COMMUNICATIONS TECHNOLOGY

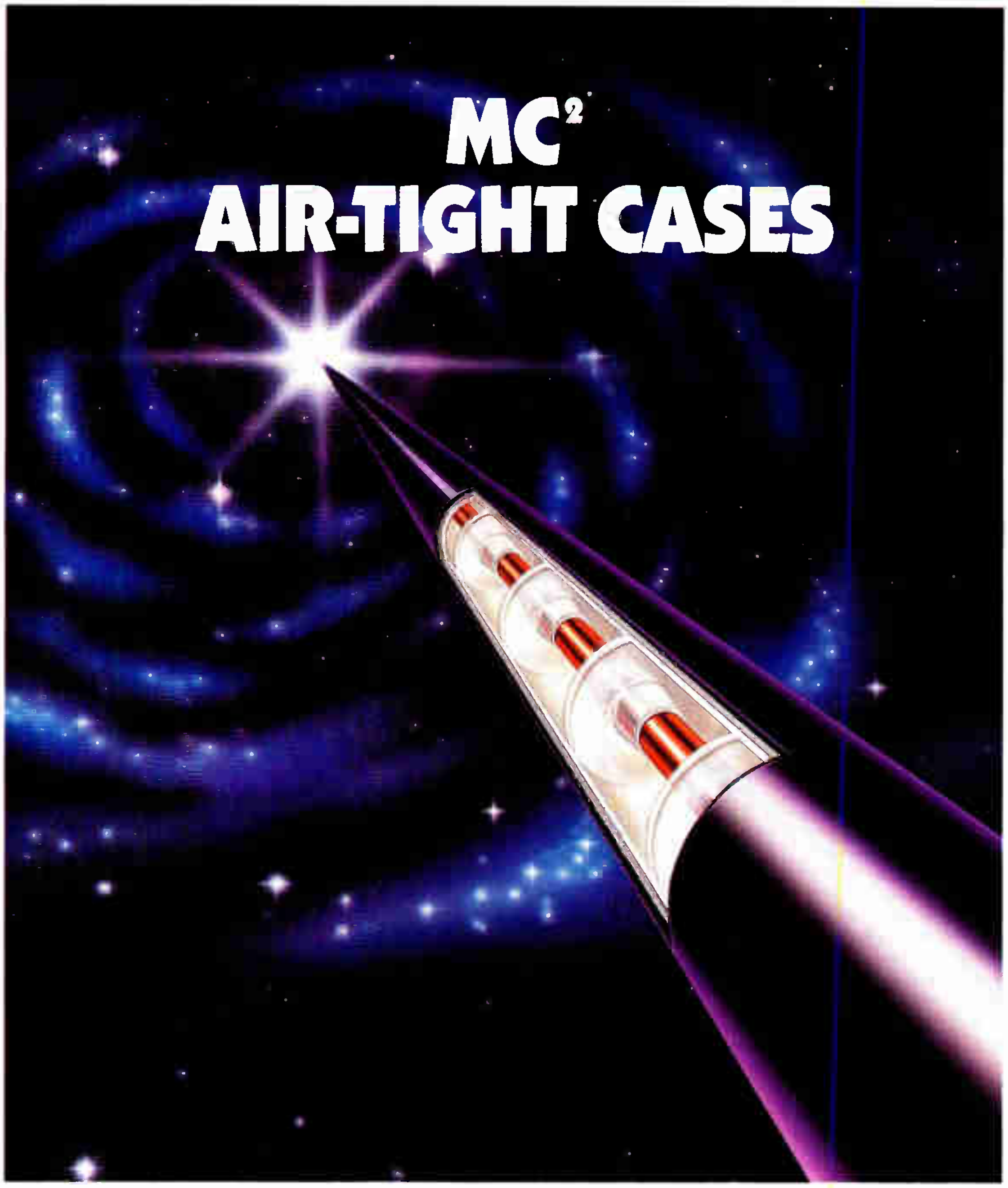
Official trade journal of the Society of Cable Television Engineers

Lab test: CADCO's new processor

Fiber: A close-up

RF design

September 1990



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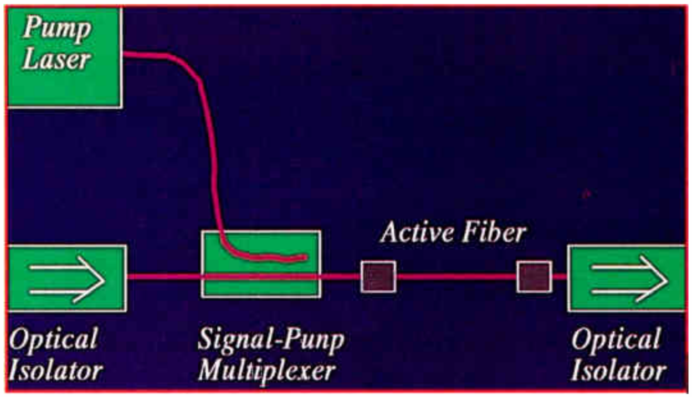

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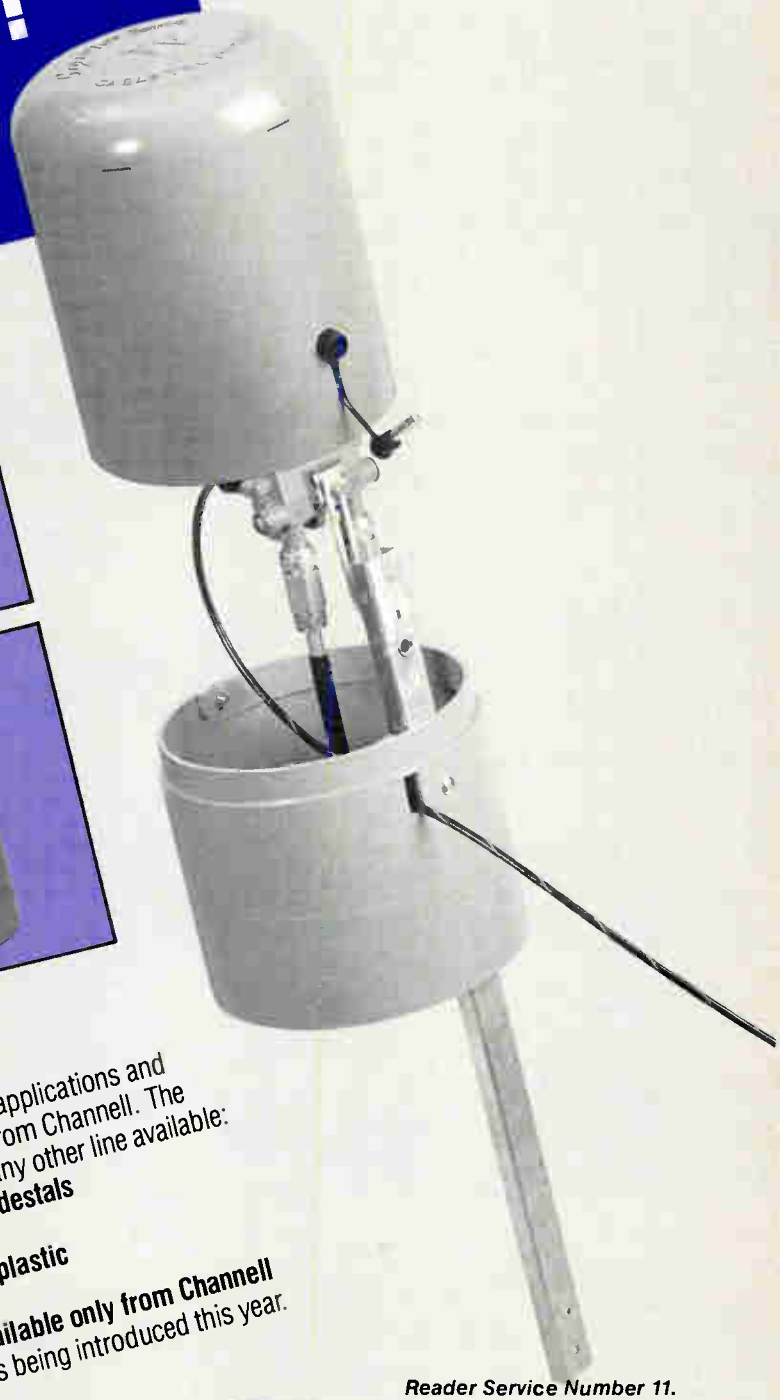

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RF spectrum chart

While interviewing for a Massachusetts cable company I noticed your "The RF Spectrum" chart on my interviewer's wall. It is the most complete and most up-to-date I have seen. I write you to find out the details on how to acquire a copy for myself. Thank you, and I look forward to your contact.

