fiber and feeder fiber. Transportation fiber is the fiber bundle originating from the headend out to the extremities of the system. Feeder fiber is a takeoff from the transportation fiber to feed the receivers. The cable of the transportation fiber is loose tube design using up to 12 tubes with up to 12 fibers per tube cabled in a reverse lay configuration. The cable design of the feeder fiber is a single buffer tube with up to 12 fibers. Figure 2 illustrates the fiber layout for this project and the use of the various fibers incorporated in this project.

We design for a loss budget of 9 or 10 dB by using optical splitters and couplers in the field. This allows us more than one receiver per transmitter and makes all fiber equipment interchangeable, limiting the number of spares we must keep on hand. We keep the receivers that share a common transmitter in the same area for two reasons. Should the fiber get cut or a transmitter fail, we will not have outages in two or three different areas of town. By keeping one transmitter per small area we could decide to offer different channel lineups for different neighborhoods.

Figure 2 closely resembles the layout of the fiber and receivers in south St. Petersburg. It displays the use of transportation fiber and feeder fiber along with mileage for each type. In conventional design, 25 percent of the plant is overlashed by trunk. Counting all fiber for the 75 miles of plant in this project, fiber constitutes 23 percent of the mileage. Take out the express trunk, and 16 percent of the plant is overlashed by fiber. Amortize the transportation fiber over the proceeding build, and 17.8 percent of the plant is overlashed by fiber.

Color your world

One important item is the color coding of the fiber. The phone companies have been in the multiwire business for 80 years and they have developed a marvelous color code. Let's not reinvent the wheel; they needed a color code due to the complexity of their plant and we will need a color code for the same reason. The more complex the system, the more critical is the need to keep good records and use color coding for future maintenance and quick restoration.

Let's follow the fiber path of the first hot fiber for Receiver 15 (R15). R15's

"During the design phase is the time to decide how many spare fibers you want to run and to what point...The labor is free if the spare fibers go into the same cable and path you are planning."

signal originates from Transmitter 6 and goes into the transportation trunk as the blue fiber in the green tube. The transportation trunk at this point has 42 fibers in it of which four are blue in different color tubes. We have four drop-off points before our fiber goes into the feeder network, and we stay with the same color scheme throughout the transportation fiber.

In the feeder fiber that feeds R12 to R15, we need two blue fibers (one for R15 and one for R12) and can only put one into the single tube design, so R15 blue fiber is changed to white fiber. The change in color code for R15 must be noted in the splicing plan for initial activation. This is just one example of a color change. Throughout the fiber design we must occasionally make color code changes.

Should the transportation fiber get cut anywhere along the line we know to splice the green tube blue fiber first. This will be the only hot fiber to R15 initially. If the 42-fiber cable is cut, we have a splicing plan for all hot fibers by service and priority. This plan changes as fiber count and usage changes. We estimate it will take 12 to 16 hours to replace a small section of transportation fiber carrying 42 fibers. It may take only two hours to temporarily restore 14 hot services if we have a splicing plan and follow through with it. If good

(Continued on page 50)

Table 2: Specifications for 550 MHz loading

	Trunk	Fiber	Delta
C/N	-44.1	-48.2	+4.1
CTB	-50.4	-53.0	+2.6
X-mod	-49.9	-51.4	+1.5
2nd	-61.0	-57.7	-3.3
Hum	-39.1	-56.0	+16.9

Aerial plant fiber performs well in lightning

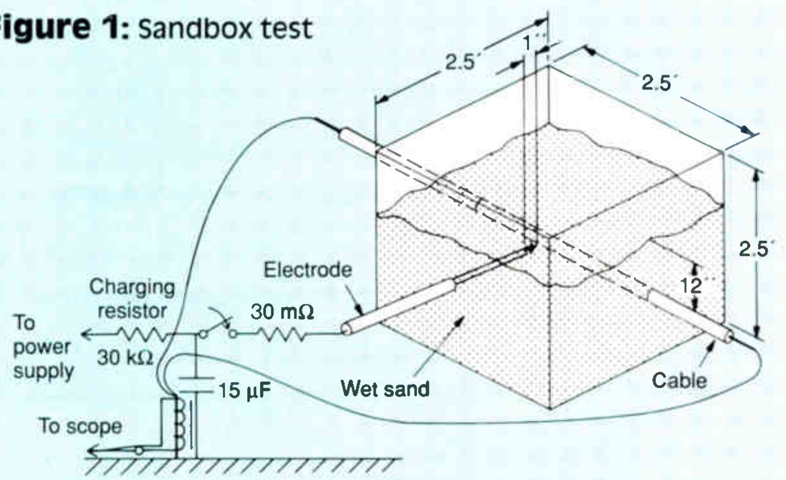
By P.D. Patel
Distinguished Member of Technical Staff
And Terry Coffman
Product Planner, AT&T Bell Labs

Test results

Damage to	LXE-ME	LXE-LW	LXE-DE	Loose tube	Coax
Strand(1)	Light	Light	Light	Light	Light
Lashing wire(2)	Yes	Yes	Yes	Yes	Yes
Outer jacket(3)	Medium	Medium	Medium	Medium	Medium
Strength members	None	None	None	None	NA
Metal armor	None	NA	NA	NA	None
Metallic parts (due to arcing)	None	None	NA	NA	None
Core tube(4)	None	None	None	None	NA
Fibers(4)	None	None	None	None	NA
Central member	NA	NA	NA	None	NA
Conductor	NA	NA	NA	NA	None

(1) Light damage as indicated by strand discoloration due to ohmic heating and cooling.
(2) Lashing wire melted and completely broke in almost all cases.
(3) All samples sustained damage to the polyethylene outer jacket by hot lashing wire.
(4) No damage to the core tube or the fibers in all cases.

Figure 1: Sandbox test



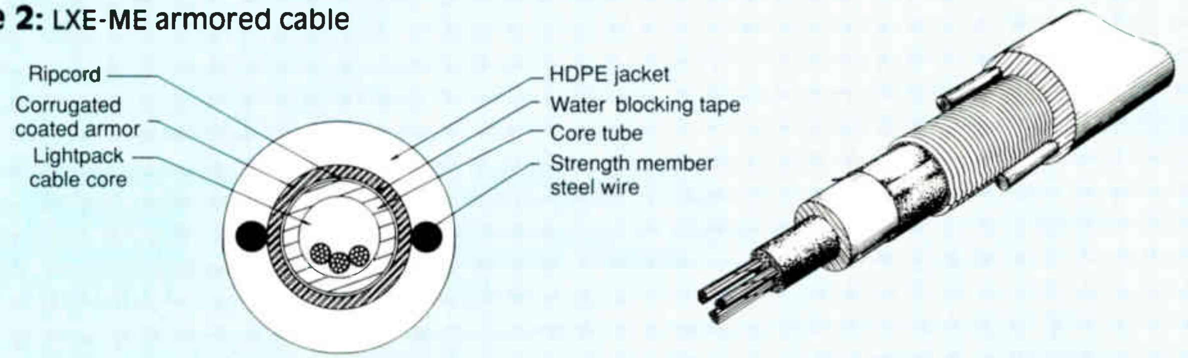
Recently, various viewpoints have been presented concerning the lightning performance of fiber-optic cables used in the cable TV plant. For fiber used in aerial plant lashed to a metallic strand, there is no advantage of one cable construction over another as far as lightning protection is concerned. This position is based on years of field experience and simulated aerial lightning tests that show the strand carries almost all the current. The CATV industry has many years of successful lightning experience with coaxial cable and our aerial lightning tests show that fiber performs as well as coax.

In addition, both metallic and dielectric cables perform equally well in the lightning tests as long as they are lashed to a metallic strand. However, dielectric cables are more susceptible to rodent damage. In this article, we will substantiate this position with results of tests that simulate lightning in the aerial plant. Specifically, we will discuss a modified "sand box test" and present lightning test results on different cable designs.

Modified sand box test

Since the CATV industry has almost 97 percent of cable mileage installed aerially, it is important to understand

Figure 2: LXE-ME armored cable



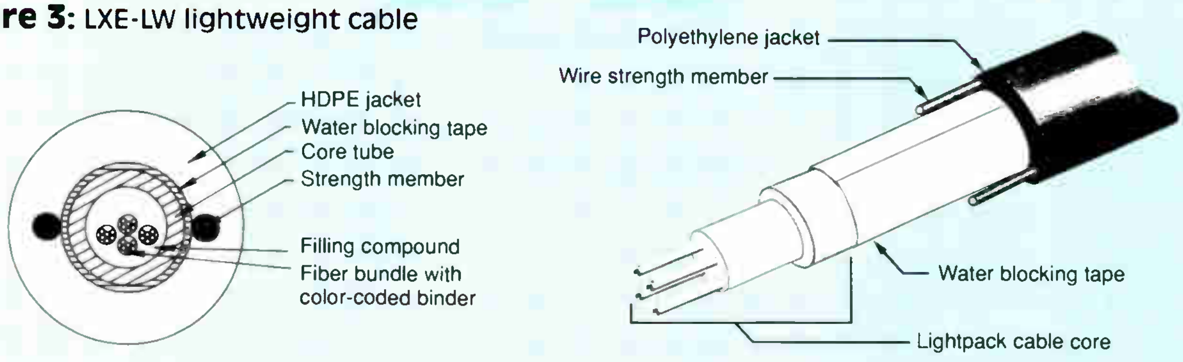


Figure 3: LXE-LW lightweight cable

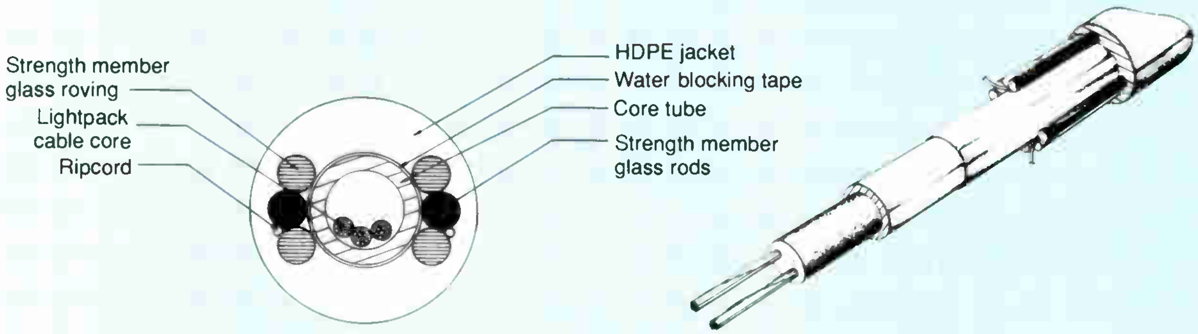


Figure 4: LXE-DE dielectric cable

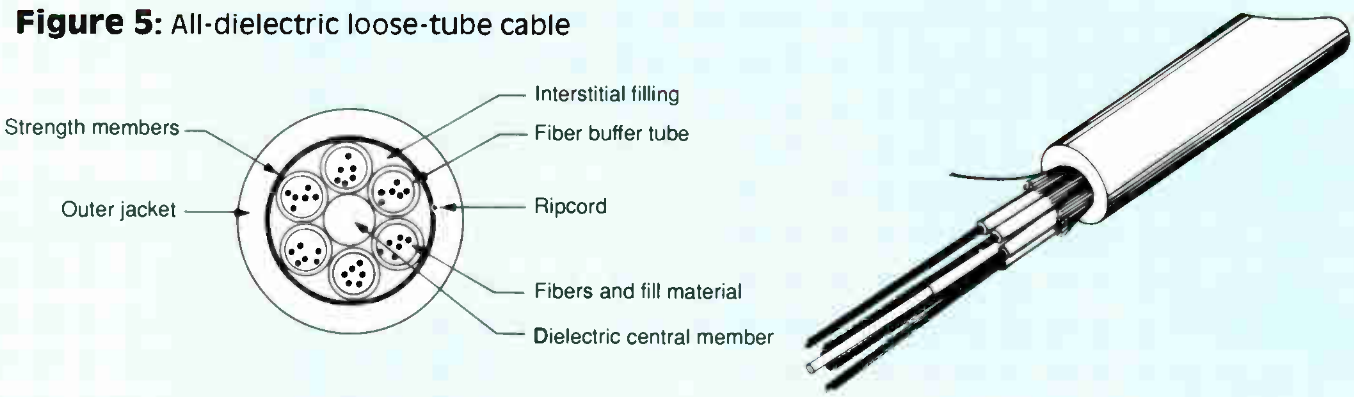


Figure 5: All-dielectric loose-tube cable

the effects of lightning on this aerial plant Therefore, the traditional sand box test has been modified to more closely simulate the lightning performance of aerially installed fiber.

The traditional sand box test (Figure 1) was developed in the 1960s to simulate lightning strikes to buried copper pair and coax cables. This test was not designed to test fiber-optic cables. However, Bell Communications Research (Bellcore) and the Electronics Industry Association (EIA) have proposed this same test to be used on buried fiber. To date, there is no stan-

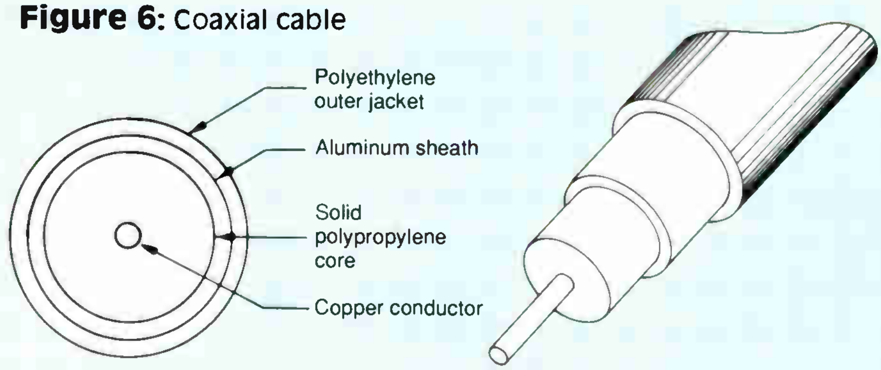


Figure 6: Coaxial cable

depth of modulation
status indicator
return path
preset
set
lock
set
preset
laser
bias
laser
opt pwr
gnd
laser
bias
laser
opt pwr

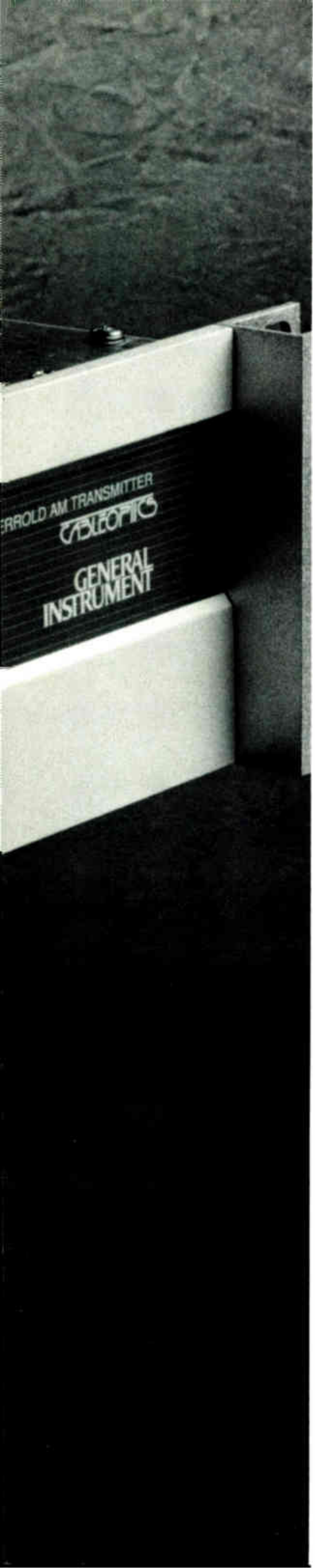


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Figure 7: LXE-ME sample in test position

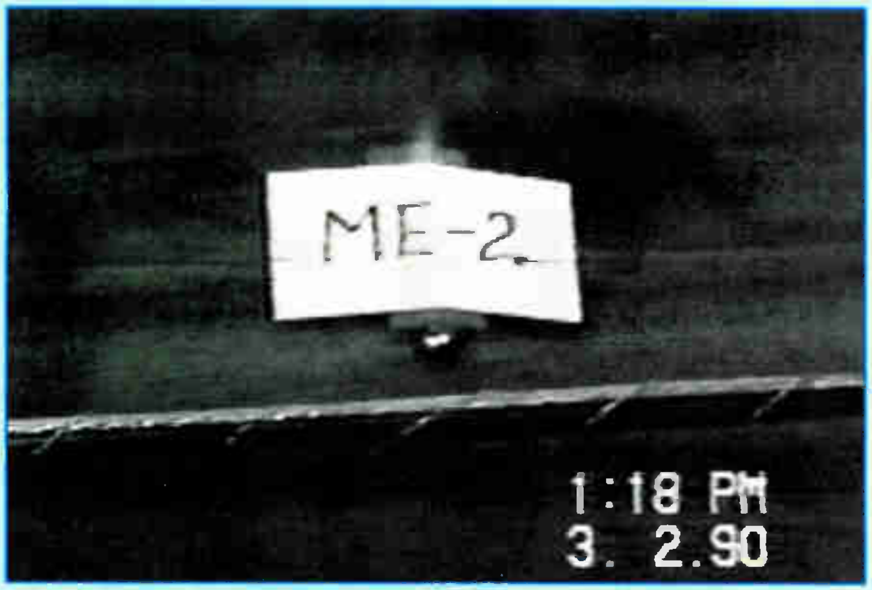


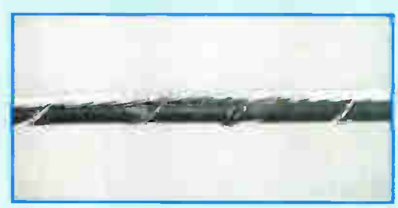
Figure 8: Simulated lightning strike

Figure 9: LXE-ME sample after test

Figure 10: LXE-LW sample after test

Figure 11: LXE-DE sample after test

Figure 12: Loose-tube cable sample after test



dard test or specification available to evaluate fiber used in aerial plant.