Marden L. Pride
Haverhill, Mass.

Editor's note: The chart is in the mail.

Faraday rotation

I read with interest your article "The Sun and Communications" (*CT*, March 1990). Cable television engineers are, of course, familiar with outages of satellite signals due to sun transits. Less familiar, but possibly also troublesome—particularly to facilities where both uplinking and downlinking occur from a single dish—is the phenomenon of Faraday rotation.

Faraday rotation occurs when an electric field propagates through an ionized medium; e.g., the ionosphere. The electric field vector is skewed relative to the orientation at which it was launched from the transmit antenna. The degree of skew, or rotation, is dependent upon both the frequency and the degree of ionization. During the solar maximum we are now experiencing, the rotation could be expected to be on the order of 2 or 3 degrees at 4 GHz. Of course, the rotation effect is less at night when the sun's radiation doesn't cause as much ionization.

For cable TVRO operators, this rotation typically means that the cross-polarization isolation of your antenna could drop by 10 dB or more, allowing the crosspole channels on the satellite to "bleed" into the desired signal. The obvious fix is to physically rotate the antenna feed by an amount equal to the Faraday effect. Unfortunately, when the sun sets, the feed would have to be rotated back. Thus, there is no "quick fix," but cable headend operators should be aware of the phenomenon.

The Faraday effect is direction-independent. That is, a signal propagating either upward or downward through the ionosphere undergoes the same *relative* direction of rotation. One consequence of this is that uplinkers have to rotate their feeds in one direction while downlinkers rotate in the other. This obviously creates a serious problem for transmit/receive stations using a single antenna, since correction for uplink rotation introduces a downlink polarization error that is more than twice as large.

Bob Weller
Satellite Specialist
Federal Communications Commission

Editor's note: The views expressed are those of the author and do not necessarily reflect the views of the commission.

Cover to cover

Just a word to say thank you and all your staff for providing such an excellent magazine. You know, yours is the only magazine I receive that is read as much as my fishing magazine. I read it cover to cover and, sir, that is saying something!!!

I would like to thank Mary Sharkey, your circulation manager, in particular for all the help she has been in ensuring *every* technical employee of Rogers Cablesystems here on the west coast of Canada receives your magazine. Well done, Mary!

Good luck to all at *CT* and keep up the excellent work.

Glenn Shield
Regional Technical Trainer
Rogers Cablesystems West

Cadweld

Congratulations on doing such an excellent job with the article "How to Cadweld ground connections" in the May issue of *Communications Technology*. We have received several calls already from interested systems.

In the future, it may be worthwhile to do another article on lightning or indoor facilities grounding.

Thanks again.

Richard E. Singer
Cadweld Product Manager
Erico Products Inc.

A plus for students

I am the technical trainer for the Paragon Cable system in San Antonio. As I have new students come through my classes, I have those interested fill out a request.

Please accept these requests for the *Communications Technology* magazine.

I enjoy your magazine and I am sure your new readers will also.

John C. Lanier
Technical Staff Trainer
Paragon Cable of San Antonio

A training tool

I wish to take this opportunity to thank you for your assistance in helping me locate and obtain the series of articles from *Installer/Technician* on "Basic Electronics Theory." The arrival of the material was a pleasant surprise, only one week after the initial inquiry was made!

Installer/Tech (now "Back to Basics" in *CT*—Ed.) as well as the other CT publications, have become a "must read" for our technical/engineering departments as both a training tool and a reference source.

Your fine efforts reflect on CT Publications as a whole.

Sean Stewart
Field Engineer
FSN Cable TV

Frank Winship (left) of Anixter Cable TV installs a fiber training system at the Continental Cablevision Regional Training Center in Portsmouth, N.H. The Laser Link system is installed in the training center lab, where a fiber system was recreated for training purposes. Kevin Casey, Continental's director of engineering, and Joel Welch, technical training manager, (right) inspect the new equipment.

Soft market leads to layoffs

ATLANTA—In a soft economy compounded by anxiety over reregulation issues, several cable TV equipment suppliers are laying off workers and others are cutting back production. Scientific-Atlanta laid off 25 full-time employees in its broadband division, 100 part-time workers and some 43 workers in the electronics systems group. Elsewhere, Gilbert Engineering in Phoenix let 47 workers go and Comm/Scope is "rotating" week-long, voluntary layoffs among 25 workers per shift at its Hickory and Catawba, N.C., plants. C-COR laid off about 90 employees at its State College and Altoona, Pa., plants.

S-A officials tie their layoffs to a need to "reduce production costs." Greg Couch at Comm/Scope, which added 250 workers last fall, said "trepidation" over reregulation, as well as credit-market crunches, are impacting cable system operators' building plans. "We just have to pull back our production capacity for now," Couch said.

At Magnavox's cable division in upstate New York, several production lines working on the company's Series V equipment may soon go to four-day, eight-hour/day work weeks, even though company officials say 1990 will be a record sales year. Magnavox's Vice President Michael Senken said, "All this talk about rereg and HLT (highly leveraged transactions) restrictions is affecting the domestic market." He said it's too early to tell if Magnavox may have to lay off anyone. No cutbacks have been announced at Pyramid Industries in Phoenix, but its Vice President Steve Youtsey says, "If the (current market) trend continues, we'll have to re-evaluate our position."

CableLabs announces battery, ATV research

BOULDER, Colo.—Cable Television Laboratories, United Artists Cablesystems and Shelley-Ragon are jointly conducting tests of the lifespan of batteries used by cable systems as standby power supplies. The 10-week testing will try to determine the life expectancy of batteries tested, the degradation each battery suffers, if conditioning affects battery life, and the data needed to be able to compare different batteries. The final product of this experiment will be information depicting battery life, weight loss and thermal runaway, and the relative effect of conditioning.

In another announcement, CableLabs and the Public Broadcasting Service reached an initial agreement to conduct joint field demonstrations of advanced television (ATV) systems in several U.S. cities. Data from this project will support the deliberative process underway by the Federal Communications Commission's Advisory Committee on Advanced Television Service. CableLabs committed to spending more than $4.1 million on this committee's testing process, including $2.5 million it agreed to spend with the Advanced Television Test Center in Alexandria, Pa.

The joint CableLabs-PBS demonstration's purpose is to show, in a real life setting, the end-to-end systems needed to distribute ATV signals as well as to demonstrate to the U.S. public what it will receive in ATV. CableLabs and PBS also are testing over-the-air correction methods for eliminating reflections and other artifacts from the broadcast signal, thereby continuing the high quality characteristics of PBS transmissions.

Finally, CableLabs is issuing a request for proposals (RFP) that will help cable operators improve the level of satisfaction that subscribers have with cable system and service, while at the same time improving that system's financial performance. This is part of CableLabs' Optimized Systems Operation (OSO) project and is sponsored by the CableLabs Technical Advisory Committee's Operations Subcommittee. This project will define and prioritize the opportunities cable systems have for improving customer satisfaction, identifying and choosing cost-effective innovations that address these opportunities, and then distributing the results to CableLabs members.

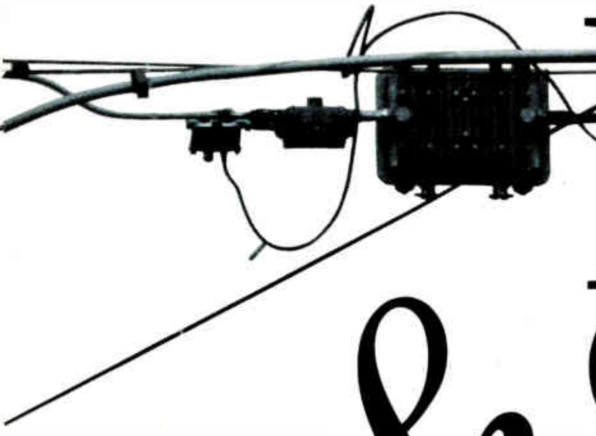
TCI, Columbia order S-A equipment

DENVER and ATLANTA—In Denver, Tele-Communications Inc. and Scientific-Atlanta jointly announced that TCI will use S-A's addressable interdiction technology in its single dwelling unit configuration in several of TCI's cable systems. Interdiction allows cable operators to addressably control the delivery of programming to the subscriber without the need for additional electronics in the subscriber's home. The two companies will finalize the details over the next several months on where the technology will be used initially.

In Atlanta, S-A received a major order for distribution equipment from Columbia International for its Woodbridge, Va., system. The 550 MHz type "FT" feedforward trunk amplifier distribution equipment will be used to rebuild and upgrade a 750-mile system in eastern Prince William County, Va. Installation is expected to be accomplished over a five-year period, with approximately 65 percent of the plant located underground. The Woodbridge system plans to upgrade further by integrating fiber equipment eventually.

C-COR unveils facility plans

STATE COLLEGE, Pa.—C-COR announced it will construct a new manufacturing plant adjacent to the existing building here. The facility will house the manufacturing functions, engineering support



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- ❑ Amplifier Basics, Power Supply Options, Spacing
- ❑ Amplifier Technology (Feed Forward, Push-Pull, Power Doubling)
- ❑ Antenna Theory, Co-Channel, Path Problems
- ❑ BCT/E Certification Review Courses
- ❑ BTSC Stereo and Audio Over Cable
- ❑ Baseband Video and Audio Signals
- ❑ Cable System Design (CAD)
- ❑ Coaxial Cable Theory and Basics, Impedence, VOP
- ❑ Construction Techniques - Aerial and Underground
- ❑ Developing Marketing Skills in System Installers and Technicians
- ❑ Digital Services Via Cable
- ❑ Distortions of CATV Pictures and Methods for Correction
- ❑ FCC Update, Technical Deregulation
- ❑ Fiber Optics - State of the Art Today
- ❑ Grounding and Bonding (NEC)
- ❑ Headend Maintenance
- ❑ High Definition Television (HDTV)
- ❑ Improving Installation and Service Skills
- ❑ Interfacing Cable with Consumer Equipment
- ❑ LANs (Design and Operation)
- ❑ Local Origination - Studio Design, Commercial Insertion Equipment
- ❑ Long Haul Transmission Options: AM/FM Microwave Supertrunk, Fiber Optics
- ❑ Management Skills for Technical Personnel
- ❑ OSHA Rules and Regulations
- ❑ Pay-Per-View Hardware
- ❑ Pay TV Security Options, Available Hardware
- ❑ Proof of Performance Testing
- ❑ Satellite Signal Scrambling Basics
- ❑ Satellite Technology, Reception, Processing
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- ❑ Other (specify): ________________________________

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services and field service personnel. It will total 46,000 square feet. Plans will be submitted to the State College Township for approval and construction is expected to begin in fall 1990 with completion planned for spring 1991. The company plans to pave the unfinished portion of Decibel Road up to Carolean Drive as well as the unfinished portion of Carolean Drive. Cost for the entire project is expected to be $2.75 million.

In a joint announcement, C-COR and COMLUX said they will provide NewChannels with a 42-channel digital fiber-optic system. This is part of NewChannels' overall upgrade to a 60-plus channel capable system to cover 37 miles. According to the companies, this contract will make NewChannels the first traditional cable system to install digital fiber trunking for CATV applications. The system will use the C-COR/COMLUX 3583 and 3584 optical transmitters and 3803 and 3804 encoders and decoders.

Comcast enters U.K. cable venture

PHILADELPHIA—Comcast announced it entered into agreements with the U.K.-based Birmingham Cable Co. Under the agreement, Comcast will participate in the construction and development of a cable TV and telephone systems in Birmingham, England. The company has entered into similar agreements with US West, an existing shareholder of Birmingham Cable.

Comcast will be an equity investor in Birmingham Cable and will provide cable management and consulting services. Birmingham Cable covers about 460,000 homes and 40,000 businesses.

CCTA urges FCC to audit Pacific Bell

OAKLAND, Calif.—The California Cable Television Association (CCTA) filed "Comments and Request for Audit" with the Federal Communications Commission to review Pacific Bell's books to determine if cross-subsidy has taken place in the operation of its broadband distribution facilities in Palo Alto, Calif.

When Pacific Bell constructed the Palo Alto facility, the FCC's chief of the common carrier bureau stated, "We will require Pacific to maintain separate books of account for its broadband channel service to assure that any cross-subsidy will be apparent."

The telco has recently requested a waiver to be allowed to discontinue leased channel service over its broadband facilities in the city in order to sell its facilities to its channel lease customer, the Cable Community Cooperative of Palo Alto Inc. The CCTA argues that the time is right to take a closer look at the experiment. Alan Gardner, vice president of CCTA said, "Not only does the commission have a perfect opportunity to determine if cross-subsidy from telephone ratepayers for this channel lease delivery system took place, but this case could also assist the FCC in looking at the issues of telco involvement in cable generally. We're urging the commission to seize this important opportunity."

Interactive TV tested by ACTV Corp.

SPRINGFIELD, Mass.—ACTV Domestic Corp. began a market evaluation in April of its interactive TV system in 300 homes served by Continental Cablevision here. During the evaluation, ACTV provided 100 hours of interactive programming to the randomly selected homes each week for four weeks.

This new technology allows viewers to become involved in the TV program and actually lets the user vary the content of the program itself. Using a small device similar to a standard TV remote control and a cable converter incorporating patented technology, a viewer can respond to questions from the TV set, make choices (such as the difficulty of an exercise show), play games (such as on-screen blackjack) or choose a camera angle during such events as concerts or sporting events.

Malarkey-Taylor conducted research on audience reaction to the ACTV interactive programming during the Springfield evaluation period.

- Superior Electronics Group is providing on-site demonstrations of its Cheetah system at the Eastern Show in Washington, D.C. It will be available for general release at the beginning of next month. The system, with the HE-4650F (headend) and PC-4650D (line) monitors driven by analytically oriented software, provides the user insights into the operational integrity of the cable plant.
- Lightning Master was awarded a patent for its full line of PP Series static dissipators and UL-listed static dissipating air terminals. Once installed, the LMC dissipators are said to have the capability to minimize static ground charge accumulation, reducing and controlling static build-up during electrical storms.

Distribution system evolution

This article addresses the likely evolution of the CATV distribution system over the next 10 years. Further developments in RF technology as well as the integration of fiber-optic technology into the distribution plant is discussed. The emergence of international CATV markets and the influence of these markets on the architecture evolution also is included.

By Geoffrey S. Roman
Vice President of Marketing
Jerrold Distribution Systems Division

The average CATV distribution system in the United States today was designed to carry 35 to 40 channels and deliver a carrier-to-noise ratio of 40 to 45 dB at the subscriber's TV set. The key word is "designed," since the typical system has been expanded after the original design was completed yielding performance at the "worst case" subscriber location that may be as much as 10 dB worse than the original design goals. Similarly, the typical system design goal is for −49 to −52 dB composite triple beat (CTB) with worst case performance being significantly below the design goal.

Today's systems consist of trunk cascades of 20 to 30 amplifiers or more followed by a bridging amplifier and two to three line extenders, each of which contributes to a degradation of system performance. While each of these amplifiers is typically quite reliable—with a mean time before failure (MTBF) of 35 to 40 years—the cascade may have a combined MTBF of approximately a few years or less. Add to this the fact that each of these requires power and this power must be inserted at several points along the cascade, and it's easy to see that today's architecture helps fuel customer dissatisfaction.

The CATV system of the not too distant future will deliver 80-120 channels or more as well as some form of high definition TV (HDTV). In fact, technological advances now in development can very shortly remove bandwidth constraints entirely from the planning equation. Channel carriage would then be determined solely by the availability of programming and the consumer demand for that programming. Coupled with additional channels, the system will be called upon to deliver improved noise and distortion performance. Likely design targets are 48 to 51 dB for carrier-to-noise ratio (C/N) and −55 to −57 dB for CTB. In addition, the demand for improved reliability must be addressed through shortening the cascade of equipment required to reach the subscriber. Both fiber optics and enhanced RF equipment performance play critical roles in achieving these goals.