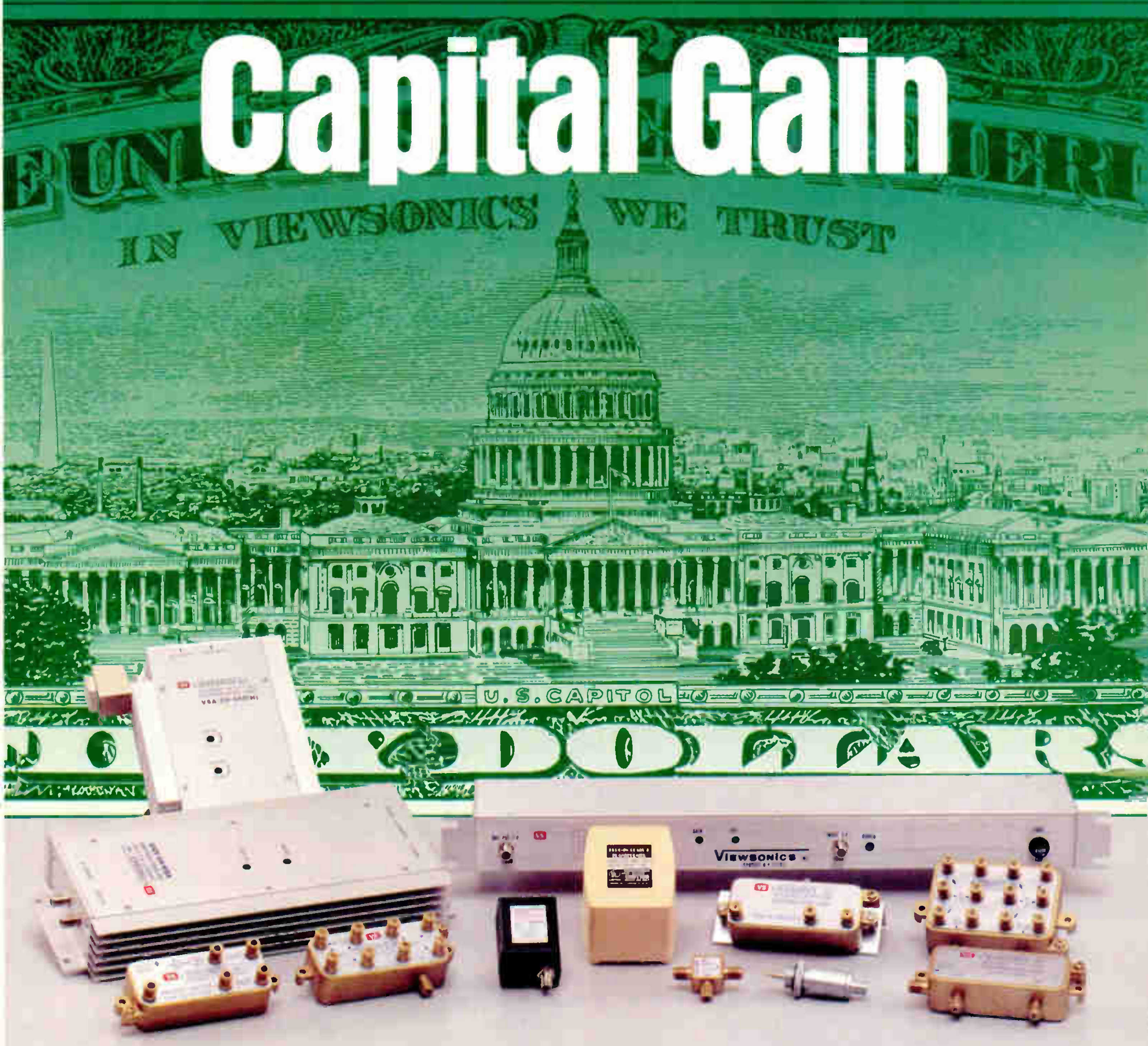
The modified test used the standard sand box arrangement but without the sand to reflect the conditions of a strike through air. Unlike the buried test, a meter long sample was lashed with a metallic lashing wire to a quarter-inch galvanized steel strand (6.6 m strand). The ends of lashing wire were anchored to the strand with standard D clamps.

Samples of five different cable designs were prepared as previously described to evaluate the lightning performance of different cable constructions. A commonly used coax was included as a control sample for comparison. The following list provides detail of these cable samples:

1) LXE-ME: An armored design with two linear steel strength members over the armor and a high density polyethylene (HDPE) outer jacket (Figure 2).
2) LXE-LW: An armor-free design with two linear steel strength members over the core tube and a HDPE outer jacket (Figure 3).

(Continued on page 52)

Capital Gain



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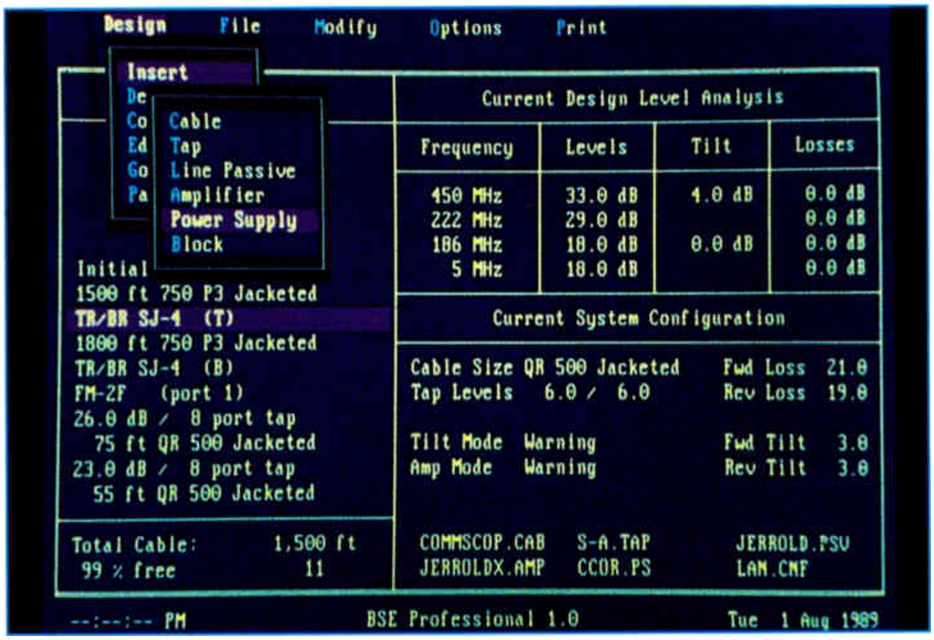
Sorting out CATV CAD: Part 2

In Part 1 (October 1990), we took an overview of how computer-aided drafting (CAD) for CATV evolved, and how the management and technical issues for CAD interacted together. In Part 2, we'll look at the hardware requirements for computer-aided design and drafting along with what's important to develop a good PC design program, including fiber-optic considerations. The scope of computer-aided design tools and types of hardware is very broad, and it is beyond the scope of this article to detail all available products. The names of some software packages may be offered, either because of their market dominance or unique capabilities. Part 3 will begin with the most often asked questions and answers about cable design software and wrap up with CAD training issues.



By John S. Gutierrez
President, ComNet Co.

The PC you select for *drafting* purposes should the fastest PC you can afford. The PC XT (8088) should never be considered for CAD. The XT is prohibitively slow and major drafting software will not run on it. The faster 286 PC is fine for light or casual drafting. CAD software vendors recommend the speedier 386 for the serious drafting user. A 386SX is not recommended for CAD either. 386SXs can run 386 specific programs, but their throughput speed is not any faster than a 286 running at 16 MHz. You'll need a math coprocessor chip to run most CAD programs. Some CAD programs can run without a math chip, but at the speed of a snail. Drafting programs can take advantage of extended or expanded random access memory (RAM) beyond 640K; 4 megs of RAM seems the recommended choice. You'll need a hard drive with a minimum of 110 megabytes; however, if you plan to store hundreds of maps, you'll need a higher capacity disk drive or an optical disk drive. Both 1.2 M and 1.44 M floppy drives are recommended, but if you have to do without one, keep the 1.2 M drive. A tape backup is optional and is preferred over conventional disk backups. You can get by with a 14-inch VGA color monitor having 640 x 480 resolution. Super VGA monitors having 1,024 x 768 are preferred. This resolution can be best appreciated on 19-inch or larger monitors, but at a heftier price.

For cable *design* software, PC hardware requirements are not as strict. Some cable design programs work acceptably with a XT for small designs. Programs that offer unique features will be more math-intensive and operate best on a fast 286 or a 386 for optimum calculation speed. Some design programs take advantage of a math chip for faster recalculations. A math chip can cut recalculation time by over 300 percent. A laser printer is highly recommended for fast printing, but be prepared to have at least 2 MB of printer memory to support 300 dpi CAD prints.

"The PC you select for drafting purposes should be the fastest PC you can afford... For cable design software, PC hardware requirements are not as strict."

In general, cable design software is not limited to any PC hardware type, but if you're planning to use the same PC for drafting, be prepared to purchase a 386 or 486 PC with all the bells and whistles. If you're comparing

"Although CAD software can be purchased for under $500, these programs are of limited use because they are not supported by third-party developers nor can these programs support end-user enhancements."

It is important that you can create CATV symbols as write blocks. This way you easily can insert complex drawing symbols at any location by a simple command call from your tablet menu without having to redraw the same symbol repetitiously. The CATV design can be "layered." That is, streets can be drawn on a layer called "Streets," poles and stand on a layer called "Stand," .750 trunk on a layer called "Trunk," MDUs on another and so on. In addition, you should be able to create each layer in a different color, although the number of colors may be limited. Layering allows you to design on a specific layer, while other layers are "frozen" or invisible. This is helpful when a screen regeneration occurs. With all layers turned on, screen regeneration takes longer to complete.

A CAD drawing should be easy to plot. A major problem with pen plotting is that it takes time, depending on the drawing density, to plot the drawing. The PC is tied up until the plot is finished, and this ties up the designer's productive time. A quick cure to this problem is to create a plotter memory buffer available through third parties. Before doing a plot, you should first print the drawing on a printer, preferably a laser printer. A printer gives you a draft plot of the drawing and you can make corrections before doing a final plot. Some plotters come with a pen carousel for multicolored pens to enhance the drawing. Other plotters have a single pen and require manual intervention to change pen colors.

Drafting software should feature the ability to import or export drawing files to other software brands. This is usually done by converting a drawing file to a DXF file. Just about every software drafting package offers the DXF capability. The downside is that you can lose the original drawing's layering, colors and attribute designations. Word processors easily read one another using a similar format—ASCII files. However, bold or italicized letters, special indentions or paragraph formatting, and special characters do not become part of the ASCII file. This means that the file must be reformatted to retain its original appearance. Many word processors offer the ability to translate a file to another word processor brand using special export filters that eliminate the need to reformat the file. Unlike word processor developers, CAD software developers are reluctant to create program translators, perhaps to retain user loyalty. However, there are a few emerging CAD programs that can translate their drawing files to AutoCAD.

Managing CAD drawings

Some systems can have over 2,000 as-built maps, and the first concern, when installing a CAD drafting work station(s), is how to get all the maps into the computer. One way is to trace the maps on a digitizing table by hand, but this takes time. By some estimates, it can cost about $400 of company overhead and 16 hours of time per map conversion. You can figure it out from here. Another way is to have the maps scanned and converted into a DXB or DXF file that can be used by any major CAD program. Scanning a "D" map generally takes less than 90 seconds and vectorizing it takes about 45 minutes or less. Large document scanners, a dedicated 486 PC and associated software programs are expensive—about $28,000. You may wish to look for a mapping service company who may offer to convert your maps for about $100 and up each.

The downside to map scanning is that you don't get an intelligent map to run a BOM. The upside is that street layout, poles, addressing, notes, etc., are already there, the map is to the original scale, and it's faster than doing it by hand. If you're starting from scratch, it would be best to have city plat maps scanned. You might consider using TIGER (topologically integrated geographic encoding and referencing) maps, which are based on a data base constructed by the U.S. Census Bureau. TIGER maps include road names and political boundaries.

It would not be advisable to merge 2,000 as-built maps as a single file. The detail of the drawing could not be viewed, even on a larger CRT, and it would take a tremendous amount of time to generate the drawing. If it takes 90 seconds to generate one map on the PC's screen, imagine 1,999 more to go! Some vendors offer a special video board termed as list processors. These video boards are recommended for the most intensive CAD viewing requirements. They can cut down the time to regenerate a complex drawing to a matter of a few seconds rather than minutes.

In another instance, what happens when you have 2,000 drawing files and you can't remember the file name that has the power supply number PS-1234. In this case, you should consider using a program called Magellan, by Lotus Development Corp., which has the unique ability to search your disk drive for PS-1234, and when it finds the power supply the drawing file name is highlighted. Magellan also gives you ability to "launch" right into your CAD software from the highlighted file name. This application might be useful for system maintenance, where the radio dispatcher can search drawing files for a particular name or address and bring up the drawing file. The problem area can be visually "zoomed" in and then faxed over to the field technician's vehicle. This application can be greatly sophisticated if the field technician has the ability to access the drawing files remotely via terminal hardware attached to two-way radio equipment.

Cable design software

Commercially available CAD software for CATV design has been around for quite a number of years, but, for one reason or another, design operations remain faithful to their calculator or simple BASIC PC programs. Cable designs are extremely math-intensive and can be complex. There also are the issues of powering, distortions and noise calculations besides insertion losses. Cable design programs are often perceived to be all things, but it's important to face a single fact: *No* cable program will automatically design a cable system for you. They take over repetitive calculations for the designer. In fact, a good cable design program can improve

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design productivity by a factor of over 1,000 percent compared to a calculator. This factor improves dramatically if the design program also can calculate powering and distortion within the design, but it must be in real time. Even with all the bells and whistles that cable design software can offer, it is very difficult, if not impossible, to develop cable design software that satisfies every designer's expectations. There are a small handful of cable design programs to choose from, and they greatly vary in features and price.

Four important principles are necessary to develop a good PC cable design program: 1) The programmer and the seller should be CATV engineering-oriented and experienced in cable design issues. 2) The programmer must be proficient in the trade of programming. 3) The software should be well-documented and easy to read. 4) The vendor should offer a good support program.

It is very important that the software programmer has an excellent understanding of CATV operating principles. As previously mentioned in Part 1, most cable design programs have been developed by those who were

"Cable design programs are often perceived to be all things, but it's important to face a single fact: No cable program will automatically design a cable system for you."

once cable designers. Cable design has many interactive calculations. An expert programmer, who has little cable design experience, has little chance to develop a good cable program. Likewise, a cable design program should be represented by a company that has broad cable experience, even broadband LANs. Look for a vendor that can dialogue cable design issues with you and can explain how its software can solve your design problems.

A programmer should design the software with meaningful but simple command operations. A good programmer will design a user-friendly program. A programmer should take advantage of pull-down menu features, though they don't necessarily have to be operated by a mouse or a pointing device. The program's screen display should not appear cryptic or confusing. Ideally, the program should make use of pop-up dialogue boxes for displaying system information or editing features. Color is nice, but it doesn't have any effect on design quality. In all a good programmer should develop a program that is user-intuitive.

A software program that is poorly documented can often leave you in the lurch. Good program documentation should include a practice exercise that demonstrates the program's capabilities from A to Z. The document should include screen graphics that enhance the document's dialogue. Just as important, the document should have a table of contents and an index.

A CAD software vendor should offer responsive technical support. Generally, technical support is referred to as help over the telephone. Major software companies offer unlimited telephone support at no charge, and anyone who charges annual fees for telephone support should be asked why. Obviously, poor or unclear documentation will result in a higher incidence for telephone support. On the other hand, not reading or not properly comprehending the manual is another reason for panic calls to the vendor for help, which is probably why they may charge a fee.

Always ask about updates and upgrades. An update informs you that software bugs on the present version or release have been fixed. Updates always should be free and automatically mailed to you. (Why should you pay for bug fixes?) An upgrade is a substantial enhancement to the present version that comes with new features. Users are notified that their version has been upgraded and, for a small nominal fee, they can purchase the improved software.

In addition, ask about training. If you're new to the CAD environment, you'll find that training is essential. For CAD cable design, some vendors may provide one day of on-site free training, if you're willing to pay for the vendor's travel expenses. Additional fees may be required for additional days of training. If you are a program user outside the United States, make sure that you can get technical support using the FAX or, best yet, insist that the vendor can offer 24-hour telephone support. As well, get several end-user references currently using the product from the vender.

CAD for fiber optics

Fiber optics is a mature technology within the realm of telephone or digital communications, but is admired as a "new kid on the block" for CATV. Presently, the distance for AM fiber communications is limited and FM fiber communications is too expensive to deliver to the home. However, fiber-optic TV transmissions have many technical advantages over microwave and long amplifier cascades. The importance of fiber for CATV is to improve system reliability and to reduce the number of cascaded amplifiers for improved technical performance for wider bandwidths. RF cable design software should be postured for this development.

A good RF cable design program should have the ability to design fiber. At best, RF cable design software should be able to simulate fiber losses. There are several things to look for:

1) The program should have an ability to design any cable for flat losses. Though fiber levels are expressed in dBms, they are easily converted into dBmVs.

2) The program should design distances in metric units or vice versa. With this, the program should be able to automatically convert to feet. (Fiber has historically been measured in metric units.)

3) The data base editor should allow you to create special fiber splitters (star couplers) with flat insertion losses. These losses should be user-defined. The data base editor also should allow the creation of user-defined splice losses.

4) You should be able to calculate C/N and distortion levels at the fiber receiver.

5) You should be able to print a BOM and signal level analysis report. If you're planning for a fiber upgrade, you'll be pleasantly surprised to know that a design program is available. **CT**

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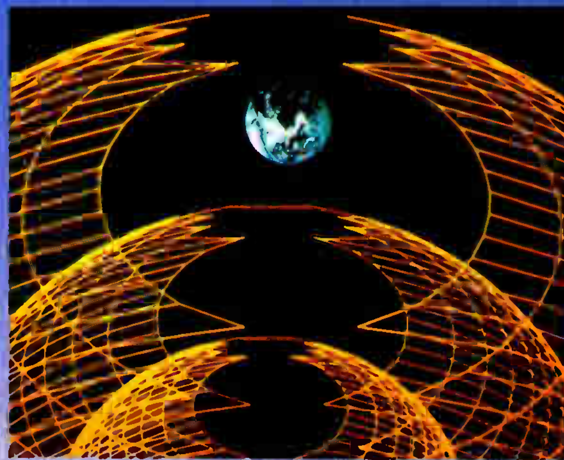

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Lindsay

A comprehensive backbone system

(Continued from page 24)

ern Ontario. No degradation is anticipated from the cascade of four optical links required to reach the Brantford hub from the origination hub at New Dundee. Both 1,310 and 1,550 nm wavelengths will be used for those links where a limited number of fibers are available.

Secondary hubs

The first secondary hub equipment has been installed in the ADE hub in Toronto. The optical loss budget for this two-fiber AM system is 7.6 dB for the low frequency band and 9.5 dB for the high frequency band. A lower quality fiber path was chosen for the high band link to allow observation of performance on a high path loss. This was possible due to the low number of channels presently being carried on the system, which results in the high band laser being loaded with only half of its capacity. Measured performance is summarized in Table 3 for CW carriers.

The transmit lasers as well as the optical receivers are packaged in rack-mounted shelf modules. Secondary hubs are co-located with cellular telephone fourth level cell equipment. Modules for signal combining and switching, system monitoring and optical switching fit into a common shelf with the optical receivers. The dual optical receiver module accepts both low and high band fibers and outputs a combined RF signal at +30 dBmV for subsequent splitting and launching onto coaxial trunks. Automatic gain control ensures uniform output levels regardless of optical path loss or laser transmitter variation, including laser module changeout.

Encouraged by the performance shown in Table 3, deployment of additional hubs is proceeding. The high quality and reliability of signals at secondary hubs will give subs a noticeable improvement in service. System channel capacity to 550 MHz will be achieved while simultaneously improving signal quality with the concurrent upgrading of trunk amplifiers and secondary hub deployment. The short feedforward amplifier cascades that result with the secondary hub deployment will allow delivery of 50 dB S/N to the home while reducing the number of devices needed to reach the system extremities. **CT**

Fiber to the feeder

(Continued from page 30)

records are kept and updated, activation and restoration will go smoothly. If not, hours will be added to a simple task.

Fiber routing is a very important part of this project and the future success of the fiber system. Look to the future and avoid routes where road widening projects, dangerous intersections or unusual conditions exist. Replacing a small section of fiber because of poor routing can result in a 0.1 to 0.3 dB splicing loss. This same loss could be used to route around problem areas and taken into account in the loss budget. Unplanned splice loss will reduce the system performance by dropping the receiver below its minimum input. Design around problem areas and avoid splice loss!

Finished product

FTTF offers distortion improvements and improved reliability vs. conventional design, can be constructed for the same cost as a conventional system and positions your system for the future. It is not without hidden problems. New test equipment is needed, personnel need to be retrained and operation procedures will change. It is the design of the 21st century and if you're going to be a player in the 21st century, you must make the change. Conventional system design worked well for the industry from the 1950s to the present time, but the future is in telecommunications design. Fiber to the feeder is more than a cable system. It is, or can be, the basis for a telecommunications system. **CT**

"FTTF offers distortion improvements and improved reliability vs. conventional design, can be constructed for the same cost as a conventional system and positions your system for the future."

Aerial plant fiber

(Continued fom page 36)

Figure 13: Coaxial cable sample after test

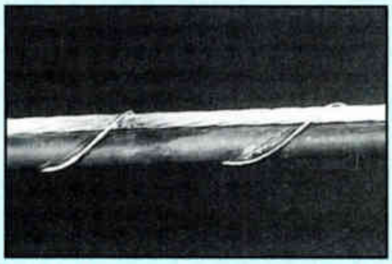
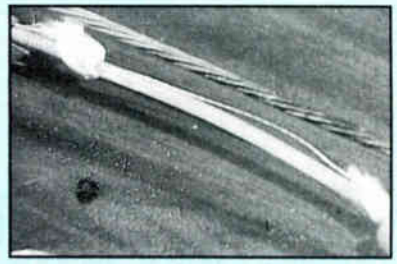


Figure 14: LXE-ME sample core tube



3) LXE-DE: A dielectric design with linear dielectric strength members over the core tube and a HDPE outer jacket (Figure 4).

4) Loose-tube: A non-AT&T loose-tube dielectric design with a dielectric central member and Kevlar/glass yarn strength members between the loose-tube core and the medium density polyethylene (MDPE) outer jacket (Figure 5).

5) Coax: A non-AT&T 75-ohm broadband coaxial trunk cable with jacketed aluminum sheath (Figure 6).

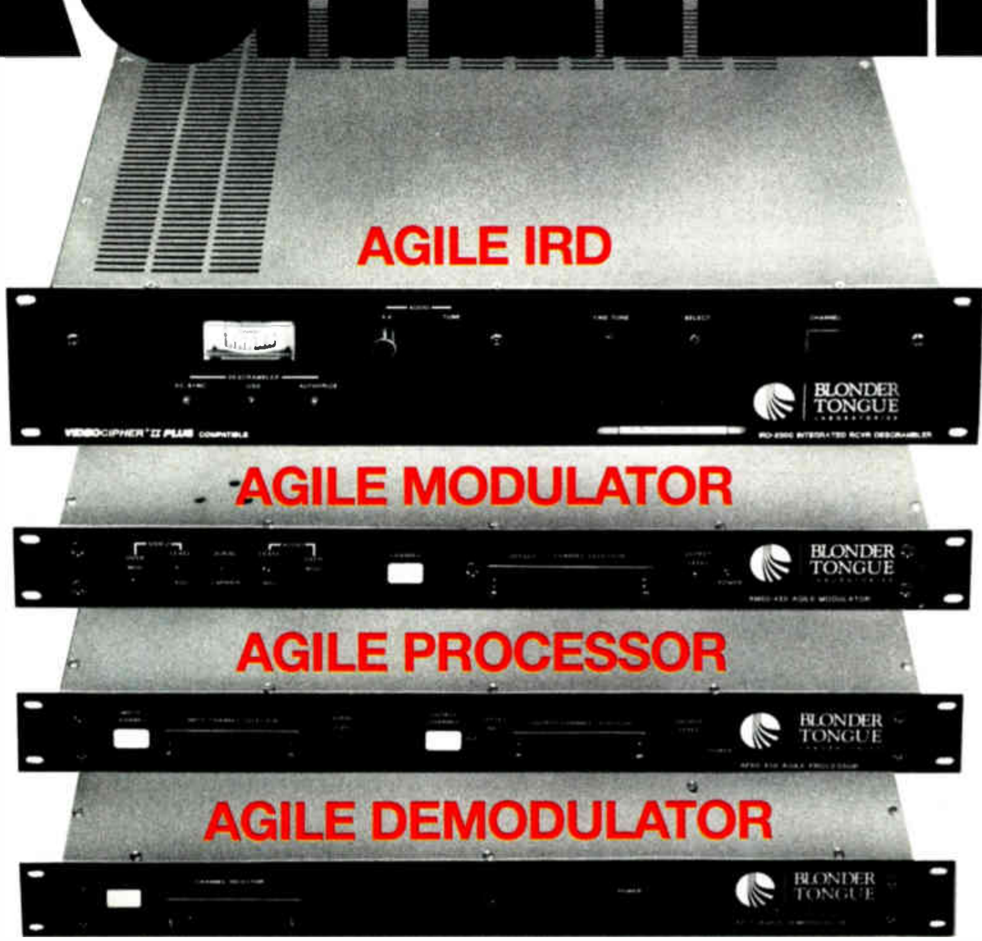
Procedure, results

Like the buried test, the lashed cable samples were positioned in the test box one inch from the electrode (one-inch diameter) and the strand was grounded. Tests were conducted with the electrode facing the strand. Although the average lightning strike is 20 to 40 kiloamperes and 95 percent of all strikes fall below 100 kiloamperes, these test were run at 200 kiloamperes—a limit of the test facility. This level is five to 10 times higher than the average strike and over twice as powerful as 95 percent of all strikes nationwide. Each sample was exposed to the same amount of current for the same duration. All tests were conducted on the same day at the same test laboratory using the same test equipment.

Figure 7 shows the LXE-ME sample in the test position before the test. Figure 8 shows a sequence of four frames during the test. Examination of the sample after the test confirmed that the majority of the current was carried by the strand without seriously damaging the cable. However, as shown in Figure 9, a melting of the outer jacket was observed due to overheating and melting of the lashing wire. Figures 10 through 13 show the remaining four samples after the test with similar results. Specifically, the LXE-ME armored design in Figure 9 and the non-AT&T dielectric loose-tube design in Figure 12 show that there is no difference in lightning performance. Later the LXE-ME sample was dissected and the core tube and fibers were examined as shown in Figures 14 and 15, respectively. All samples were similarly examined for damage to the fibers, core tubes, strength members and armor. The results are presented in the

(Continued on page 57)

AGILIZE



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Aerial plant fiber

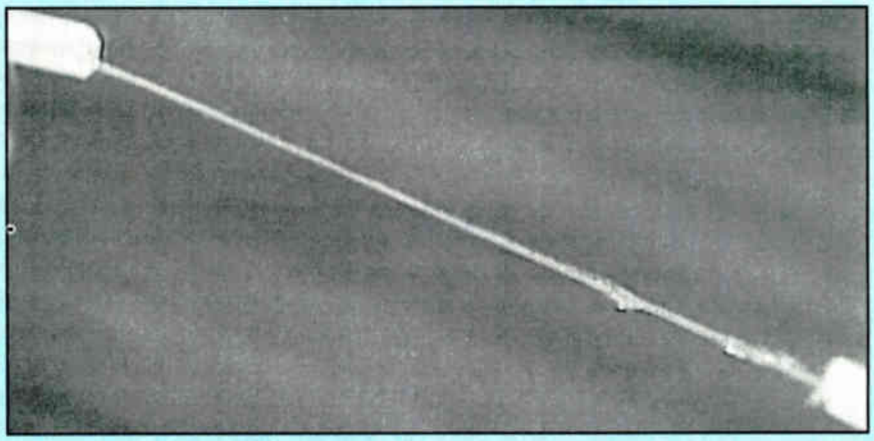
(Continued fom page 52)

accompanying table.

The test results were the same in all cases; there was no damage to the fibers or core tube. The only cable damage observed was to the outer jacket as the heated lashing wire melted the polyethylene. From this we recommend the use of a dielectric lashing on metallic strand as it will be advantageous in high lightning areas.

Furthermore, there was no evidence of arcing among the metallic members within the sheath or metallic members with either the lashing wire or the strand. Hence, the strand sustained light damage indicated by slight discoloration due to heating and cooling. The results conclusively show that whether the cable design is armored or dielectric and LXE or loose-tube, the results are the same. In fact, the lightning performance of fiber is the same as the commonly used coax cables in the CATV plant.

Figure 15: LXE-ME sample fiber



Conclusion

Test results verify that for aerial plant lashed to a metallic strand, there is simply no advantage of one cable construction over another as far as lightning protection is concerned. This is because the strand carries the current. Furthermore, test results are the same in all cases. That is, there was no damage to the fiber or the core tube. Lightning tests also showed that fiber-optic cables are equal in performance to commonly used coax cables in the CATV plant. Claims that dielectric cables are better suited for aerial applications than armored cables are not substantiated. In fact, both metallic and dielectric cables lashed to a metallic strand performed equally in the lightning tests. **CT**

Reference

1) "Lightning damage susceptibility of fiber-optic cables," Richard E. Clinage, Siecor Corp., paper presented at Society of Cable Television Engineers seminar in Monterey, Calif., March 21, 1990.

How to enhance tech training

By Rikki T. Lee
Consultant

You shouldn't use the words *training* and *exact science* in the same sentence (except in this one). On the one hand, training tech employees how to perform specific procedures (e.g., installation, leakage detection and repair, maintenance or troubleshooting) allows for easy evaluation: Here's the situation, now show me how you would handle it. You emphasize "get it right the first time" but allow students to make enough mistakes until they do get it right. Send them out after more practice and they should succeed.

On the other hand, not all training has a performance base. For example, there's training in safety awareness, management techniques and field worker/subscriber interface. In these areas, you might not notice there are certain gaps in your program, sinkholes that let learning slip out of sight no matter how hard you try.

Say your recent safety class covered every topic imaginable. So what could you have omitted? No, don't look at your outline; the ingredient probably won't be missing from there. (Note: Training can be hard work, and we're not saying you're doing a poor job.)

As most instructors know, there's a big difference between the curriculum and the act of training. You'll know if there's something missing in the course content of your safety class by the students' questions—and accidents later on. But as the class is being taught, the trainer and students fall victim to communication gaps. Some information is just not getting through to some students.

Communication during a training session occurs in four different areas: speaking, listening, reading and writing. Not every training session incorporates all four areas, nor should each technical person need to master all four. But without ensuring that students are receiving the information clearly, curriculum is only partially learned. It's one reason why frequent training may become necessary.

"You'll know if there's something missing in the course content of your safety class by the students' questions—and accidents later on."

Look at some examples of communication gaps in the classroom:

Speaking: In the mind of one of your techs is a question about safety near electrical wires. Yet he can't express it orally, perhaps because of bad experiences in high school or the inability to talk in front of groups. A few minutes later he forgets the question; a few weeks later in intensive care he remembers it.

Listening: You've always believed that giving recaps of important points is necessary to improve comprehension after each topic has been discussed. During these reviews, you notice that eyes are wandering and mouths are whispering more than normal. So you consider having fewer reviews—nobody's listening, anyway. Right?

Reading: Your well-prepared handouts go unread for various reasons: 1) Some of your students can't comprehend written material (i.e., their reading level is poor), 2) A few of them have little or no time during the day to read (and they won't do it at home), or 3) Most of them know you'll cover the important stuff in your lecture.

Writing: During the final exam—a series of open-ended questions about safety situations—students who aren't normally expected to write anything except work orders are having trouble. In their answers, they use single words, phrases and incomplete sentences. Doesn't this "prove" they haven't grasped the course content?

Improve your skills

Short of holding "technical communication" classes (what—can't you make any time for yet another training program?), you can't expect to overturn a student's poor skills in speaking, listening, reading or writing. But even if you're an occasional instructor, you can improve your effectiveness and your students' performance in a formal or informal classroom situation. By practicing some communication techniques, you'll be able to increase comprehension:

• *Speaking up*: To paraphrase a cliché, an ounce of participation is worth a pound of learning. At least once, break students into groups for about 15 minutes to discuss how to handle a certain situation. Instruct groups also to generate questions, at least one from each group member. Then walk around and briefly observe the interactions. Refrain from intervening unless one person is monopolizing or the discussion is moving off the track. Group leaders report their findings and present you with their questions. You should answer all questions before the class ends.

• *Listening up*: As many different media should be used in one class as possible, especially to cover the same point twice. Show a pre-screened video or film; make sure the sound quality is good. Then use the overhead or easel to bring the same message home.

During the regular presentation, ask students a question on what you plan to cover next. OK, get downright devious: Don't stop responses after you get a right answer. And keep reviews lively; instead of repeating yourself, throw out questions to the class.

• *Handling handouts*: Don't expect a class of varying job levels to enjoy reading. In this case, your handouts should contain only what you plan to

"Communication during a training session occurs in four different areas: speaking, listening, reading and writing."

cover in the class. Everything you cover should be on the handout. Include copies of overhead transparencies. For the diligent, you can make supplemental handouts available.

• *Manual labor*: When you must prepare a student manual or workbook, see how many drawings or photos you can find to illustrate the "cold, hard" text. In general, people tend to remember what they see (even once), not what they hear or read (especially once). If the manual addresses a procedure, provide drawings for each step. And illustrate to help poor readers understand tough concepts.

• *Test your skills*: As much as possible, evaluation should be performance-based. If you teach a procedure, demonstrate it. As a part of testing, make sure the student performs the procedure. But if that's not possible or applicable, give a multiple choice test, containing the words used in your training. Make the test slightly hard (no-sweat tests are not taken seriously). No trick questions.

Learning's the thing

Before administering your test, go over a few of the questions with the students. In general, steer clear of any required essay questions, except for extra points or "door prizes" for the good writers. If you have time, review the test; ask students to correct their own papers and use it for later reference. In not-for-credit training, tests are another opportunity to learn. And learning's the thing. **CT**

Author's note: The techniques in this column are meant only as suggested approaches for in-house classroom training, based upon my experiences as an educator. Therefore, they do not apply to the SCTE's BCT/E Certification Program, nor to any other industry training program for accreditation or certification.

An HDTV flat panel display contender

By Lawrence W. Lockwood
President, TeleResources
East Coast Correspondent

A most interesting new system for flat panel liquid crystal displays (LCDs) that promises the possibility of economical manufacture of large display formats was disclosed by Tektronix in a recent paper in the journal of the Society for Information Display[1].