Figure 1: Fiber-optic supertrunk architecture

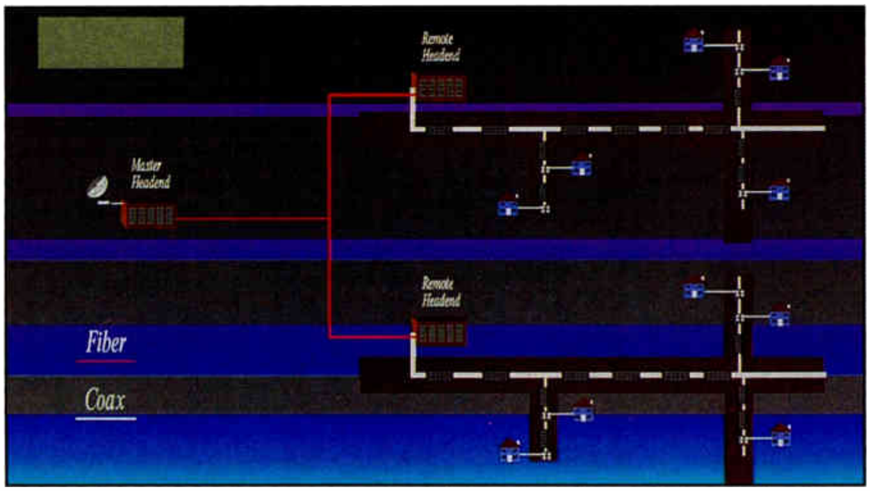
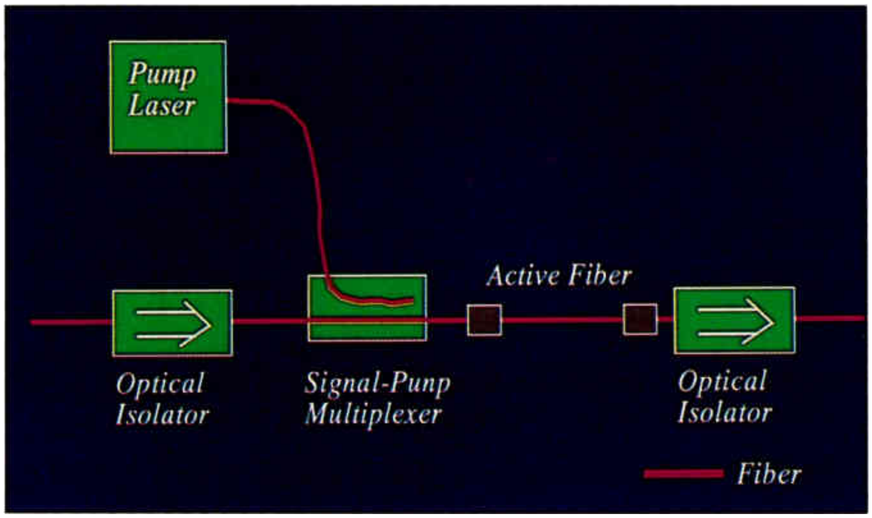


Figure 2: Generic fiber-optic amplifier



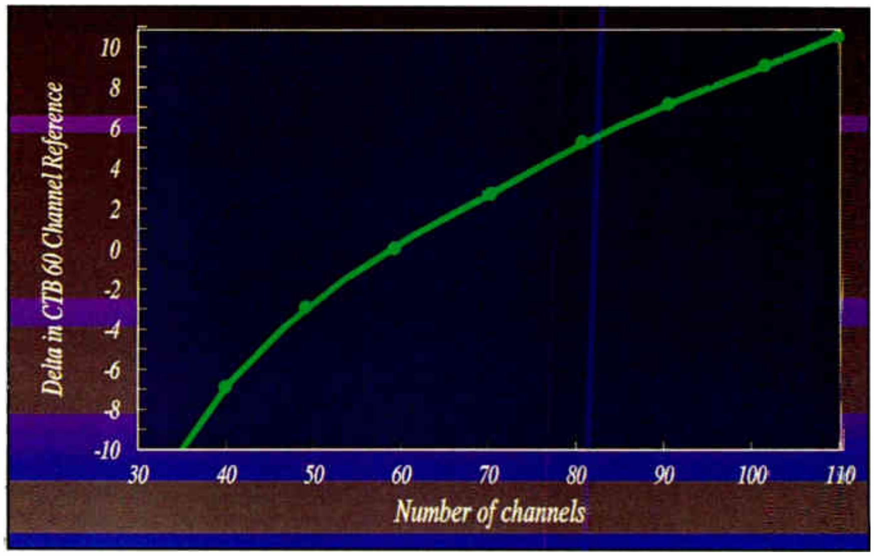
Fiber optics

Fiber optics is a major key to effect an evolutionary upgrade of existing broadband plant. It eases the task of bandwidth expansion to provide additional channels of video programming and other communications services. Optical communications also provides improved picture quality and service reliability. It further allows the investment associated with system improvements to be made incrementally as it makes sense from an economic standpoint.

Fiber optics has developed into a medium for CATV distribution in an evolutionary manner over the last five years. Supertrunking, although some installations occurred as early as the late 1970s, has become a routine "component" of system architecture since 1985. Fiber-optic trunking (backbone architecture) was developed in 1987 and now is becoming a common tool to reduce the length of trunk amplifier cascades. This evolution to

"It is likely that RF distribution into the home will remain a preferred...technology for another 20 years or more."

Figure 3: CTB vs. channel loading (relative to 60 channels)



shorter cascades is expected to continue. Projected technological developments during the next 10 years are expected to make a fiber-to-the-tap architecture economically viable, at least in some applications.

The supertrunk architecture shown in Figure 1 has been driven by a number of factors such as regional consolidation of MSOs and the desire to simplify the remote or slave headends. Fiber-optic supertrunks also have been used to eliminate and/or provide backup to AML microwave particularly in those areas subject to rain fade conditions. Supertrunks typically accomplish the signal transportation with minimum degradation. Such links are often said to meet RS-250B short-haul or medium-haul specifications.

Frequency modulation is the norm today for most supertrunk applications. Links of 25 to 40 miles are achievable with signal-to-noise performance of 60 dB or better. Transmission is usually accomplished with 16 channels per fiber and each channel occupying a 40 MHz bandwidth. Terminal equipment costs $4,000 to $6,000 per channel. FM technology is the technology of satellite video communication and is thus at a mature state of the art. Major cost reductions are not likely without sacrificing performance.

Digital modulation is rapidly becoming cost-competitive with FM. Nine-bit digital systems offer performance equal to the best FM systems, but without analog FM's requirement for alignment and adjustment. Further, digital systems offer the ability to span unlimited distances with repeaters. Digital modulation requires data rates in excess of 100 Mb/s (uncompressed) yielding typically less than 16 channels per fiber. Technology is advancing rapidly and there is significant opportunity for cost reduction.

The new distributed feedback (DFB) lasers developed for trunk applications also have implications for AM supertrunking. Such links can span from 15 to 25 miles while achieving carrier-to-noise ratios ranging from 54 to 59 dB. Although this is lower than FM or digital performance, it is competitive with RF-based transmission and AML performance with a cost of $2,000-$2,500 per channel, and using 10 channels per fiber, this is significantly lower than FM or digital approaches. Distortion performance includes immeasurable composite second order (CSO) and −70 dB CTB. Laser technology is advancing and should yield cost reductions in the mid-term horizon.

Reducing amplifier cascades

The second step in the fiber-optics evolution is the use of the technology to reduce the cascade of amplifiers serving a customer. This improves both picture quality and subscriber reliability. However, the total number of RF devices in the system remains unchanged. Backboning, as this approach is called, also simplifies bandwidth expansion since the technology (performance) requirements of individual amplifiers is reduced along with the length of the cascade. This complements programs to upgrade the RF distribution components to accommodate frequencies as high as 1 GHz since the performance achievable in the near term is not acceptable for full channel loading in long cascades.