HDTV display sizes

As has been said often and by many, HDTV (whether analog, digital or whatever transmission scheme is finally approved) will not become a large business (a consumer business) unless the home receivers produce a substantially larger picture than the current popular NTSC receivers—and at a price the consumer will pay, in volume. At a recent IEEE/ATSC HDTV conference in Washington, D.C., the question was somewhat lightheartedly asked "What would a 70-inch CRT weigh?" The dimension was based on viewing an HDTV 16:9 aspect ratio picture at the proposed viewing distance of three times picture height, taking an average living room viewing distance of 9 feet. William Connolly, president of Sony America, made a "back of an envelope calculation"—well over a ton! Ipso facto, the classic CRT will not be an acceptable HDTV display device for satisfactorily large pictures.

Flat panel displays

A number of Japanese manufacturers have recognized this. Twenty-nine Japanese LCD companies will invest over $1 billion this year into the development, continual improvement and mass production of flat panel LCD displays. The flat panel display has significant advantages over the CRT. It doesn't require the massive glass enclosure of a CRT, or the high voltage or power-consuming sweep circuits. Of all the flat panel display technologies, LCD appears best suited for TV viewing; electroluminescent and gas or plasma panels are better for computer displays (largely because of limited tonal capabilities and/or restricted refresh rates).

"Of all the flat panel display technologies, LCD appears best suited for TV viewing."

The flat panel LCD display already has penetrated the TV consumer market, albeit in a relatively small way. There are a number of TV receivers and the Sony Watchman tape player with 2- to 5-inch screens.

The principles of operation are straightforward. Liquid crystals respond to varying voltages by changing light transmittance (getting lighter or darker) at the point of voltage application. This property currently is used in flat panel LCD TV displays with the use of "matrix addressing." (See Figure 1.) Matrix addressing utilizes a thin film

Figure 1: Matrix addressed flat panel LCD

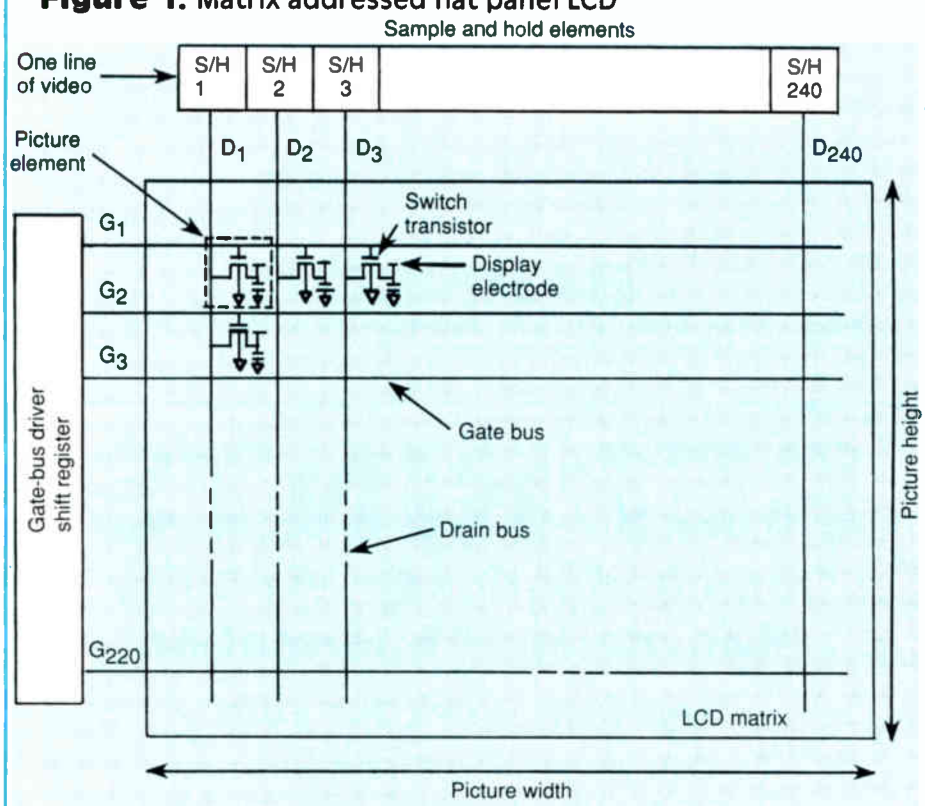



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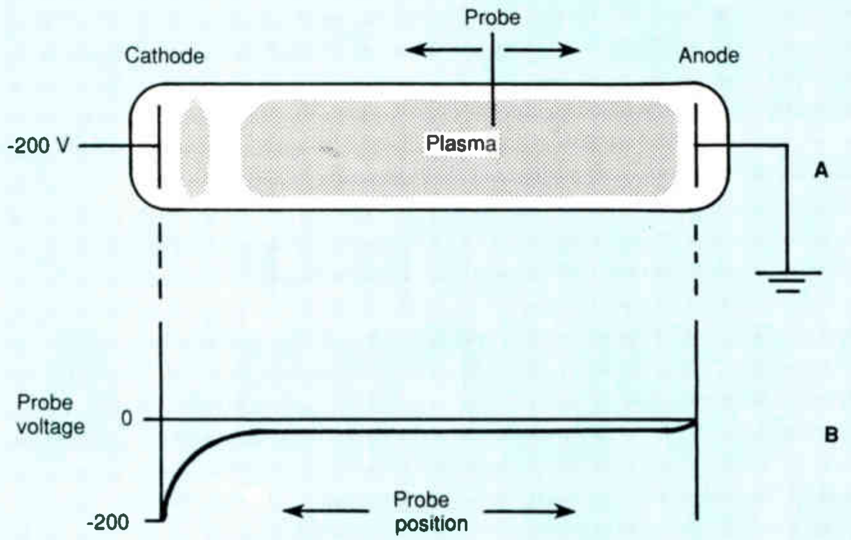
Figure 2: Making a switch using ionized gas



transistor (TFT) at each pixel (picture element) point in the display that is addressed with the video voltage of that pixel. This transistor holds the pixel voltage (and the transmissivity of the pixel) until addressed again, in this case until the next field. This is called an active-matrix liquid crystal display (AMLCD).

Figure 1 shows a small display of 220 horizontal lines with a 240 pixel horizontal resolution[2]. (In this case each field is repeated over the same lines.) However, regardless of the scan configuration the principles are the same. The vertical scan is produced by sequentially driving the gate busses from a 220 stage shift register. During horizontal scan, video information is placed on each column bus. A given line of video is broken into 240 pieces and stored in 240 sample-and-hold (S/H) stages, all of which drive their respective drain buses simultaneously, thus creating a line sequential display. The information on a drain bus is therefore changed only once for each horizontal period (63.5 µs).

However, aside from the aforementioned advantages and the simplicity of operation, the AMLCD has a more than significant disadvantage—the difficulty of achieving a reasonable yield in manufacture. Even only 10-inch active-matrix liquid crystal displays are achieving manufacturing yields of 10 to 20 percent, or 80 to 90 percent rejects. And worse, the problem is aggravated as the displays get larger.

Panels of any appreciable size are complex because an active element is required at each pixel location. For example, in a l,000-by-l,000 pixel display there are 1 million addressable elements, each containing at least one TFT along with a data storage capacitor (which simply may be of capacitance of the liquid crystal layer). Such a display is essentially wafer scale integration on a 10-inch glass wafer. The wafer scale manufacture complexity is enormously increased by the fact it must be perfect. One or more bad TFTs (and therefore one or more bad pixels) becomes immediately apparent to the eye, ruining that whole display.

The new flat panel LCD

In the system developed at Tektronix, the transistors are removed from the active matrix completely. It is a new active matrix technique that is functionally identical to an array of TFTs but does not rely on semiconducting materials or the manufacturing processes normally associated with integrated circuits.

The new addressing technology relies on the properties of a confined ionized gas and is called plasma addressing (PA). PA uses the gas to perform electrical switching. When the gas is in an ionized state, it is conducting; when in a deionized state it is nonconducting. To make a switch using this principle the gas must be incorporated into a three-terminal device that alters the conductivity between two terminals through the controlling action of a third. (See Figure 2.)

What is important to PA is the voltage on a probe inserted into the gas (such as helium or neon) at various positions along the tube. The potential measured along the discharge is nearly equal to the potential at the anode everywhere except very near the cathode. (See Figure 2B.)

When the gas is in its normal deionized state, the probe floats; it is electrically isolated from both the anode and the cathode. When the cathode voltage is switched on and the gas is ionized, the probe electrode appears electrically connected to the anode, which can be at ground potential. When the control electrode (cathode) voltage is reduced below the plasma sustaining voltage, the plasma is extinguished and the probe electrode is no longer connected to the grounded anode. Thus, the cathode connection can be thought of as a control or "gate" electrode. With the addition of a capacitor and analog signal source, the plasma switch functions as a sampling switch in a simple S/H circuit as seen in Figure 3.

Plasma addressing technology replaces an entire row of solid-state TFTs with a single channel containing

Figure 3: Plasma switch functioning as a sampling switch

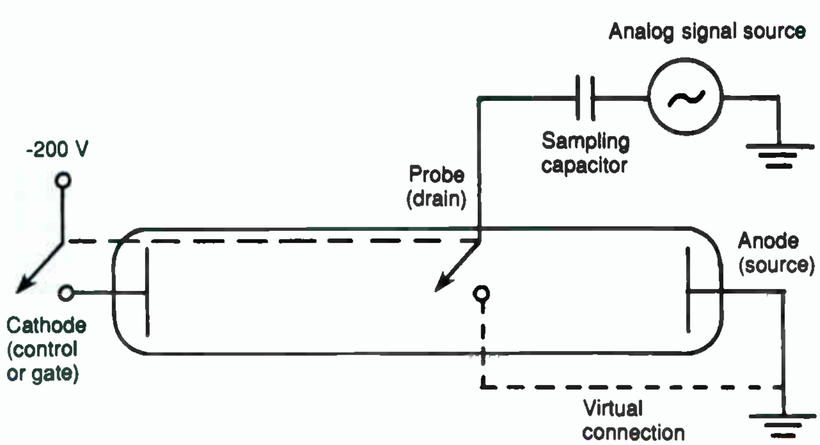
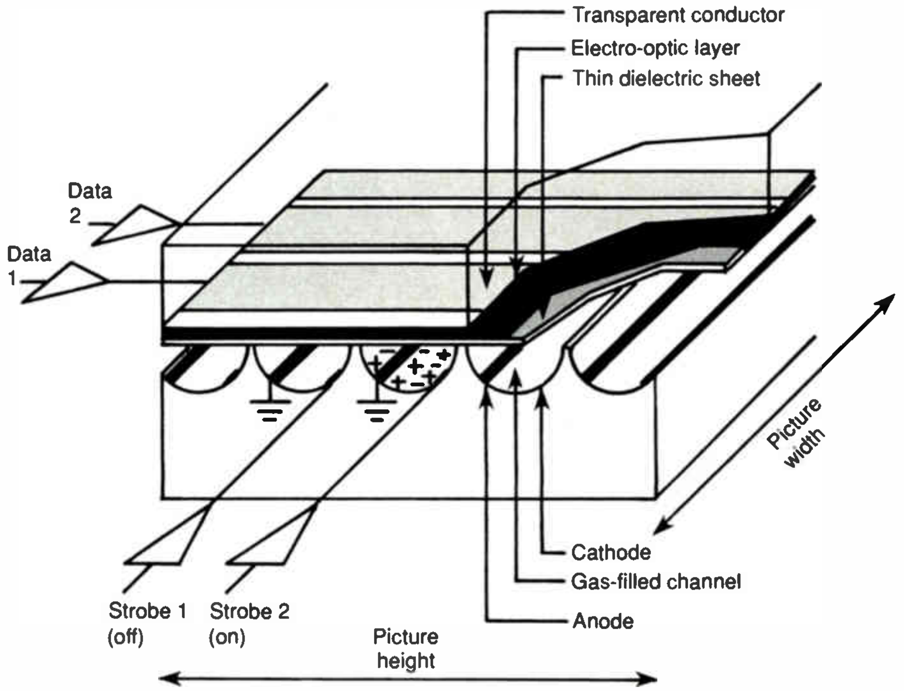


Figure 4: Plasma addressing technology



an inert gas (Figure 4). The gas can be ionized by a strobe voltage applied to the plasma electrodes. A plasma addressed liquid crystal panel encloses the liquid crystal and a protective dielectric layer between upper and lower glass sheets. The upper sheet is patterned with data electrodes of conductive and transparent indium tin oxide. The lower sheet has parallel grooves (or channels) in its surface. Each groove contains two parallel electrodes for the anode and cathode that run the entire channel length. The anodes are shown as grounded; the cathodes are hidden by the channel walls and are electrically connected to the strobe drivers. The channel is filled with a noble gas. Momentarily "firing" a plasma channel causes a full line of analog data values to be sampled and held.

During one horizontal line time, analog data corresponding to a single line of video appears on the data outputs and the transparent conductors. Except for the one row where the gas is ionized, the analog voltage has no effect on light transmissivity of the liquid crystal since the other rows have no electrical connection or conductor on the bottom side of the liquid crystal. Along the line above the ionized channel, however, the pixel capacitance can change to the value determined by the data voltage because the bottom side of the liquid crystal behaves as the probe electrode of Figures 2 and 3. In effect, the plasma completes the electrical circuit between the data electrodes and grounded channel anode as shown in the simplified Figure 5. Although physically much simpler, a plasma addressed LCD is electrically equivalent to a TFT active-matrix LCD.

For each pixel along a channel, the gas discharge functions as an electrical switch that changes between a conducting (plasma) state and a non-conducting (deionized) state in response to the applied data strobe signal. Analog data values are sampled and held on a row-by-row basis, sequentially addressing an entire image field of the liquid crystal layer. The plasma addressed LCD is not a plasma display; there is no image in the barely visible plasma glow. Power consumption is low because only one line of the plasma is on at any give time, and then only for a fraction of a horizontal line time.

Conclusions

At Tektronix they have made a 300-by-300 dot, 5-inch-by-5-inch plasma addressed LCD technical demonstration unit that exhibited color and gray scale performance at video rates. It was progressively scanned at 35 kHz and updated at a 67 Hz field rate.

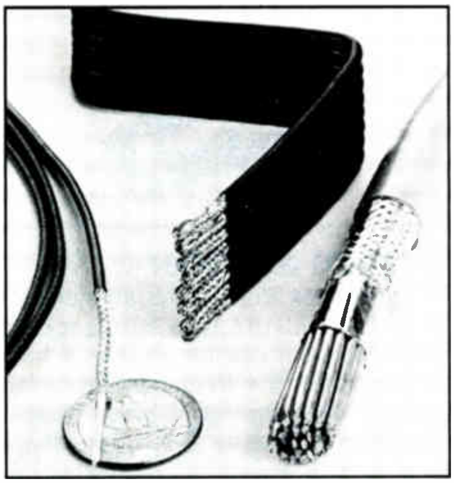
The larger flat panel displays get,

Power supply

Performance Technological Products announced its ferroresonant power supply that converts 120 VAC utility power to 60 V RMS and delivers 15 amperes of current. An optional cooling fan may be plugged directly into the unit, which avoids the need for additional wiring.

The input is protected from surges by use of an MOV and the circuit breaker is rated at 20 amperes, which according to the company avoids nuisance tripping. A convenience handle is located at the front of the chassis, which is fabricated to withstand rough handling in the field.

Reader service #125

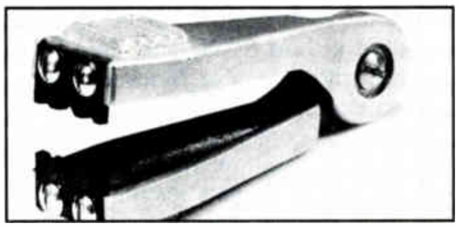


Mini coax

Montrose Products unveiled a new line of miniaturized coaxial cable. It features a small, highly foamed cellular dielectric for applications requiring high speed data transmission. The MCX subminiature coax has a cellular structure that is more than 50 percent air, allowing a propagation delay of 1.24 ns per foot. Signals are said to propagate 20 percent faster through cables that are up to 50 percent smaller than MIL-C17 types.

According to the company, the coax is easy to connectorize using conventional blades and stripping tools. The extruded insulation on the product is said to strip more evenly than tape wrapped conductors. Offered with impedences from 50 to 150 ohms, single coax, twisted pair, flat eight to 10 conductor and round cables consisting of up to 50 coaxes are available in lengths to 1,000 feet or more.

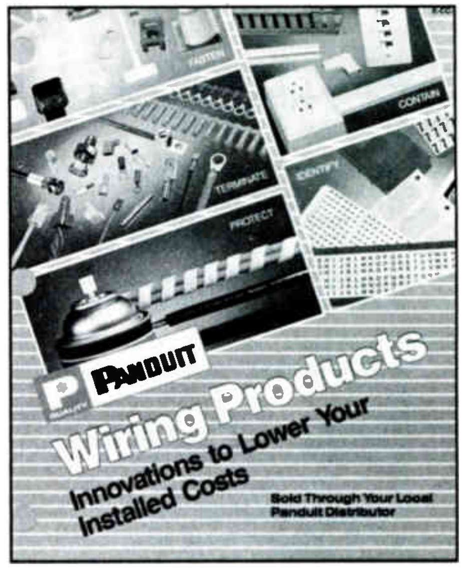
Reader service #123



Conductor cleaner

Ripley's new Model CC-100 super conductor cleaner has been introduced for all sizes of trunk and feeder cable. It is designed to remove residual dielectric and adhesive from the center conductor. The tool features an aluminum body and has notched, replaceable blades.

Reader service #121



Wiring catalog

A 52-page condensed catalog covering the full line of Panduit wiring products is now available. Included is product selection and packaging information on the company's cable ties, tooling and wiring accessories, abrasion protection products, stainless steel clamp system, wire markers, computer printable labels and facility identification, solderless terminals, lugs and wire connectors, heat shrink tubing and more. The catalog is free.

Reader service #120

Headend equipment

DWR Cable TV Importers has introduced its Aurora ASM 100 line of headend equipment to North America. This is a complete agile system for cable TV

consisting of various modules (e.g., modulators, receivers, heterodyne processors, wideband amplifiers, FM amplifiers and switching modules). All these modules plug into a 19-inch by 5.25-inch base unit that accommodates up to 16 different units, making it the world's smallest headend, according to the company. The system uses surface-mount technology and is formatted for NTSC, PAL, SECAM and MAC systems.
Reader service #119

Dissipator

Lightning Master is offering a static dissipator set designed for direct mounting on top of almost any DC-grounded antenna. Consisting of two LMC PP-1S dissipators and an HC-48-A2 clamp, the complete unit weighs only about 8 ounces and presents minimal wind loading, according to the firm.

The static dissipators and dissipating air terminals minimize static ground charge accumulation during lightning storms by reducing and controlling static buildup. Through installation at specific points on a given structure, the dissipators bleed off the charge in very low amperage over a long period of time, as opposed to the high, short duration amperage of a lightning strike.
Reader service #117

Data, video return links

Orchard Communications released new data and video return links for the AM5000 fiber-optic video system. These come in three models, including the AM5000TDR, which provides a 5 to 30 MHz transmission link designed to transmit data carriers for status monitoring of the optical receiver and OEM equipment. The AM5000TDV provides 5 to 110 MHz broadband data transmission for receiver and OEM status, plus video suitable for local access. The AM5000TSV provides 5 to 110 MHz broadband data transmission for receiver and OEM status, plus multiple high-quality video channels with a C/N in the low 50s.

For data, all models operate at a 10^{-9} bit error rate over an optical path loss of 10 dB. Transmitting in the opposite direction, a forward data carrier at 6 MHz provides information for the diagnostic system and can provide remote switching if needed.
Reader service #116

Tool, test catalog

Jensen announced its new 1991 master catalog. It is illustrated in full color and offers 232 pages of tools and test instruments. The catalog covers a full range of scopes, power supplies, function generators, hand-held multimeters and other test equipment. Also included is information on ATA-rated shipping containers, foam lined carriers, circuit board carriers, tool kits and hand tools.
Reader service #122

AD INDEX

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COMMUNICATIONS TECHNOLOGY DAILY

A Transmedia Publication

Western Show Wrap-Up

Donations Made to U.K. and U.S. SCTE Scholarship Programs

Rex Porter of Midwest CATV and his wife Mary donated a total of $10,000 to the scholarship programs of the U.S. and U.K. societies of cable engineers. The presentation of the donations occurred at a luncheon sponsored by CT Publications Corp. at the Anaheim Hilton. The U.S. SCTE joined the Porters to present $5,000 to the U.K. SCTE, represented by its vice president, Jerry Crusan. The National Cable Television Institute has agreed to match the funds derived from these contributions to both Societies' scholarship programs in every instance that tuition assistance is applied to NCTI correspondence courses.

Jerrold Introduces Addressable Interdiction System

Jerrold Communications showed its Agile Jammer, a second-generation addressable interdiction system that is not part of the distribution system. The system is designed to be mounted within an enclosure on the subscriber's home or adjunct to the tap in the distribution system. It can be powered from the home and will not force a redesign of the plant power grid, according to the company. Eight oscillators cover 54 to 450 MHz. **Reader service #209**

Augat Introduces Improved Fiber Trunking System, New Connector

Augat's Communications Division featured a new innovation—telemetric status monitoring—for its OptiFlex AM 1000 fiber trunking system. The innovation provides a service tech, on the ground below the unit, with information through a hand-held device. The OptiFlex can be applied to standard coaxial trunking and, according to the company, is easily upgraded for optical trunking by adding up to four optical receivers. Also introduced by the Communications Division/LRC Operation was the Multi-Fit F connector that the firm says simplifies cable connections by eliminating the need for multiple connectors. Multi-Fit is designed to reduce inventory since only two connectors are required to accommodate a broad range of RG-59 and 6 series cables. **Reader service #208, status monitoring; #207, Multi-Fit**

S-A Introduces New System 60 Fiber Products

Scientific-Atlanta formally introduced its System 60 series of AM fiber products at the show. The series shares a common chassis and each of the new products are contained in modules that can be installed in the 5-1/4 by 19-inch chassis. Each of the modules is a self-contained unit with its own power supply and status monitoring capability. The Model 6460 transmitter contains state-of-the-art analog DFB lasers. Other features include an integrated preamplifier to drive the laser, automatic gain control (AGC) capability, automatic power control (APC) capability and expanded status monitoring capability. The Model 6960 receiver contains up to two optical receivers in a standard System 60 module and single receiver configurations also are supported. It is designed for indoor receiver applications. The Model 6901 receiver is designed for outdoor installations. An individual receiver component, incorporated into both models, has extremely low noise and a 6 dB optical range. The Model 6961 combiner is capable of operating as either a switch or combiner, or a combination of the two. It can be used as a combiner for two Model 6960 receivers to provide a two, three or four receiver configuration. It also can function as an RF A/B switch, switching from the primary input to a backup input, either with separate inputs or the combined signal. The Model 6461 switch controller controls up to four optical and/or RF switches. It allows for manual or automatic operation of the enclosed switches. The Model 6464 optical switch is a cooperative effort between S-A and Corning. It is housed in a sub-module that plugs into the Model 6461 switch controller. Up to four switches plug into the rear of each Model 6461. **Reader service #206**

Nexus Introduces Series 2000 Headend Product Line

Nexus Engineering unveiled its Series 2000 headend product line at the show. The line was specifically designed to take full advantage of optical transmission techniques while offering greatly improved performance in coaxial application, according to the company. The Series 2000 features fully redundant power supplies to enhance overall system reliability. The company uses external power supplies to isolate heat dissipating components from RF circuits. The modulators were designed to achieve a predicted MTBF of 40,000 hours, using MIL-HDBK-217E. Other features include remote status monitoring and on-line intelligent, agile backup modulators. These monitors automatically switch to the appropriate programming and the respective channel should one of the primary modulators fail. Carrier-to-noise ratio exceeds 67 dB and weighted signal-to-noise ratio from 10 kHz to 5 MHz is greater than 68 dB. **Reader service #205**

SCTE Committee Approves F Interface Dimensions

The Society's Interface Practices Committee met during the show and among other business, approved the proposed threaded male and female F interfaces mechanical dimensions for RG-59 and RG-6. ATC's Dave Franklin motioned for the dimensions to be approved, the motion was seconded and, following a short debate (much of it concerning casting lines and a possible cost increase in die-cast splitters), the dimensions were put to a show-of-hands vote and accepted as presented with some explanatory notes to be added. Look for these recommended dimensions to be published in the near future.

Triple Crown Introduces Wideband Trunk/Bridger Amps

The Titan series of wideband trunk/bridger amplifiers was shown by Triple Crown Electronics. They are specifically designed for high capacity fiber/coax builds. The series is based on an 862 MHz platform that comprises an eight-port housing with switchable ports. The trunk and bridger cables may be ported horizontally or vertically for simplified installation. The series features push-pull or power doubled trunk and bridger, 5-862 MHz bandwidth, automatic level and slope controls, all bidirectional ports and fully removable electronics. It also has a switch-mode power supply, an AM fiber receive option, a reverse fiber transmitter option and an overall package size of 7 by 14 inches. **Reader service #204**

Magnavox Unveils 750 MHz Taps and Passives

Magnavox featured its new 9000 Series taps and line passives designed to perform over 5-750 MHz of bandwidth. The units feature a 90° rotatable seizure mechanism for easy installation, RF and weather seal gaskets for RFI protection, an improved environmental coating for corrosion resistance and brass F-ports that are in compliance with SCTE standards. Each unit can be used in either a pedestal or aerial mount and can fit into a 6-inch pedestal. The taps come in two-, four- and eight-way models made from one interchangeable die-cast housing. **Reader service #203**

CaLan Announces Signal Level Measurement System

CaLan introduced its Star 2010 signal level measurement system that consists of a portable meter and a specially developed PC-based software package. According to the company, the hand-held microprocessor-driven signal level meter enables field service personnel to better schedule, collect and analyze field test data. The software can be tied in with the operator's install and maintenance schedule and has memory sufficient to accommodate 50 or more records, greater than a typical day's field work. The unit incorporates tactile feedback elastomeric keys and an LLD display. An optional umbilical wand provides bar code entry of memory file name and PC connection is via integral RS232 interface. An integrated strand-mount allows the unit to be attached to field objects less than 2 inches thick, including strand, cable and amplifier housings. A safety strap is included. **Reader service #202**

Interdiction/Digital Compression Technologies Described in Panel

Several representatives from hardware manufacturers detailed the advantages and disadvantages of interdiction and the pros and cons of digital compression at a technical session yesterday. Vice President of Engineering for Continental Cablevision Terry Mast moderated the panel and started the discussion off with, "What will the cable TV interface look like in two years?" The basic applications of digital video compression were outlined by Tony Aukstikalnis of Jerrold's Subscriber Systems Division and he also considered blue sky enhanced applications of the technology such as pay-per-view possibilities, interactive TV and ultimately digital telephony. Steve Necessary, vice president of marketing subscriber products, summed up the Scientific-Atlanta interdiction side of the story with, "Most consumers will prefer to have their multichannel entertainment needs met via a broadband supply/deny technology...interdiction." Lew Corvo of Magnavox went on to describe compression's virtues and Regal Technologies' Gaylord Hart finished up with the advantages of interdiction and described Regal's commitment to a family of interdiction products.

ONI Introduces Optical Interface Unit

ONI showed its new optical receiver designed to translate optical signals into RF efficiently. The Optical Interface Unit (OIU) segments the optical system from the coaxial plant, which is said to enhance operational ease for European CATV companies. DC powering is compatible with the external power supplies available in each country and the system has full bandwidth capabilities up to 1 GHz and bidirectional operation. **Reader service #201**

Pyramid Announces PI Series Connectors

The new PI series connectors for Quantum Reach cable were introduced by Pyramid Industries. The PI-QR connectors were designed to meet and exceed the specifications (including reusability) set by Quantum Reach users, reports the company. The PI .540 and .860 size connectors are available for delivery. **Reader service #200**

Fiber and System Rebuilds Explored in Technical Session

The session titled "Fiber Optics and System Rebuilds," sponsored by the Society of Cable Television Engineers, included information on the fiber construction sequence, testing, designing with couplers and certain specific applications of fiber in systems. James Refi of AT&T Bell Labs discussed construction sequence and Corning's Doug Wolfe defined and explored the specifications and types of optical couplers. Cox Cable of San Diego's experiences with fiber upgrading were shared by Robert Lonn, system engineer. Considerations included upgrade vs. rebuild, fiber vs. coaxial supertrunk and AML microwave as a backup for the fiber. Other speakers included Al Kuolos, a regional engineer for Continental Cablevision and Tom Colegrove of Lectro.

Catel Unveils Fiber-to-Feeder Product Family

Catel Telecommunications is displaying its new FybrNode fiber-to-feeder product line that delivers 60 channels on a single fiber. Typical performance over a 7 dB optical link is 49.5 dB C/N, -64 dBc CTB and -60 dBc CSO. Also announced was an outdoor optical repeater that enables the link to span a 13 dB optical path or up to 40 amplifiers deep into the system. The family includes a modular optical transmitter, a compact optical receiver and the outdoor repeater. The transmitter uses a high-yield DFB laser for transmission links of up to 16 km over a single fiber and includes front panel test points to measure RF level and visible LED alarms. The receiver is a completely new design to provide performance in a compact strand-mounted unit and the PIN photodetector is complementary to the FybrNode transmitter. The RF output of the receiver is capable of driving a feeder system made up of three to four line extenders or distribution amplifiers. The pole-mounted trunk station has a mechanical base that houses the optical receiver modules, combining network and status monitoring together with up to five FybrNode AM fiber transmitters. **Reader service #199**

Arvis Announces Laserdisc Commercial Insertion System

Arvis displayed its new 7000L laserdisc commercial insertion system. The product offers up to 400 lines of resolution and will require only a one time dub from an ad master to videodisc with little or no generational loss, according to the company. A video compiler for frame accurate tape to disc transfer is included in the offering and the system also is available with a mix of videotape and videodisc players. The product also is available as an upgrade to customers with the existing Arvis 7000 product line. **Reader service #198**

Zenith Announces Compatible Addressable Decoder

The new PM2-C compatible addressable decoder was demonstrated by Zenith. Features include mutlimode scrambling compatibility and pay-per-view capability. The company says only the Zenith controller and a data inserter for each encoded channel are necessary for start-up. The PMII system features process scrambling, audio masking, four-function self diagnostics, 550 MHz/84-channel capacity, headend addressable control, channel mapping and switch-mode power supply. Subscribers get volume control, LED clock display, VCR timer, parental control and more. **Reader service #197**

Pioneer Unveils Interactive Music Video System

Pioneer introduced its CableJuke System, a music video ordering technology for the cable industry that uses laser videodiscs in conjunction with the company's Laserdisc Autochanger. The Autochanger allows quick random access within and between discs—a minimum access time of three seconds and a maximum of 35 seconds. The system provides a barker screen while videos are not playing, giving the subscriber ordering instructions and a list of videos to order. According to the company, the responsibility of the cable operator could become as simple as changing videodiscs. **Reader service #196**

"FCC/Washington Update" Session Highlights FCC, OSHA Concerns

After a brief introduction by Steve Ross, partner with the law firm Fletcher, Heald & Hildreth, SCTE Executive Vice President Bill Riker recapped this year's Cable-Tec Expo and provided information on next year's expo to be held in Reno, Nev., in June, along with the Society's Fiber Optic '90 conference scheduled for Jan. 9-10 in Orlando, Fla., and the Technology for Technicians II workshop planned for Feb. 11-13 in Sacramento. "I try to be nice but sometimes it's difficult," were the opening words for the next panelist, Ron Parver, chief of the FCC's Cable TV Branch. Parver added, "Our role at the FCC is not to be the bad guys" but when needed the commission will be aggressive in going after violators. Next up was John Wong, assistant chief of the Cable TV Branch, who said that "just last week we sent out 3,700 post cards notifying operators that they didn't file their Form 320s." However, Wong did admit that the FCC's computer program did crash three times in July and a good number of those notified likely did file. Wong covered notification procedures for operators adding aeronautical frequencies, plant extensions and annual proof-of-performance filings. The session ended with Roger Keith, director of classroom training for NCTI, asking, "Why are we hearing so much about OSHA?" The reasons: the Bush administration's concerns about a safer workplace in America, more money budgeted for OSHA and better leadership for the group. Keith continued with information about a new OSHA proposal covering vehicle safety and a proposed Senate bill to increase criminal penalties for OSHA violations that will give OSHA more teeth to deal with offenders.

S-A Extends Fiber Products, Introduces Software With CableData

Scientific-Atlanta showed two additions to its fiber product line, a headend driver amplifier and an optoelectronic bridging amplifier with advanced receiver. The Model 6451 amplifier is an indoor, feedforward amp that has a minimum RF gain of 21 dB over the 46 MHz to 550 MHz bandwidth and uses a feedforward gain block to obtain optimum distortion performance at output levels as high as 46 dBmV. The Model 6901 amplifier is designed for outdoor installation and now carries a receiver with extremely low noise and a 6 dB optical range. S-A also announced along with CableData the availability of a new billing software module that supports S-A's System Manager V interdiction systems. **Reader service #195, Model 6451; #194, Model 6901; #193, software module**

AML Introduces 18 GHz Microwave Transmitter

AML Specialties unveiled a new broadband solid-state 18 GHz microwave transmitter. Signal-to-noise ratio is 60 dB or better. Single channel transmitters are offered in 1, 2.5 and 5 watt power levels with up to 24 channels in one 7-foot rack. AC/DC power with total backup support is featured. **Reader service #192**

Magnavox Introduces Dual Output Bridger

Magnavox CATV Systems unveiled its dual output bridger module featuring two independent bridger output hybrids. The unit is backwards compatible and has 6 dB better performance for fixed station output levels and up to 14 dB more system reach for fixed performance levels, according to the company. **Reader service #191**

ESPN Picks GI for New IRD System

ESPN reached an agreement with General Instrument for the development and implementation of a new integrated receiver descrambler (IRD) system, designed to automate the satellite switching procedures for alternate feeds to ESPN affiliates. Scheduled to be implemented in August 1991, the new equipment will enable ESPN to switch satellite feeds directly from its headquarters in Bristol, Conn. **Reader service #190**

European Laser Link II, Fiber Splicer Introduced by Anixter/ONI

Anixter Cable TV International introduced a version of the Laser Link II for the European market. Developed and manufactured by Optical Networks International and AT&T, the new product features seven universal plug-in slots for laser transmitters, RF amps, receivers and advanced network management modules. As well, it supports all video formats telecast in the VHF and UHF spectra, with optional bandwidth up to 1 GHz. ONI is featuring AT&T's new CSL LightSplice system for single- and multimode fibers. The system includes a field assembled cleave and mechanical splice designed primarily for restoration purposes. Splicing time, including fiber preparation and cleaving, averages two to three minutes per splice, according to ONI. **Reader service #189, European Laser Link; #188, LightSplice**

Cable "Over There" and European Build Strategies Discussed

Wendell Woody, president of the U.S. Society of Cable Television Engineers, kicked off the discussion at the "International Cable Opportunities and New-Build Strategies" technical seminar with news of the development of an International SCTE Council. Canadian, U.K. and U.S. representatives met at the show in the second of three ad hoc meetings. The third will be held at the National Show where Woody reports the council with its archival, training and engineering committees will be officially formed. The director of the U.K. Cable Television Association, Richard Woollam, took the discussion into the realm of U.K. regulation considerations for cable and telephony carriage and stressed that U.K. cable "will ensure a higher quality of telecommunications service and break the existing monopoly on residential telephony." US West's U.K. efforts for a cost-effective solution for integrated video, voice and data were considered by the company's Earl Langenberg and he went over the technical considerations for the overlay network. "Now is the crunch time for (U.K.) network planners," said United Artists' Vice President of Engineering Jerry Crusan. He described differences in the U.K. cable market (like the virtual non-existence of aerial plant, NICAM stereo considerations and DBS, MAC and PAL) as reasons that the key to doing business overseas is to "improvise and carry on." Moderator Dean DeBiase (president of Anixter International) briefly considered penetration and construction costs in Europe and pointed out the tremendous opportunity especially in the United Kingdom and France.