Although several analyses have been performed that propose taking system architecture to cascades of four to six trunk amplifiers, such architectures have not yet been deployed on a widespread basis. The deployment has been limited by the cost and availability of lasers and the associated receiver components. The backbone concept has been used on a more limited scale by a number of systems. These systems have used the technique to address specific system problems such as extremely long cascades or extension of plant beyond original design areas.

Backbone systems typically employ amplitude modulation because its compatibility with existing plant simplifies and reduces the physical size and complexity of the node. Electronic equipment typically costs under $500 per channel per link. The laser technology has improved significantly in the last 18 months as shown in Table 1 and laser costs for the highest quality available have remained constant and even declined in some cases. The combination of these factors has made optical splitting feasible. Optical splitting allows a single optical transmitter unit to serve more than one link lowering the electronics cost per link. Table 2 shows an example using a $30,000 transmitter cost and a $10,000 receive node. Link savings with splitting are even more significant as the ratio of transmitter to receiver cost increases. Increased transmitter power yields greater splitting capability, that is to say that more splitters can be handled by a single transmitter.

Optical amplifiers will make it feasible to extend the backbone concept further by increasing the number of nodes that can be served by a single transmitter. The use of optical amplifiers makes architectures such as fiber-to-the-feeder and optical tree-and-branch possible. The optical amplifiers and passives also can be clustered allowing for a cellularized distribution

(Continued on page 46)

CATV for the '90s: Fiber and a vision for the future

The following is adapted from a speech given at Cable-Tec Expo '90 in Nashville, Tenn.

By Jim Chiddix
Senior Vice President of Engineering and Technology
American Television and Communications

In thinking about the upcoming decade, cable TV can compare where our industry is today to where the railroads were at the turn of the century. At that time the railroads were in their golden age, putting rails across the nation. I think the people in our industry are very much like those people who spent the 1890s and the first decade or two of this century building railroads, surveying lines through the mountains and engineering that network. We have a different kind of network but we are evolving very rapidly in the same way the railroads did. I will leave it to you to figure out who the robber barons are today.

We need to know whether we are "in the 1890s" and have all that growth ahead of us, or whether we are "in the 1950s" with business becoming grim in another decade or so. I think a lot of that is up to us —much of it has to do with the decisions we make today. But it is very important that the decisions we make each month and each year are all aimed toward something that is much longer term.

Today's decisions

We all have to make some of those decisions. We've got to renegotiate our franchises. We agree to add more channels, more services, more public access, etc. The way in which we undertake these upgrades is very important. We can patch things together and get some higher gain modules and add a few more channels to our systems. That's OK, but when we start making major investments, if we box ourselves in and build brand new, all-coaxial systems, I think we are really missing the boat. I don't think that fits into where we are going to be in five or 10 years.

Let's take a look at the way we have structured our systems and what that means. The basic elements of our system are the headend, the supertrunks and microwave links, the trunking network that feeds out into individual neighborhoods, the feeder (which is the last mile to the home) and then the drop and home wiring. Looking at our investment, we've got perhaps $17 per subscriber in the headend, maybe $4 in supertrunks and microwave links, $50 in trunks, $194 in feeder and $70 in drop and house wiring for a total historical investment of about $335 per sub.

Now let's explore the performance of those network elements in terms of signal-to-noise ratios. (The basis for this is work done by Tom Elliot of CableLabs and is shown in Figure 1.) The headend gives us maybe 48 or 49 dB. That number is limited by the carrier-to-noise ratios developed by our satellite receiving dishes and by the other equipment in the headend. The supertrunks are very high quality in terms of video performance, but the trunks aren't so good. All those amplifiers in cascade add a lot of noise, yielding about 47 dB (and we have all seen worse). Feeder is pretty good, in terms of noise at least: it is well into the 50s. In the home, we have a converter that may be 45 dB or less. Add all of these together, and we are at about a 41 dB video signal-to-noise ratio in the transmission path from the programmer's studio to the subscriber's display. And that's not great.

There are two obvious targets for improvement here. One is the headend, which contributes a lot of noise to our systems but can be improved in a variety of ways. We could change satellite modulation technology or switch to terrestrial fiber program distribution. We could get that number well up into the 50s with larger dishes and lower noise LNAs. That's worth some thought but that's a

(Continued on page 53)

Figure 1: Signal-to-noise ratio contribution

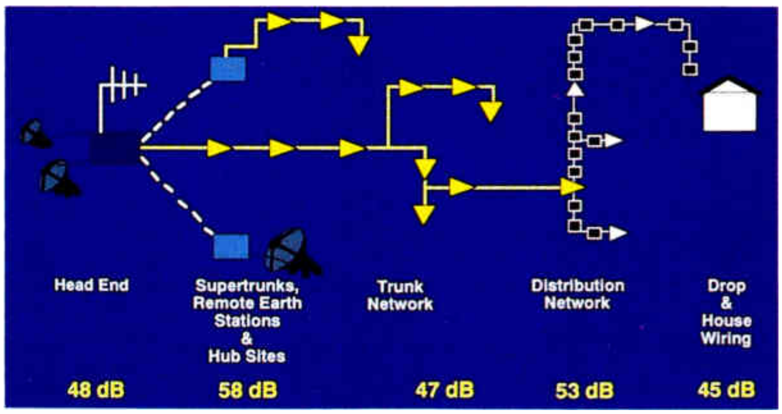
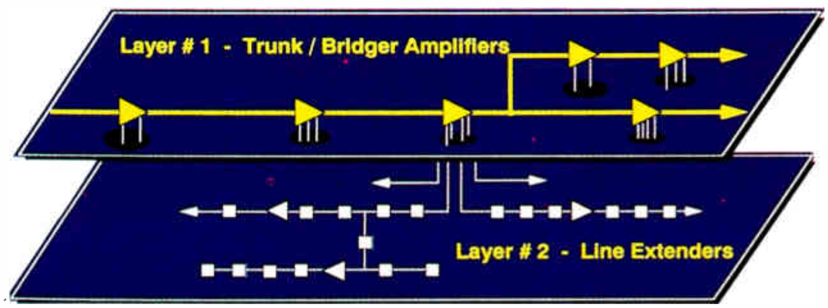


Figure 2: Conventional coax plant architecture



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Reader Service Number 18.

Broadband AM lightwave transmission systems

The CATV system engineer must constantly evaluate the impact of new or improved technology. Information in the form of device and systems specifications, costs, life-cycle costs and environmental constraints flows into the marketplace constantly. The rapid evolution of AM lightwave technology over the past 18 months has added to this burden the introduction of new terminology, new applications architectures and capabilities that in many cases did not exist with prior technologies. The focus of this article is to review the well-defined design parameters of a generic AM link, highlighting key device and system parameters that CATV engineers often see in specifications or data sheets. It will discuss practical trade-offs in using those specifications with regard to their relationship to the fundamental physical properties of the devices and look at what has been achieved in the past year.

By Carl J. McGrath
Supervisor-CATV Lightwaves, AT&T Bell Laboratories

Two equations useful in an AM link performance discussion are 1) carrier-to-noise ratio (C/N) and 2) linearity (input to output as a polynomial expansion):

$$C/N = 10\log\left(\frac{\frac{m_i^2}{2} P_{recv} \times \eta}{\overline{i^2_{FE}} + \overline{i^2_s} + \overline{i^2_{RIN}}}\right) \quad (1)$$

Where:
m_i = index of modulation, channel i
η = receiver efficiency
P_{recv} = CW power incident on receiver
i_{FE} = input noise current of front end
i_s = shot noise
i_{RIN} = total relative intensity noise (RIN)