Tektronix Displays New Software for 2710 Spectrum Analyzer

Tektronix introduced its new S26UT10 GPIB utility software to expand the storage, display and application capabilities of its Model 2710 spectrum analyzer. The software, which runs on MS-DOS computers and has built-in print capability for graphic displays, provides for storage, cataloging and documentation of waveform displays and measurement data acquired by the 2710. **Reader service #187**

S-A Shows New Audio, Interdiction and Amplifier Products

Scientific-Atlanta introduced a variety of products at the show including the cd-x digital audio system, which is the only complete line providing true CD standard digital audio signals, S-A says. The line includes the Model 9430 QPSK digital audio satellite receiver, the 9440 headend demultiplexer, 9450 QPR modulator and DM-2000 digital music tuner. The cd-x can provide 160 audio channels, pay-per-listen capabilities and customized audio programming. Two new headend products that provide stereo capabilities are the Model 6390 integrated stereo encoder module and 9420 FM processor—both designed to minimize additional rack space requirements. New additions to S-A's addressable interdiction product line include a strand-mount, single-port unit and eight-port unit. Both will secure channels up to 450 MHz. The single-port unit is designed for limited deployment situations or low density systems, while the eight-port unit handles high density or multiple dwelling applications. Also introduced was a 32 dB 550 MHz dual parallel hybrid bridging amp module that utilizes two output hybrid amps and two sets of controls to provide 3 to 4 dB higher output levels than a single bridger module. **Reader service #186, cd-x; #185, headend products; #184, interdiction products; #183, amp module**

Oak Returns With Upgraded Sigma 2000 Converter

Oak Communications resurfaced at the show, following its acquisition earlier this year, with the new Sigma 2000 converter and addressable control system (ACS). Oak says the ACS is unique in that it features a distributed PC-based architecture capable of high speed operation with large subscriber systems, handling over 600,000 subs and 3,000 simultaneous PPV orders. **Reader service #182**

Tips for "Increased Productivity for a Better Margin"

Paul Venturella, director of engineering for TCI Cablevision of California, kicked off this tech session by giving the keys to increasing productivity: better training, supervision, routing and tracking. Barbara Wyatt, general manager of TCI's Tacoma, Wash., system, provided her approach to "40 minutes a month to greater profits," a management tracking system that incorporates daily and monthly stat reports and manager call backs to new subs to see what they think of the service they received. She offered three tips in analyzing data—look for the obvious, pay attention to the smallest detail and when you've got it right, change it. Pam Nobles, Jones' senior staff engineer/technical training, followed with a presentation on training, highlighting her company's Qualified Installer Program and the advantages of using interactive video. The next two speakers—Martin Gareau, CNG Energy's manager of the Technical Products Division, and Pat Murphy, vice president of technical operations for Simmons Cable in Long Beach, Calif.—both provided details on in-vehicle systems to improve work load routing and supervision. Gareau covered his company's computer-aided radio dispatching system (CARDS) that uses two-way radio for mobile data terminals, while Murphy offered his system's experience with an automatic vehicle location system.

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Reader Service Number 51

ONI's Laser Link II fiber-optic system

By Ron Hranac
Senior Technical Editor

Fiber-optic technology has been used by the CATV industry for several years, with early applications limited primarily to FM supertrunks. Had anyone attempted to predict today's widespread acceptance and use of AM fiber signal distribution even three or four years ago, the likely reaction would have been one of disbelief. But the cable industry has seldom been afraid to quickly embrace new technologies, and AM fiber is no exception.

The first Laser Link system was shipped by Anixter in late 1988 to the cable system in Orlando, Fla., and we've since seen the development of several AM fiber architectures such as ATC's backbone, Jones' cable area network, Rogers' ring configuration and now various forms of fiber trunking (fiber to the bridger, fiber to the feeder, etc.). Along with this evolution of architectures has been the introduction of fiber equipment by most of the major manufacturers in cable.

Anixter formed a relationship early on with AT&T (the manufacturer of the optical components in Laser Link) and has since created a separate company (Optical Networks International) to handle fiber engineering, product development and support. The company's sole business is fiber and it is operated separately from Anixter. Early in 1990 ONI introduced Laser Link II, a second generation AM fiber system for CATV that includes versions for the domestic market as well as the European market.

Courtesy ONI

The Laser Link II.

The product

The original Laser Link—a 1,310 nm-based optical system—housed each DFB (distributed feedback) laser transmitter in a two-rack unit (3.5 inches) high, 19-inch chassis, similar in size to a headend modulator or processor. The companion optical receiver was available in either a rack-mount configuration for indoor applications or a trunk amplifier housing for strand or pedestal mounting. Laser Link II (shown in the accompanying photograph) uses the same receiver configurations as the original Laser Link in addition to a new bridger-only housing for fiber trunking; however, the transmitter packaging is considerably different from its pre-

Figure 1: RF input to laser transmitter

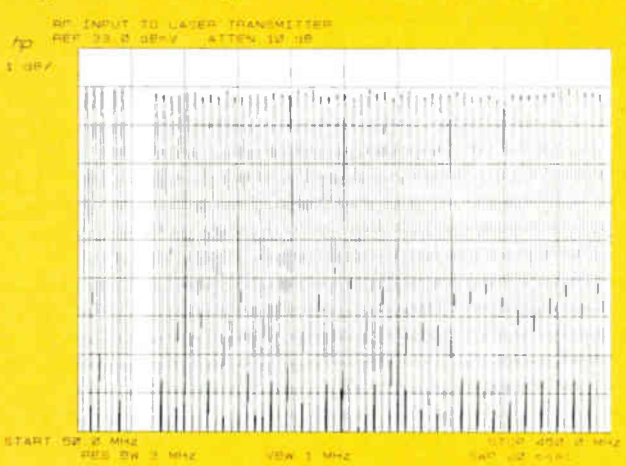
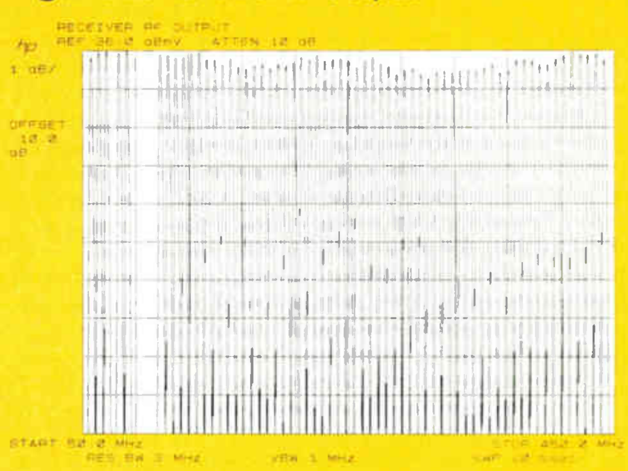


Figure 2: Receiver RF output



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Reader Service Number 52

Table 1: Laser Link II specifications

Technical specification	Transmitter module	Amplifier module	Receiver module	Return data receiver module
Input signal level	32 dBmV	15 dBmV	—	—
Input impedance	75 ohms	75 ohms	—	—
Nominal output signal level	—	32 dBmV	20 dBmV	10 dBmV
Output impedance	—	75 ohms	75 ohms	75 ohms
Gain control range	^{2}5 dB	^{2}5 dB	^{2}5 dB	—
Slope control range	—	$^{\$}$3/0 dB	—	—
Return loss	16 dB	16 dB	16 dB	16 dB
Modulation bandwidth (U.S.)	50-550 MHz	50-550 MHz	50-550 MHz	5-30 MHz
Modulation BW (Europe)	50-860 MHz	50-860 MHz	50-860 MHz	5-50 MHz
Wavelength	1,310 nm	—	1,310 nm	1,310 nm
Fiber pigtail	SM, 15 feet*	—	SM, 15 feet*	SM, 15 feet*
Optical connector type	RMS**	—	RMS**	RMS**
Power consumption	0.5 A typ.*** 0.75 A max.	1.08 A	0.2 A	0.2 A
Weight	3 pounds	2.75 pounds	2.75 pounds	2.75 pounds

* SM designates single-mode fiber
** RMS designates rotary mechanical splice
*** Typical power dissipation is at room temperature (25°C)

decessor. (The original Laser Link is still available from ONI.)

The transmitter assembly is a modular design that can accommodate four complete nodes in one shelf. Seven slots are available in the 8.5-by-19-inch rack-mount chassis, and although up to five DFB laser transmitter modules can be plugged in, four-node operation would use four laser modules, a four-output RF amplifier module and two receiver modules each with two PIN diode receivers for return data from each of the nodes. (This module has data-only receive capability at this time, but video return capability is being developed.) The shelf also can accommodate a plug-in 50-550 MHz receiver module and an ANMM (advanced network management module).

The chassis includes a built-in "universal" power supply that can operate over a 105-265 VAC, 47-63 Hz range. Reflecting AT&T's contribution to the product design, a rear-mounted barrier strip provides for an external +24 VDC source for backup power input as well as alarm contact closures. Status monitoring is included and front panel LEDs provide quick indication of the operation of Supply A (the built-in power supply), Supply B (external +24 VDC), alarm (failure of any of the seven plug-in modules) and limit (excessive temperature). Also provided on the front panel are voltmeter test points for both supplies and ground, plus a socket for a wrist ground strap.

The chassis design makes use of convection cooling, and each of the active plug-in modules has vertically finned heatsinks to promote efficient heat dissipation and module cooling. Eight fully loaded shelves (56 plug-in modules) can be installed in a 6-foot rack without the need to use spacers between each chassis or cooling fans, and each shelf is temperature-isolated from the unit above and below it. Maximum power consumption is 100 watts per shelf.

Each module has its own front panel RF test point and power LED indicator; laser and receiver modules include status LEDs. The RF amplifier module, which is used to provide four equal outputs at +32 dBmV each to drive the laser modules, includes level and slope controls. (If sufficient operating levels are available in the headend then the AMP/4 module will not be necessary.) The laser modules also include a front panel modulation adjustment pot. All of the modules are located behind a hinged access panel that conceals the modules when closed but leaves the primary status indicator LEDs visible on the shelf's right side. Table 1 summarizes Laser Link II module specifications.

Several receiver configurations are available; strand-mount versions are based on Texscan's Pathmaker amplifiers and all receivers have 50-550 MHz capability. The indoor receiver, Model LLR-1000, is in a 19-inch rack-mount chassis designed for 120 VAC operation; it provides +30 dBmV output. The outdoor receivers operate from cable system 60 VAC powering and, depending on the model used (LLR-2000, LLR-2100 or LLR-3000), can provide +20, +38 or +50 dBmV RF output. Minimum optical receive power for all the receivers is -7 dBm at 1,310 nm and single or multiple laser/fiber operation for each node is possible.

List prices for Laser Link II are $19,000 per laser module, $2,500 for the shelf and power supply, and $1,100 for the RF amplifier module. Receiver pricing is $2,750 to $3,400 each, depending on options and configuration. As with most manufacturers' list prices, these are guidelines and subject to MSO discounts.

Table 2: Laser Link II RF performance

	Ch. 3	Ch. 17	Ch.28	Ch.45	Ch. 61
CTB	>-70.0 dB	>-70.0 dB	>-70.0 dB	-66.9 dB	-67.9 dB
CSO	-61.2 dB	-63.2 dB	-64.9 dB	-62.5 dB	-60.8 dB
C/N	51.2 dB	51.8 dB	52.0 dB	50.9 dB	51.9 dB
Hum	>-65.0 dB	>-65.0 dB	>-65.0 dB	>-65.0 dB	>-65.0 dB

(Bypassing the AMP/4 RF amplifier module did not change the C/N; CSO improved 1.6 dB and CTB was 3.1 dB better.)

Lab tests

A single laser/fiber/receiver 50-450 MHz combination was tested, with CW signals (60 channels) from a Matrix generator as the RF source. Operation with and without the AMP/4 RF amplifier module was measured using a Hewlett-Packard HP 8568B computer-controlled spectrum analyzer. Laser launch power was +8.24 dBm, and total link loss was 9.47 dB (8.73 dB loss through 22.4 km of single-mode fiber and an additional 0.74 dB miscellaneous loss from splices, con-

"Several hundred Laser Links now in operation (in addition to what has been shipped by other manufacturers) confirm that fiber is no longer just the latest buzzword, but a regular member of our distribution architectures."

nectors and jumpers). RF performance was measured at the output of an outdoor receiver (set to +36 dBmV) on Chs. 3, 17, 28, 45 and 61.

Input levels to the laser were adjusted to a nominal +32 dBmV per channel, and all single channel performance measurements were performed through a Trilithic VF4XX tunable bandpass filter. All measurements were based on NCTA guidelines.

Figures 1 and 2 show the RF input to the laser and the receiver output respectively, and provide an indication of the relative frequency response of the Laser Link II system; Table 2 summarizes its RF performance using the AMP/4 RF amplifier module in the transmitter shelf.

Comments

The test results indicate good performance and a relatively transparent (pun intended) medium for CATV signal transmission. There is no magic in the fiber-optic equipment available to the industry today and AM fiber has become another tool in the technical toolbox of the engineer. Several hundred Laser Links now in operation (in addition to what has been shipped by other manufacturers) confirm that fiber is no longer just the latest buzzword, but a regular member of our distribution architectures.

AM fiber has come a long way since its introduction in the late 1980s. Where at one time manufacturers were testing lasers developed primarily for data transmission with nonstandard procedures (e.g., multitone DIN style), manufacturers today have optimized production and testing techniques specifically for CATV. It's common to see Matrix generators and automated spectrum analyzers being used in the production process, and hand-picked "hero" lasers are becoming a thing of the past as the yield of higher quality optical semiconductors increases.

Although ONI's Laser Link II is a product that has evolved fairly quickly from early designs, its rugged construction and innovative packaging will provide long-term reliability, quality and flexibility. Looking beyond the domestic market, ONI has equipped the European version with a 50-860 MHz bandwidth as well as keyed locks on each laser module to meet international standards and safety requirements. And having AT&T as a resource behind both products suggests that ONI is serious about fiber.

For more information, contact Optical Networks International at 8101 E. Prentice Ave., Suite 218, Englewood, Colo. 80111, (303) 694-9220. **CT**

January 1991

BACK TO BASICS

Reception troubleshooting

The training and educational supplement to Communications Technology magazine.

Geri Saye

Table of Contents

Formerly Installer/Technician

Reducing interference with a stagger stacked antenna array

By Steven I. Biro
President, Biro Engineering

There are several methods to protect the reception of a desired TV station when co-channel, electrical (AC) or RF interference signals arrive from the rear (i.e., 180° off the main lobe).

•One option is to conduct a factual on-site signal survey. Locate the antenna tower behind a hill or mountain ridge; the high ground will serve as a natural shield against the distant co-channel interference source. To obtain maximum protection against AC interference, move the tower away from any power lines. Ascertain the greatest possible distance between the tower and high voltage transmission lines. The receiving antennas should definitely not look through the high voltage lines.

These considerations are applicable to proposed new antenna sites. But an on-site survey can identify only existing interference conditions; an interfering two-way radio service might be established in the area a few weeks or even months later. Power companies do not need an FCC permit to expand their services along a high voltage transmission line or construct a brand new line. When the service calls start to multiply about interference on the off-air TV pictures, the installation of new interference rejecting antennas or antenna arrays must be considered.

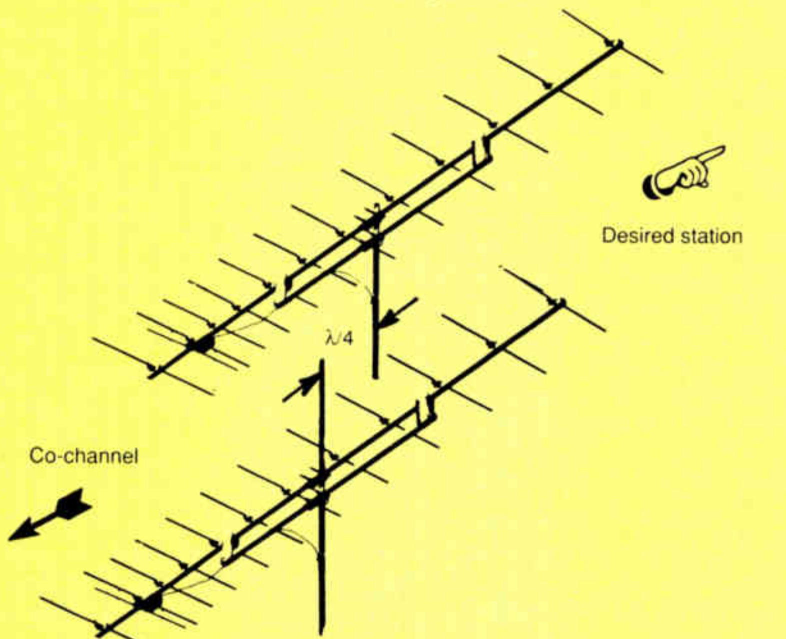
•The second method is to employ an antenna with high front-to-back ratio (F/B). Single dipole Yagis exhibit F/B in the 15 to 22 dB range. Properly designed twin-driven Yagis can increase the protection levels by another 3 dB. Log periodic antennas, without passive elements, boast 22 to 26 dB F/B specifications.