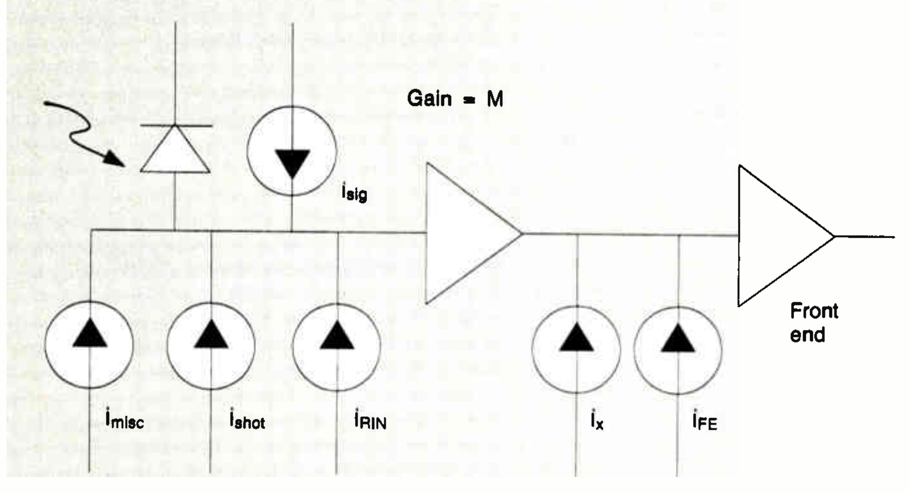
$$E_{out} = a_1E_{in} + a_2E^2_{in} + a_3E^3_{in} \quad (2)$$

Where the input to the system is a sum of sinusoids (carriers):

$$E_{in}(t) = E_{cw}\left(1 + \sum_{i=1}^{N} m_i\cos(\omega_i t + \phi_i[t])\right) \quad (3)$$

Where:
ω_i = carrier frequency, channel i
$\phi_i[t]$ = phase variation of carrier frequency, channel i

AM receiver performance model



Index of modulation

Index of modulation (m) represents the only obvious coupling between Equations 1 and 2. The absolute levels of intermodulation distortion remain to be determined for each device uniquely, by appropriate composite second order (CSO) and composite triple beat (CTB) measurements. The "normal" interdependence between intermodulation distortions and index exists for lasers in their normal region of operation, that is a 1 dB increase in m results in a 1 dB decrease in CSO and 2 dB in CTB.

In general, the optimum level for each laser device must be determined by evaluation. Devices typically operate with m set near the value at which the amplitude of the composite modulation signal exceeds full power—10 dB with 0.1 percent probability. For 42 random phase carriers, this value of m = 4.4 percent. Saleh[1] has derived a theoretical maximum value for m that represents the fundamental limit for modulation index. His results, based on seeing a laser as an ideally linear device above the threshold current, generally predict results that are 2 to 3 dB better than values generally achieved by actual tests, implying that linearity improvements, permitting higher modulation index, offer moderate additional potential for carrier-to-noise improvement.

Receiver efficiency and received power

Receiver efficiency (η) is a measure of a packaged device's accuracy in converting light incident on the pigtail (or connector) into current flow. Values of 1.0 mA/mW with high performance packaged devices are typically achievable. Variations in this parameter affect the overall loss budget since poor efficiency results in less than

(Continued on page 58)

ENTER THE ERA OF CATV OPTICAL TRANSMISSION AT YOUR OWN PACE, in your own way. OptiFlex AM 1000 is the only RF optical trunking system that can be used for standard coaxial trunking or for optical trunking. That means you can upgrade your current system to a full-featured second generation system now, then convert to fiber optic capability when the time is right for you. Upgrading to optical transmission is as simple as installing optical fiber and adding plug-in optical receiver modules.

START SMALL, GROW STEADILY. You can start with one optical receiver (42 channel capacity) and add up to three more as you need them. Status monitoring, extended bandwidth capability, and trunk amplifier choices also stretch your system's configuration possibilities.

COUNT ON STATE-OF-THE-ART FEATURES, no matter which system you choose. No other system on the market features dual output trunk ports and multi-functional local or remote status monitoring. Plus, with a redundant signal path configuration, OptiFlex AM 1000 can maintain the coaxial path as a backup to the primary optical signal.

To learn more about the flexibility of OptiFlex AM 1000, contact Augat Communications Group, P.O. Box 1110, Seattle, WA 98111. Call (206) 932-8428 or toll free 1-800-336-3526.

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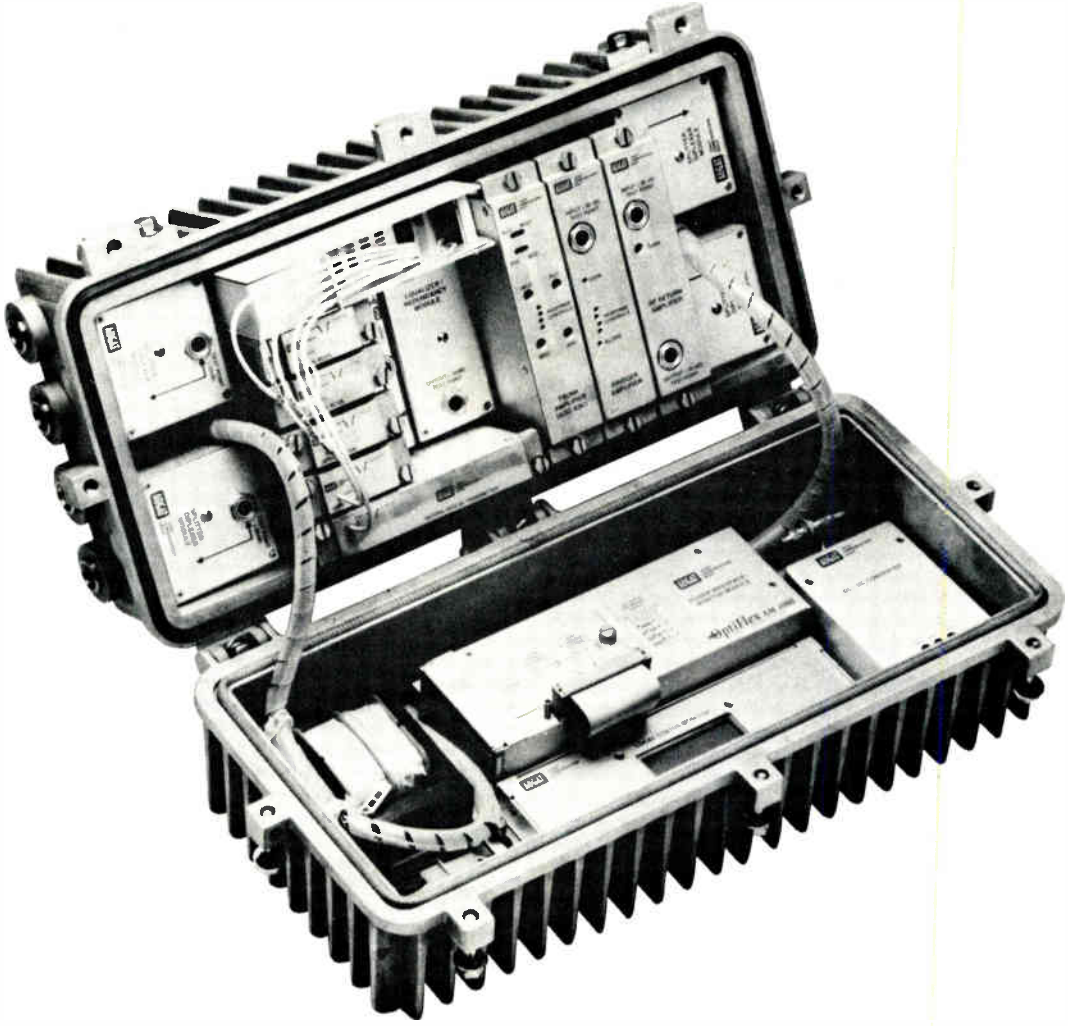

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Reader Service Number 72.

Surviving with fiber optics

By James E. Hayes
President, Fotec Inc.

And Al Bierman
Product Manager, Optical Networks International

Most of the articles you've read on fiber optics relate to network planning, system architecture, component choices, installation procedures and the like. But what happens after installation, when the installers have gone home and the electronics are in and running, and you're left all alone with this new system?

What goes wrong?

Not much is likely to go wrong, thankfully. One of the biggest selling points for fiber optics has been its amazing reliability. The cable is rarely a problem, except for "backhoe fade," the term used for cuts during construction around the fiber-optic cables. We have heard of a few systems that have failed during very hot or cold weather, when thermal stresses have caused splice failures or higher loss, but this is extremely rare.

The fiber-optic laser transmitter is the most highly stressed component in the whole system. It is driven by a fairly large electrical current and has to use a thermoelectric cooler to keep the laser temperature steady within reasonable limits. In addition, these lasers are like light bulbs, and burn out after time. But the time frame is 100,000 to 1,000,000 hours, so it's a very long time. Besides, the transmitter is usually in a very benign building environment.

The receiver, on the other hand, may be up on a pole or in a pedestal near the end user, subject to the full impact of the environment. However, photodetectors and receivers are very reliable and are often the most trouble-free component of the fiber-optic link.

The fiber-optic power meter is the most basic instrument. The laser source is used only for loss testing.

"The secret to good performance is exactly the same as with a purely electrical system: maintaining an adequate signal-to-noise ratio."

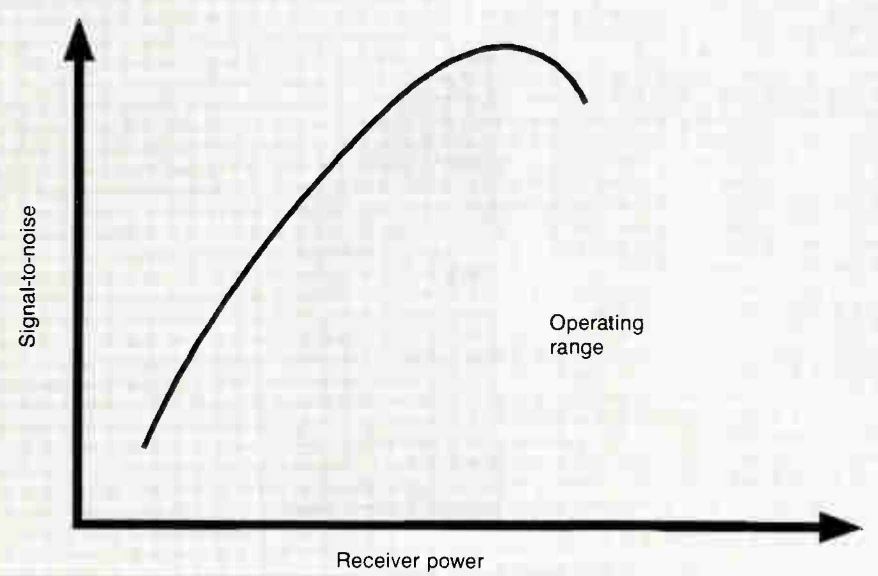
The secret to good performance is exactly the same as with a purely electrical system: maintaining an adequate signal-to-noise ratio (S/N). As shown in Figure 1, S/N is a function of optical power level, exactly analogous to copper-based systems. Thus a system must have adequate received power to function properly.

The receiver power is determined by the output optical power of the transmitter, diminished by the attenuation of the fiber-optic cable plant used for transmission. Thus optical power is the most important test parameter in a fiber-optic system, and the most important test instruction is simply a fiber-optic power meter.

Another problem associated with transmission problems in analog fiber-optic links with laser transmitters is optical return loss (ORL). This is a back reflection that occurs at splices and connectors caused by an "optical impedance mismatch." Technically it is called "index of refraction" but it is the same as an impedance mismatch in the copper world. This back reflection can cause lasers to have non-linear outputs and is especially devastating to analog systems. ORL can be measured with a laser test source, power meter and special coupler, or it can be measured with an optical time domain reflectometer (OTDR). The OTDR method is becoming the preferred method, since it shows the magnitude of the ORL and the location of the offending components.

In a typical system shown in Figure 2, the power at the transmitter output con-

Figure 1: Signal-to-noise performance of a fiber-optic CATV system



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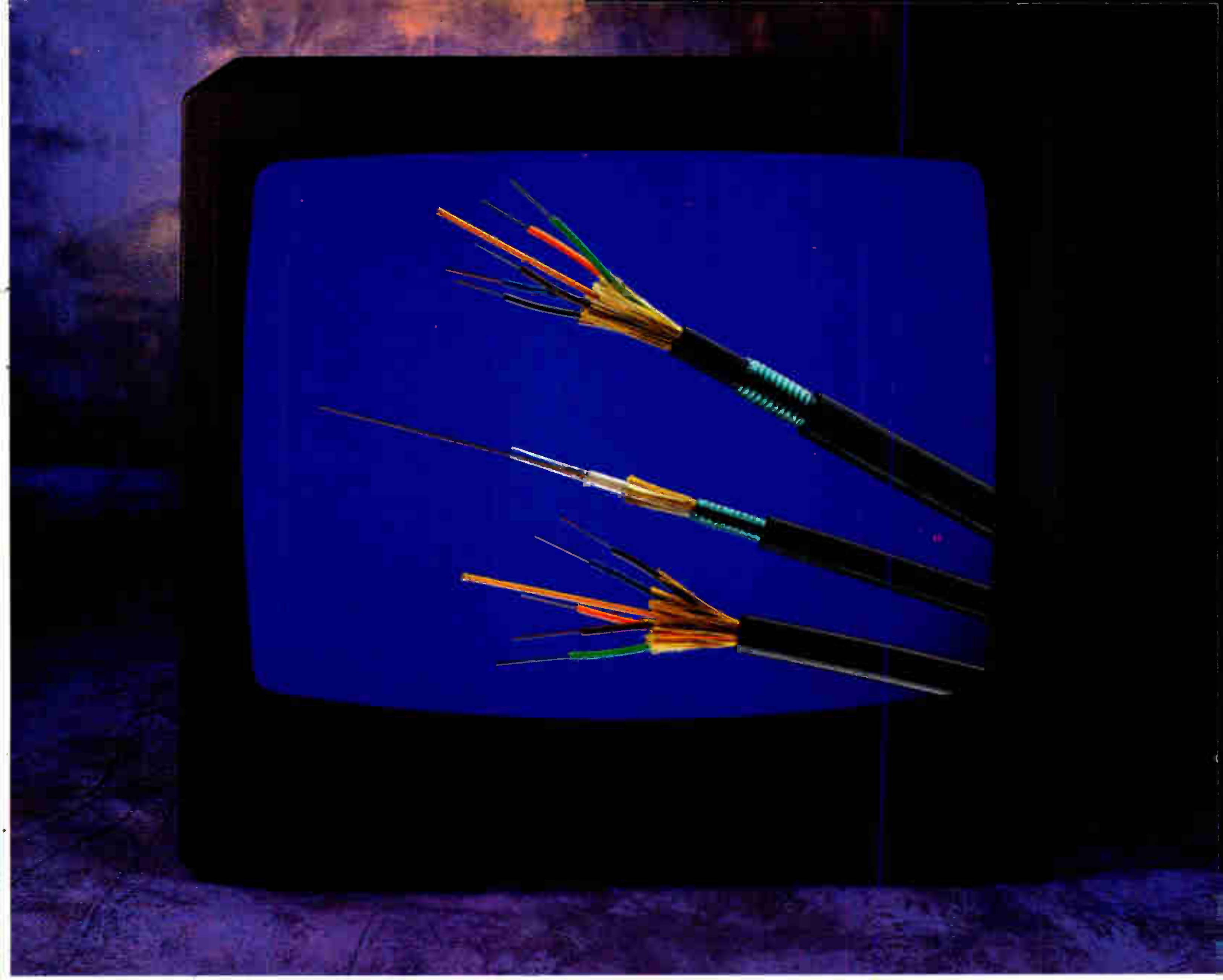


Let the Wavetek 1882A sweep you in

ONE of the most difficult aspects of making capital purchases for the cable industry is finding equipment that has an immediate as well as long-term payback. The Wavetek 1882A Sweep Analyzer offers the remarkable versatility and capacity to let you provide better subscriber service now and in the future — even if the conventional system technology changes.

A clear path home.

Today's complex systems contain many long amplifier cascades which can create signature build-up that distorts reception. In the eyes of your subscribers, that's not what they're paying for.

Storing and comparing successive amplifer response in the 1882A memory will allow you to detect the small changes that add up to major problems. Today, signature build-up can be a thing of the past.

No interference.

Why tolerate extraneous signals that simply load your system or interfere with revenue generating signals? That's precisely why you sweep, to make sure that your system properly passes each active channel.

The Wavetek 1882A utilizes the multitude of signals already on your system to test the frequency response. So you're not adding extra carriers that can interfere with picture quality, set top converter operation, or VCR usage.