•Finally, when co-channel, AC or RF interference from the rear exceeds moderate intensity levels, the protection provided by a single antenna is unsatisfactory. The application of an antenna array is mandatory. A stagger stacked array will not only force a deep radiation pattern null into the back, but might also protect the reception against interference *close to* 180° off the main beam. That is a very important asset in the case of AC interference. A high voltage transmission line seldom acts as a concentrated interference source. The transmission line, which is several thousand feet long, performs as a very long traveling wave antenna representing a wide angle of interference.

Stagger stacking is *theoretically* independent of the antenna type. Even two stagger stacked dipoles could provide effective protection against interference arriving from the back. For obvious reasons the application of high-gain antennas is preferred. →

A stagger stacked quad-array lifted in the air.

Figure 1: Vertical stagger stacking



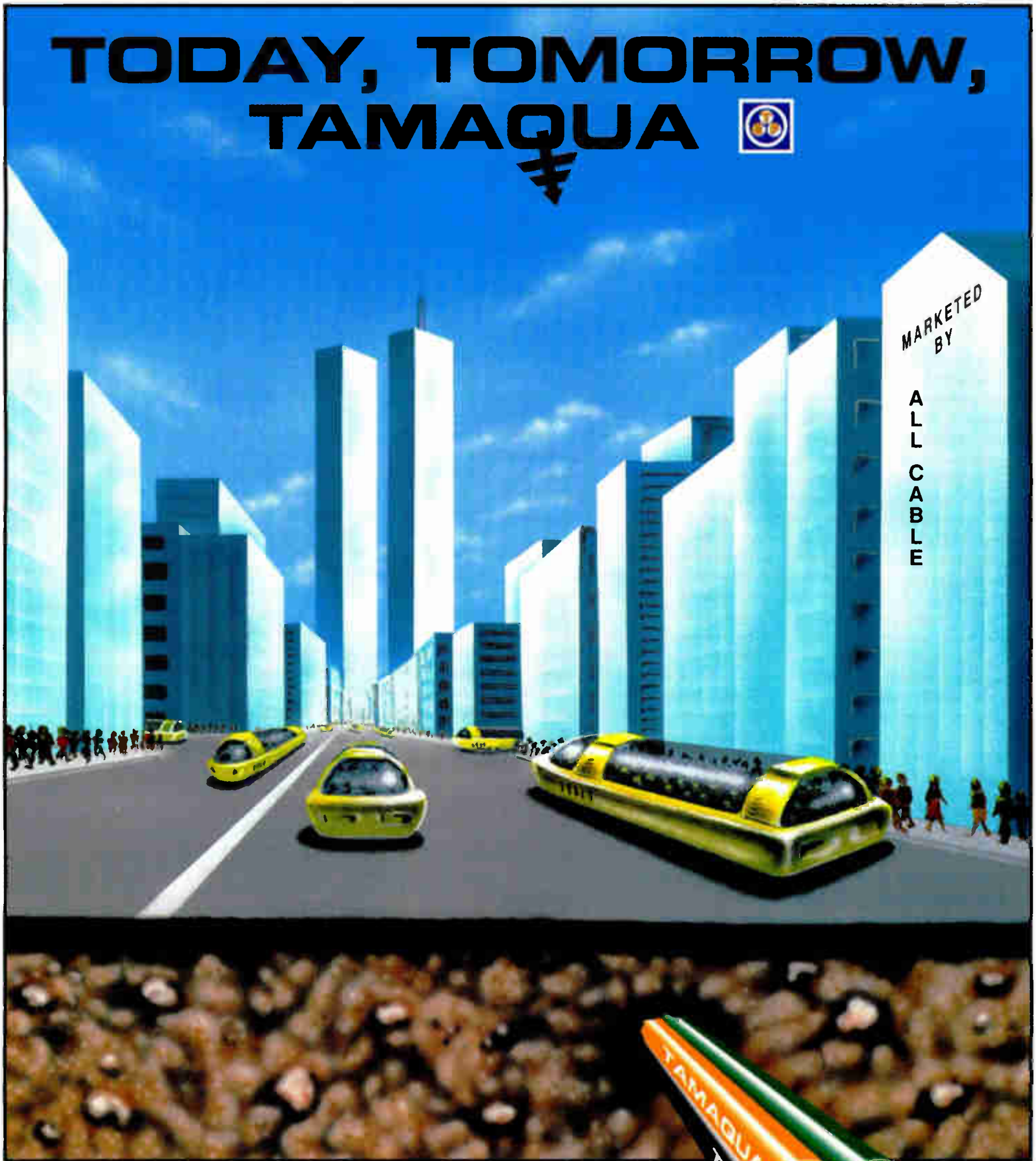

TODAY, TOMORROW,
TAMAQUA
MARKETED BY
ALL CABLE
TAMAQUA
TAMAQUA

Figure 2

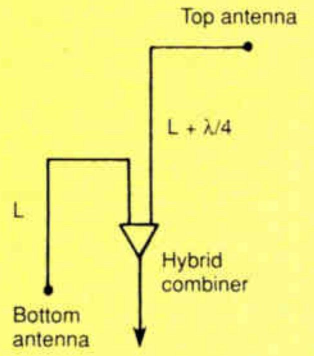


Table 1: Stagger stacking spacing for Chs. 2-13

Channel	Spacing (inches)
2	53.44
3	48.20
4	43.91
5	38.22
6	35.47
7	16.85
8	16.29
9	15.77
10	15.28
11	14.82
12	14.38
13	13.98

Table 2: Quarter wavelength cable lengths (inches)

Solid dielectric (velocity of propagation 0.66)

Channel	Length
2	35.27
3	31.81
4	28.98
5	25.22
6	23.41
7	11.12
8	10.75
9	10.41
10	10.08
11	9.78
12	9.49
13	9.22

Foam dielectric (velocity of propagation 0.82)

Channel	Length
2	43.80
3	39.52
4	36.00
5	31.34
6	29.08
7	13.82
8	13.36
9	12.93
10	12.53
11	12.15
12	11.79
13	11.46

Theory of stagger stacking

The concept of stagger stacking requires two identical antennas. In the case of vertical stagger stacking (Figure 1) the top antenna is a quarter wavelength (λ/4) closer to the desired station than the bottom antenna. In order to obtain out-of-phase cancellation, the coax feeding the top antenna must be *electrically* λ/4 longer than the cable connecting the bottom antenna to the hybrid combiner (Figure 2).

The 180° (front-to-back) cancellation can be explained as follows: Signals arriving from the desired station (front) hit the top antenna first, the bottom antenna 90° (λ/4) later. However, the cable connecting the top antenna to the hybrid combiner is electrically λ/4 longer, introducing a 90° phase delay. The quarter wavelength offset and the electrically 90° longer cable in effect cancel each other, delivering in-phase and equal amplitude signals from the direction of the desired TV station. In other words, the two signals *will add* at the combiner.

What are the conditions concerning the undesired signals arriving from the back? The interference signal from the rear will hit the staggered (back) antenna first, the top antenna 90° later. Furthermore, the signal from the top antenna arrives through a cable harness that is λ/4 (90°) longer than the cable connecting the bottom antenna to the hybrid combiner. The interference signals received by the top and bottom antennas cancel each other at the input of the hybrid combiner. Table 1 shows stagger stacking (λ/4) dimensions of Chs. 2 through 13. Table 2 is a listing of λ/4 dimensions for cable harnesses constructed of solid dielectric or foam dielectric cable.

Theoretically, a correctly designed and assembled stagger stacked antenna array provides total cancellation against interference signals arriving from 180° off-angle. Somewhat lower, but still considerable, protection is achieved between 172° and 188°.

Vertical or horizontal?

Figure 1 illustrates a vertically stagger stacked array configuration. Although vertical stagger stacking is more frequently used than horizontal, some caution is in order before selecting the final configuration.

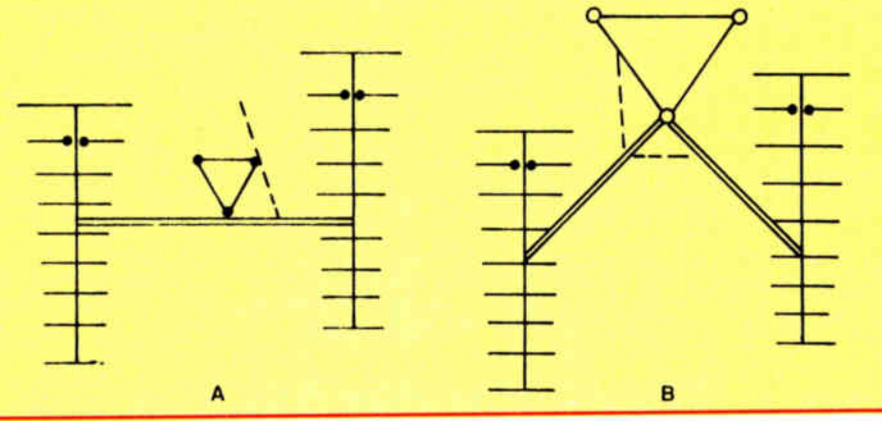
As observed and recorded in the field, the amplitude and phase of the received TV signal can change dramatically as a function of height above ground. On high band, ±3 dB variations within 5 feet of vertical movement is not uncommon. On low band, ±2 dB variations have been recorded, changing the antenna's height by 12 feet.

There are no simple means to measure and record phase variations. It is reasonable to assume that a ±3 dB or ±2 dB amplitude variation affects phase conditions as well. The combination of amplitude and phase shift may partially or totally destroy the F/B of the radiation pattern.

When in doubt, conduct an on-site test, probing the signal level variations with the aid of a telescopic mast or cherry picker. The practical height limitations are around 40 to 50 feet.

In the case of an existing antenna tower installation, the testing may encompass the entire tower height or it could focus on any segment of the tower. The accompanying photo shows the stagger stacked quad-array lifted in the air. The antenna was raised in 5-foot increments, then rotated into the desired direction by pulling the attached ropes. Around the proposed installation height, measurements were taken in 3-foot intervals and repeated a

Figure 3: Horizontally stacked antenna arrays (top view)



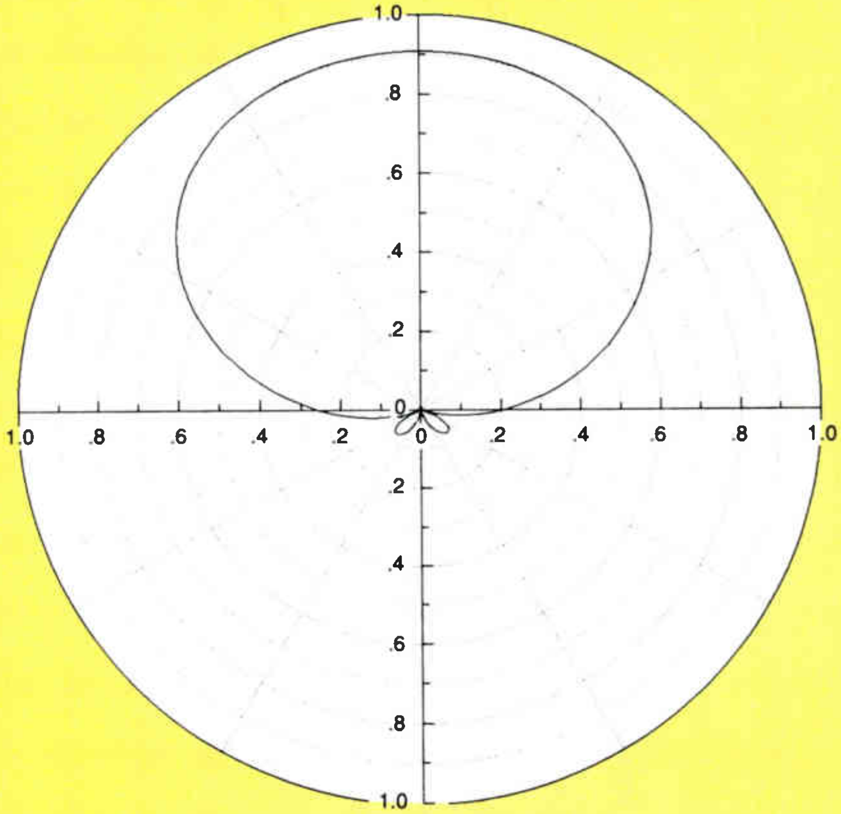
few times. The objective: to obtain factual, statistically substantiated results.

Figure 3 is a top view illustration of horizontally stacked antenna arrays designed for guyed and self-supporting tower applications. The array on the left (3A) is a conventional two-bay, side-by-side configuration straddling the guyed tower. Satisfactory separation was secured between the antenna radiator elements and the relatively narrow (42-inch) tower face.

The same antenna array configuration was not adaptable to the massive self-supporting tower (Figure 3B). The wide (96-inch) face of the tower reduced the clearance between the tower and the antenna elements. Therefore, a new, V-shaped antenna gate configuration was chosen to move the antennas in front of the tower. This prevented the antenna elements from touching the tower.

However, a second problem area was not cured. Observe the separation between the reflector elements and the tower structure on the left and right sides. The left side is one-fourth closer to the tower, resulting in asymmetrical clearance conditions. Signals reflected from the tower structure might arrive to the two antennas in *different* phase, which may cause total or partial cancellations, reducing or destroying the rear rejection capability of a well-designed and assembled horizontally stacked array.

Figure 4: Polar radiation pattern of a stagger stacked array



Practical considerations

Before applying the stagger stacking concept, verify the direction of the co-channel interference source with a computerized frequency coordination study. Table 3 is a computerized co-channel calculation for the reception of the desired Ch. 10, Philadelphia station. Observe the computer's instructions to protect the reception against Ch. 10, Providence, "Use stagger stacking." Checking the relative angle of Ch. 10, Providence (234.4° - 60.4° = 174°), we can see that it is clearly within the 172° to 188° range, acceptable for stagger stacking applications.

Table 4 shows the pertinent computerized co-channel study for the reception of Ch. 3, Hartford. While checking directions from road atlas charts or sectional aeronautical maps, one would conclude the interference arrives from the rear. The computer-calculated exact relative angle was 164.2°. That value is definitely outside of the acceptable 172° to 188° range. →

Table 3: Computerized co-channel calculation for reception of Ch. 10, Philadelphia

Channel	Call	Location	State	Network		Power (kW)	Offset	HAAT (feet)	Distance (miles)	Azimuth (degrees)	Rel. angle	CC spacing (")
10	WCAU	Philadelphia	Pa.	CBS	H	191	0	1,160	89.94	234.4		
Co-channel calculation												
10	WTEN	Albany	N.Y.	ABC	H	316	–	1,000	126.50	356.6	122.2	3H = 108.4
10	WJAR	Providence	R.I.	NBC	H	316	+	1,000	151.68	60.4	**Use stagger stacking**	
10	WTAJ	Altoona	Pa.	CBS	H	224	–	1,125	240.83	267.5	33.1	H = 55.9
10	WHEC	Rochester	N.Y.	CBS	H	316	+	505	249.90	311.2	76.8	3H = 94.2
10	WCBB	Augusta	Maine	ED	H	316	–	1,005	302.53	39.0	164.6	H = 114.8

Figure 5: Rectangular radiation pattern

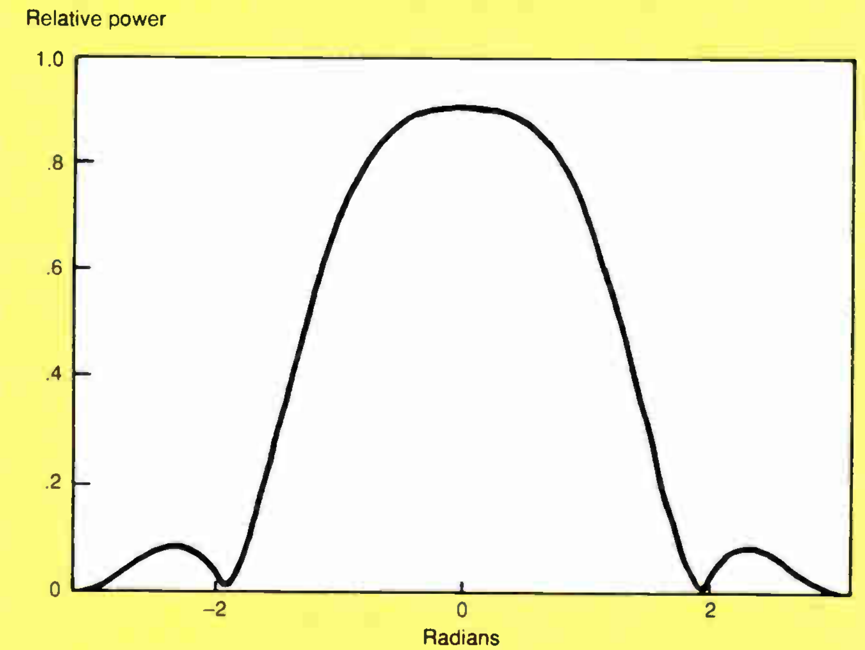
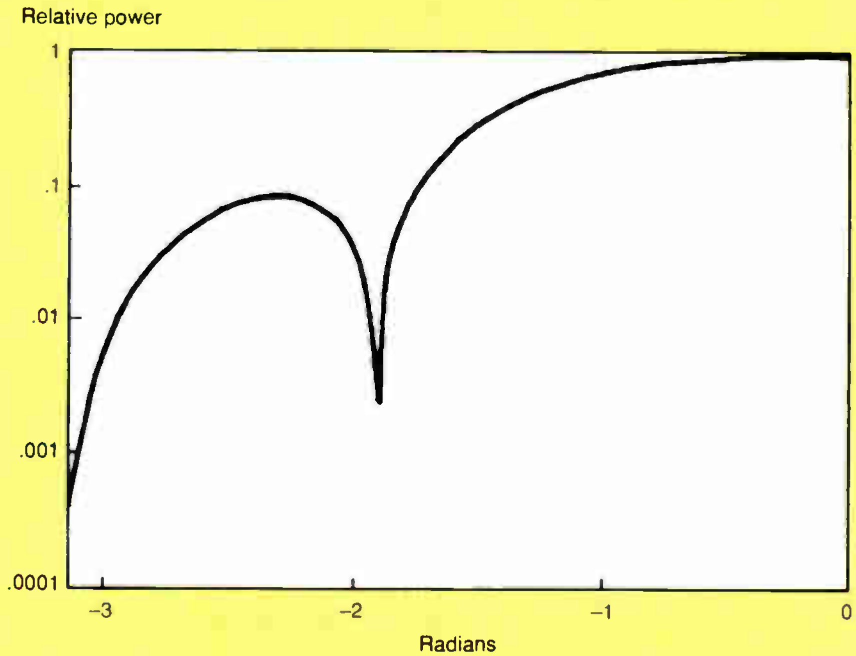


Figure 6: Rectangular format with logarithmic vertical scale



Stagger stacking may create more harm than good if the interfering signal arrives from a relative angle less than 172° or more than 188°. It is instructive to follow the development of the radiation pattern backlobes on Figures 4 through 6.

Figure 4 displays the *polar* radiation pattern of a stagger stacked array. There are two small backlobes in the rear. It is difficult to determine their relative angles and amplitudes, since the pattern in the rear is compressed.

When the same radiation pattern is converted to *rectangular* format (Figure 5) it provides a much better illustration of F/B conditions. Then, retaining the rectangular format but applying a *logarithmic (dB)* vertical scale (Figure 6), the radiation pattern shows a fast declining F/B, from an excellent 34 dB at 180° to a less than desirable 20 dB value at 164°.

Co-channel interference may arrive from more than one direction. A vertical stagger stacked quad-array can provide protection against two interference signals. The vertical stagger stacking will take care of the interference arriving from the back, while the horizontal spacing (H) will force a deep radiation pattern null into the direction of the other co-channel offender. Consider the Ch. 10, Philadelphia co-channel situation as presented in Table 3. The primary offender, Albany, arriving from a relative angle of 122.2°, should be rejected by the horizontal spacing of 108.4 inches. The secondary offender (Providence, from a relative angle of 174°) requires vertical stagger stacking.

For a perfect cancellation of the interference signals arriving from the rear:

1) The antennas must deliver identical signals. To verify, mount the correctly assembled antenna array on the tower. Check the received signal levels from the individual antennas. A variation of more than 2 dB is unacceptable. Similar signal level testing should be conducted by comparing readings from

the right vs. the left, or the top vs. the bottom bay of the array. Low quality hybrid combiners can offset delicate amplitude and phase relations between the bays, resulting in lower than expected signal levels.

2) Baluns, the 300/75-ohm impedance transformers, should provide exact and identical impedance transformation. On-site testing is the only way to ascertain that the supplier-delivered antennas are properly functioning. Check the individual antennas for impedance match 10 to 15 feet above ground. Antennas exhibiting lower than 14 dB return loss or sudden changes in response should be rejected. The testing of the assembled array should also display a flat frequency response and 17 to 20 dB return loss as measured at the input of the main (center) combiner.

3) Use the proper cable harnesses between the combiners and antennas. Apply short and equal lengths of jumper cable between the left/right and the center combiner. Cable harnesses must be precisely cut and assembled. The suggested tolerance on high-band is ±1/16 inch and ±1/4 inch on low-band.

When it comes to the final orientation process, do not neglect the tower effect. Antenna arrays are not operating in open space. Gates, the crossbars of the massive self-supporting tower, adjacent antenna arrays, etc., create reflections resulting in unpredictable phase shifts, which in turn can skew the radiation pattern null. Move the antenna gate slowly around the computer-calculated direction. Monitor the maximum signal level with the aid of a signal level meter, the rejection of the interference with a high quality spectrum analyzer and, last but not least, observe the picture quality on a large screen color TV receiver. **CT**

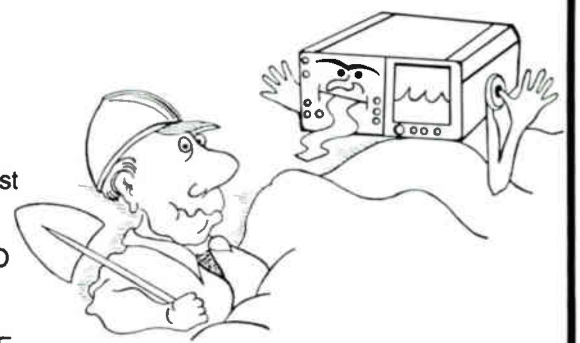


Table 4: Computerized co-channel study for reception of Ch. 3, Hartford

Channel	Call	Location	State	Network		Power (kW)	Offset	HAAT (feet)	Distance (miles)	Azimuth (degrees)		
Preferred station												
3	WFSB	Hartford	Conn.	CBS	C	100	+	904	86.06	38.8		
Co-channel calculation											**Rel. angle**	**CC spacing (")**
3	KYW	Philadelphia	Pa.	NBC	H	100	0	1,015	90.04	234.6	164.2	H = 354.9
3	WSTM	Syracuse	N.Y.	NBC	H	100	–	1,000	187.90	322.4	76.4	3H = 297.7
3	WPSX	Clearfield	Pa.	ED	H	100	+	880	240.19	276.7	122.1	3H = 341.5
3	WCAX	Burlington	Vt.	CBS	H	38	0	2,740	261.90	11.2	27.6	H = 208.4
3	WHSV	Harrisonburg	Va.	ABC	H	9	–	2,130	295.99	240.6	158.2	H = 259.9
3	WTKR	Norfolk	Va.	CBS	H	100	+	980	309.21	207.9	169.1	H = 507.8
3	CKVR	Barrie	Ontario	CBC		100	+	1,118	384.54	311.4	87.43	H = 289.5

Repairing Jerrold JLE line extenders

Last month's article described troubleshooting hybrids and quads using signal injection and its effectiveness when applied to the Jerrold JLE line extenders. Some other aspects of dealing with these amplifiers will be examined here, such as shortcuts when making repairs and the enhancement of product reliability.

By Jud Williams
Owner, Performance Technological Products

Failure-prone components used in the JLE amplifiers include bypass capacitors used along the AC path. They seem to fail at an alarming rate, so to replace them with the same value and rating as the ones installed during manufacture is simply asking for future trouble. All line extenders that come into our shop, regardless of age, have their bypass capacitors replaced with metallized polyester types rated at 400 volts. None have failed over the past five years, which attests to their reliability.

The electrolytic filter capacitor in the power supply stage is another component requiring frequent replacement. I suggest using a capacitor value of 1,000 microfarad at 65 V and a temperature rating of 105°C. It is best to replace them in all older amplifiers because electrolytics dry out over time, so their life expectancy is limited.

The fuse in older JLEs are in the wrong location so the power transformer is very prone to failure. In more recent models the problem has been corrected but since it is such a simple modification it may be worthwhile to upgrade those needing it. The objective is to situate the fuse between the secondary of the transformer and the rectifier. This is easily done because the fuse clips have solder lugs, making it a simple task to relocate several wires.

"Board shrinkage causes the input and output RF connectors to loosen and, unless they are tightened, frequency response suffers."

Look for what's loose

As the amplifiers age, much of the hardware begins to work loose. As an example, the screws holding the power transformer frequently vibrate loose. Board shrinkage causes the input and output RF connectors to loosen and, unless they are tightened, frequency response suffers. Response problems also are traceable to the small aluminum cover on the output end of the chassis if it is not firmly screwed down. It also goes without saying that the screws holding the PC board need to be tight to have good RF ground for a smooth response.

Occasionally, in the process of tightening these screws, one may break off. This is not to be ignored due to the necessity of maintaining the integrity of the RF ground. If not corrected, the response will degrade, particularly when the unit goes back into the field where it is exposed to the elements. The old screw must be drilled out and the hole retapped.

The choice of proper bit is important because it is necessary to drill out a steel screw embedded in soft aluminum. The recommended bit is a hardened chrome vanadium type, the kind that is said to "drill through anything." Select a 1/8-inch size and, for maximum control, use a drill press. The drill may be lubricated with ordinary rubbing alcohol so there is no oily residue, and the shavings brush off easily when dry. Retap the hole using an 8-32 tap lubricated with the alcohol. Finally, install an 8-32 screw. These operations should be done without removing the PC since the hole in the board acts as a guide for the drill.

To avoid unnecessary transformer failure, I advise removing the 30 V/60 V slide switch from the power supply board and soldering in a jumper so the unit is permanently set at 60 V. This modification prevents field techs from using the 30 V position to compensate for low AC voltage situations.

Readers wishing to contact me with questions or comments please feel free to call me at (404) 475-3192 or write to P.O. Box 947, Roswell, Ga. 30077. **CT**

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PLANT MGR, E, 45K	CH TCH, E,36K	LN TCH, TX, 9/HR
CH ENG, MW, 40K	REG CH TCH, E, 35K	SW TCH, NE, 12/HR
CH ENG, W, 42K	SERV MGR, W, 45K	HDEND/MICRO, E, 30K
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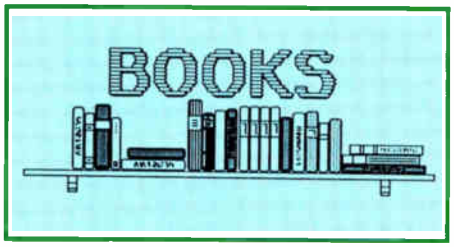

☛ *Cost-Effective Designs for Rural CATV Systems* by William Grant—An informative approach to rural cable TV system design and operation based upon the tapped trunk theory (single-cable distribution). Includes design specifications for four, eight and 12 taps per mile with up to 17 miles of cable and 45 amplifiers in cascade. Also provides guidelines to develop an effective cost estimate for rural cable build. Order #TM-1. Member: $10, non-member: $15.

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☛ *Practical Design of DC Power Supplies* by Joseph Carr, MSEE—Technical theory and data on DC power supplies for the technician and engineer. Includes basic information on the elements of a DC power supply, including transformers, rectifiers, voltage multipliers, filters, voltage regulators, overvoltage protection and current limiters. Also includes several specific DC power supplies. Order #TM-4. Member: $12, non-member: $17.

☛ *FCC Compliance Audit Checklist* by Neal McLain—This publication covers the requirements of Parts 17, 76, 78, 90 and 95 of the Federal Communications Commission rules as applicable to cable TV. Even though some changes have been made to the rules since the third printing of this manual, the information on system proof-of-performance tests is still useful in maintaining good technical standards. Order #TM-5. Member: $12, non-member: $20.

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January

Jan 14-18: Fiber Communications Corp. fiber-optic splicing and termination workshop, Sturbridge, Mass. Contact (800) 776-0518.

Jan 15-16: SCTE Appalachian Mid-Atlantic Chapter technical seminar on business procedures for technical personnel, distribution systems, fiber-optics for today and tomorrow, and data networking and architecture, Hilton and Towers, Harrisburg, Pa. Contact Richard Ginter, (814) 672-5393.

Jan. 15-18: Siecor Corp. technical seminar on fiber-optic installation, splicing, maintenance and restoration for CATV applications, Hickory, N.C. Contact Lynn Earle, (704) 327-5539.

Jan. 16: SCTE Dixie Chapter technical seminar. Contact Rickey Luke, (205) 277-4455.

Jan. 16: SCTE Ohio Valley Chapter, Ramada Inn, Columbus, Ohio. Contact Jon Ludi, (513) 435-2092.

Jan. 17: SCTE Heart of America Chapter, BCT/E examinations to be administered in Categories I, II, III and IV at both levels, American Cablevision offices, Kansas City, Mo. Contact Don Gall, (816) 942-3715.

Jan. 17: SCTE Wheat State Chapter technical seminar on fiber optics, Red Coach Inn, Wichita, Kan. Contact Mark Wilson, (316) 262-4270.

Jan. 17-18: SCTE Sierra Chapter, "Northern California Vendors Showcase" to feature tabletop displays and breakout training sessions, Party Palace Exhibition Center, Fairfield, Calif. Contact Steve Allen, (916) 786-2469.

Jan. 19: SCTE Cactus Chapter technical seminar on fiber optics, microwave and supertrunk technologies. Contact Harold Mackey Jr., (602) 866-0072, x282.

Jan. 21-25: Fiber Communications Corp. fiber-optic splicing and termination workshop, Sturbridge, Mass. Contact (800) 776-0518.

Jan. 22-23: National Cable Television Institute seminar on OSHA compliance for cable systems, Los Angeles. Contact Ray Charest, (303) 761-8554.

Jan. 22-25: Siecor Corp. technical seminar on fiber-optic installation and splicing for LAN, building and campus applications, Hickory, N.C. Contact Lynn Earle, (704) 327-5539.

Jan. 22: SCTE Florida Chapter, Gulf Coast Meeting Area, BCT/E examinations to be administered. Contact Keith Kreager, (407) 844-7227.

Jan. 22: SCTE New York City Meeting Group technical seminar. Contact Jim Demetrius, (212) 598-7339.

Jan. 23: SCTE Florida Chapter, South Florida Meeting Area, BCT/E examinations to be administered. Contact Keith Kreager, (407) 844-7227.

Jan. 23-24: SCTE Big Sky Meeting Group, consecutive meetings to be held Jan. 23 (Ramada Inn, Billings, Mont.) and Jan. 24 (Colonial Inn, Helena, Mont.) on equipment repair and VideoCipher repair. Contact Marla DeShaw, (406) 632-4300.

Jan. 24: National Cable Television Institute seminar on fundamentals of supervision for cable TV personnel, Los Angeles. Contact Ray Charest, (303) 761-8554.

Jan. 27-28: SCTE Old Dominion Chapter technical seminar and BCT/E and Installer examinations to be administered, Holiday Inn, Richmond, Va. Contact Margaret Davison-Harvey, (703) 248-3400.

Jan. 28: National Cable Television Institute seminar on fundamentals of supervision for cable TV personnel, Denver. Contact Ray Charest, (303) 761-8554.

Planning ahead

Feb. 11-13: SCTE "Technology for Technicians II" seminar, Howard Johnson Hotel, Sacramento, Calif. Contact (215) 363-6888.

Feb. 27-March 1: Texas Show, San Antonio Convention Center, San Antonio, Texas. Contact (512) 474-2082.

March 24-27: National Show, New Orleans Convention Center, New Orleans. Contact (202) 775-3669.

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

Reader Service Number 59

...Did you vote?

By Wendell Woody
President, Society of Cable Television Engineers

The Society of Cable Television Engineers' annual national election is in progress. All current paid-up national members have now received their election packages and ballots. Ballots must be returned by March 15 in your pre-addressed voting envelope. Don't procrastinate — vote today! Support your Society.

Strong leadership on the national board is paramount for future SCTE growth, benefits and support for you and your industry. Have you not received your SCTE election package? If not, perhaps you haven't kept the SCTE national headquarters informed of your current mailing address. On the other hand, has your membership expired? You can rectify both situations by merely telephoning the SCTE office at (215) 363-6888.

Now it's exclusive

Remember, beginning with this month's issue, *The Interval*, the newsletter of the SCTE, will become an exclusive publication sent to SCTE members only. It will no longer be included in *Communications Technology* magazine. The way to receive the all-new, redesigned, revised and updated monthly newsletter is to be an SCTE national member. If you have yet to do so, join now by calling (215) 363-6888.

A "technical" vacation

Plan now to attend this year's SCTE Cable-Tec Expo to be held at the Reno Convention Center, Reno, Nev., June 13-16, 1991. The convention hotel will be the Bally's Resort, Reno's largest hotel with over 1,800 guest rooms and seven restaurants. Adjoining the hotel is a modern RV and camper park.

Plan your vacation around the expo and bring the family. Reno is noted for its excellent accommodations, food and entertainment, all moderately priced. Include nearby Lake Tahoe as part of this "technical" vacation, too. Outstanding educational and technical programs are being developed for this year's expo. Exhibitors are increasing the number of hands-on demos and actual training in their booths. This show is a "must" for every CATV installer, technician and engineer. Start now and plan your "Reno or bust" trip!

Meeting the members

Presenting an overview of the SCTE certification program was part of my presentation on a technical panel at the recent eighth annual Private Cable Show at Caesar's Hotel, Lake Tahoe, Nev. This niche broadband communications industry is a strong supporter and advocator of technical training through its National Satellite Technology Institute under the direction of Steve Berkoff, director of education. A poll of

"Strong leadership on the national board is paramount for future ... growth, benefits and support for you and your industry."

those in attendance showed some SCTE members from all over the country. However, the number of technical people showing an interest in becoming active in SCTE programs was significant. Pete Petrovich, SCTE Region I director stated, "This show is certainly a large pool and good source for many new SCTE members."

Once again, SCTE developed and chaired the technical panels at the Western Cable Show in Anaheim, Calif. Members chairing panels were Steve Ross, Tom Colegrove, Dean DeBiase, Paul Venturella and Terry Mast. Other SCTE panel participants were Pam Nobles, Tom Elliot, Roger Keith, Tony Aukstikalnis, Bill Riker, John Wong, Al Kuolas, Gaylord Hart, Ron Hranac, Steve Necessary and me.

CT luncheon

For the second consecutive year, *Communications Technology*'s President and Group Publisher Paul Levine sponsored a luncheon at the Western Cable Show for the SCTE national board of directors and CableLab's staff. This is a worthy occurrence since it provided an opportunity for these two industry technical groups to be together. CableLab's support toward the SCTE in both training and standards is most significant for the Society's future position in the CATV industry worldwide.

Meanwhile, until next month, remember — vote and think Reno! **CT**

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Reader Service Number 61