1000 MHz to grow on.

The growth of cable very likely means increased frequency response requirements — 600, 800 even 1000 MHz. Why buy a sweep system that can't accommodate these increased frequency ranges?

See the light.

Fiber optic cable is already being used to shorten amplifier cascade lengths.

The 1882A lets you sweep the amplifier cascades from the fiber node by simply storing your reference at the fiber node and sweeping the rest of the system as you normally would, without an elaborate field transmitter.

You could also test parameters most affected by laser nonlinearity — cross-mod, and second and third order distortion.

Elegant but easy.

The Wavetek 1882A does so much, but so easily. Most modes of operation are entered by pressing one, two or three keys. If you make a mistake, it lets you back up, asks you a question, or lists your options.

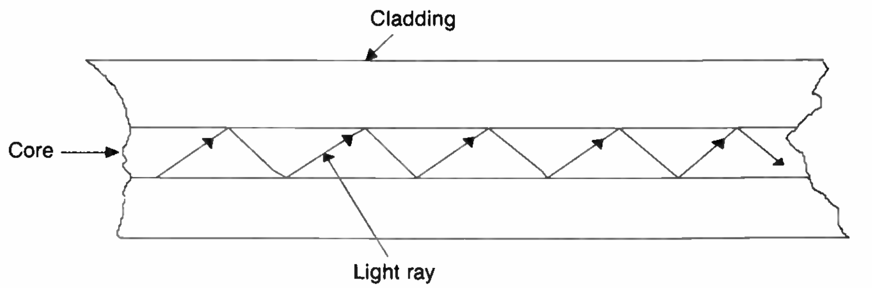
It takes only a few minutes to store your HEADEND,

Basic fiber-optic concepts

By Mike Solitro
President, Axsys Communications Inc.

Fiber optics may soon become as common as the coaxial connector in the cable TV business. More operators than ever are adding fiber to increase the capacity and reliability of their systems. Many franchise renewals are specifically calling for fiber links in the system. A basic understanding of fiber-optic terminology and concepts will be a must for technicians in the business.

Figure 2: Total internal reflection in fiber



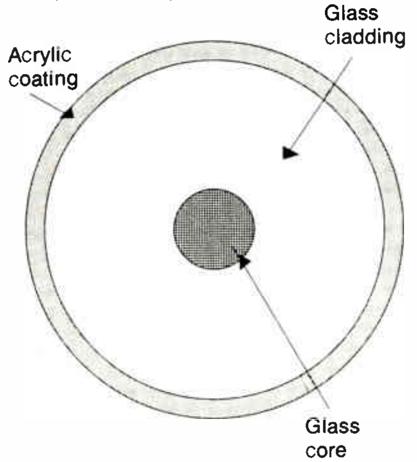
Theory

Optical fibers are circular in shape and usually are composed of two slightly different types of silica glass material. The inner glass material where the light is actually transmitted is called the core. The second material, called the cladding, surrounds the core. The entire fiber is then covered with an acrylic coating (jacket) to provide strength. Figure 1 shows the cross section of a typical communications optical fiber.

Total internal reflection (TIR) is the phenomenon that enables fiber optics to operate. It is the reflection that occurs when a light ray traveling in one material (core) hits a different material (cladding) and reflects back into that material without any loss. (See Figure 2). Theoretically, all light entering the core is confined to the core because it reflects off the cladding.

Not all of the light directed at the fiber will enter the core. Only the light that is within an area outside the fiber known as the *acceptance cone* (Figure 3) will enter the core and be reflected down the fiber; all other light will be lost. The acceptance cone area is defined by the quantity called *numerical aperture* (NA), which is a measure of the light gathering ability of an optical fiber.

Figure 1: Typical fiber cross section



Core: 9μm - 100 μm diameter
Cladding: 125 μm - 140 μm diameter
Coating: 250 μm, 500 μm, 900 μm diameter

After light enters the fiber, its speed is limited to the speed of light in the core material. The *index of refraction* is a dimensionless number that relates the speed of light in the fiber to the speed of light in a vacuum. Index of refraction is given by the relationship:

$$n = \frac{c}{v}$$

Where:
n = index of refraction
c = speed of light in a vacuum (2.998×10^8 m/sec)
v = velocity of light in the fiber core

Parameters

As with any type of system, fiber optics has certain parameters that define its operation. When designing a fiber-optic system, knowing how varying these parameters will affect your performance is important for a reliable and economic system.

Wavelength is the property of light that defines the length in nanometers (nm) of the lightwave. In the visible spectrum (400-750 nm) wavelength can be described by color. Fibers are designed to operate within specific wavelength ranges referred to as *windows*. Common windows used in communications fibers are 800-900, 1,300-1,350 and 1,500-1,600 nm.

Bandwidth defines the amount of information a fiber can transmit in a specified time period without any loss of that information. Bandwidth of fiber is measured in MHz-km and GHz-km. The kilometer dimension of these units is used to rate the fiber bandwidth per kilometer. For instance, if you selected a 500 MHz-km fiber you would be able to transmit 500 MHz down a 1 km length of that fiber. If you increased the fiber length to 2 km, you would only be able to transmit 250 MHz.

Attenuation is a measure of the optical power that is lost in a specified fiber length. Like any other power measurement, attenuation is measured in nanowatts but is commonly expressed in decibels to simplify calculations. There are two types of attenuation, intrinsic and extrinsic.

Intrinsic attenuation is caused from qualities inherent within the fiber. The natural impurities in the glass itself will absorb light energy. This type of intrinsic attenuation is commonly referred to as absorption. A second type of intrinsic attenuation is caused from scattering of the light rays in the core when they strike small imperfections and are lost in the cladding.

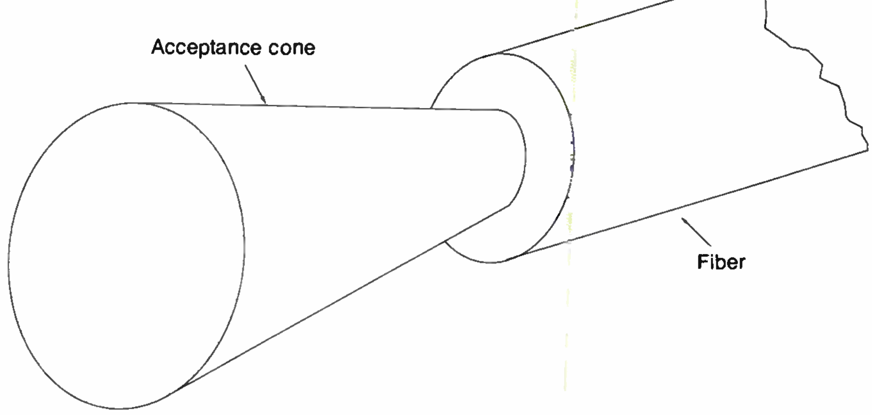
Extrinsic attenuation is loss caused by external sources. There are also two causes of extrinsic attenuation. The first is microbending where a small bend is induced in the fiber. These bends are typically caused from the crushing or pinching of the fiber. The second is macrobending when the fiber is bent to a smooth small radius (typically less than ½ inch).

Dispersion is the spreading of the light pulse as it travels down the fiber. Dispersion will limit the operating frequency or bandwidth of a fiber. As the frequency of pulses input into the fiber increases, dispersion will eventually cause the pulses to overlap the previous pulse so that each pulse becomes indistinguishable by the receiver. Dispersion is analogous to the rise and fall time of electrical signals in copper cable. The two types of dispersion are modal and material.

Modal dispersion is caused by modes (light rays) traveling in different paths along the fiber. Because the modes travel through different paths at approximately the same speed, they will reach the end of the fiber at different times.

Material dispersion is caused by different velocities of different wavelengths in the fiber. The refractive index of the fiber is dependent on the operating wavelength. Since refractive index determines the speed at which light travels in the fiber, different wavelengths will travel at different speeds in the fiber. Material dispersion is determined by the spectral width of the source, which can range from 2 nm for a laser diode to more than 50 nm for some LEDs. Material dispersion can be minimized by selecting fiber with a low numerical aperture and a source with a narrow spectral width.

Figure 3: Acceptance cone



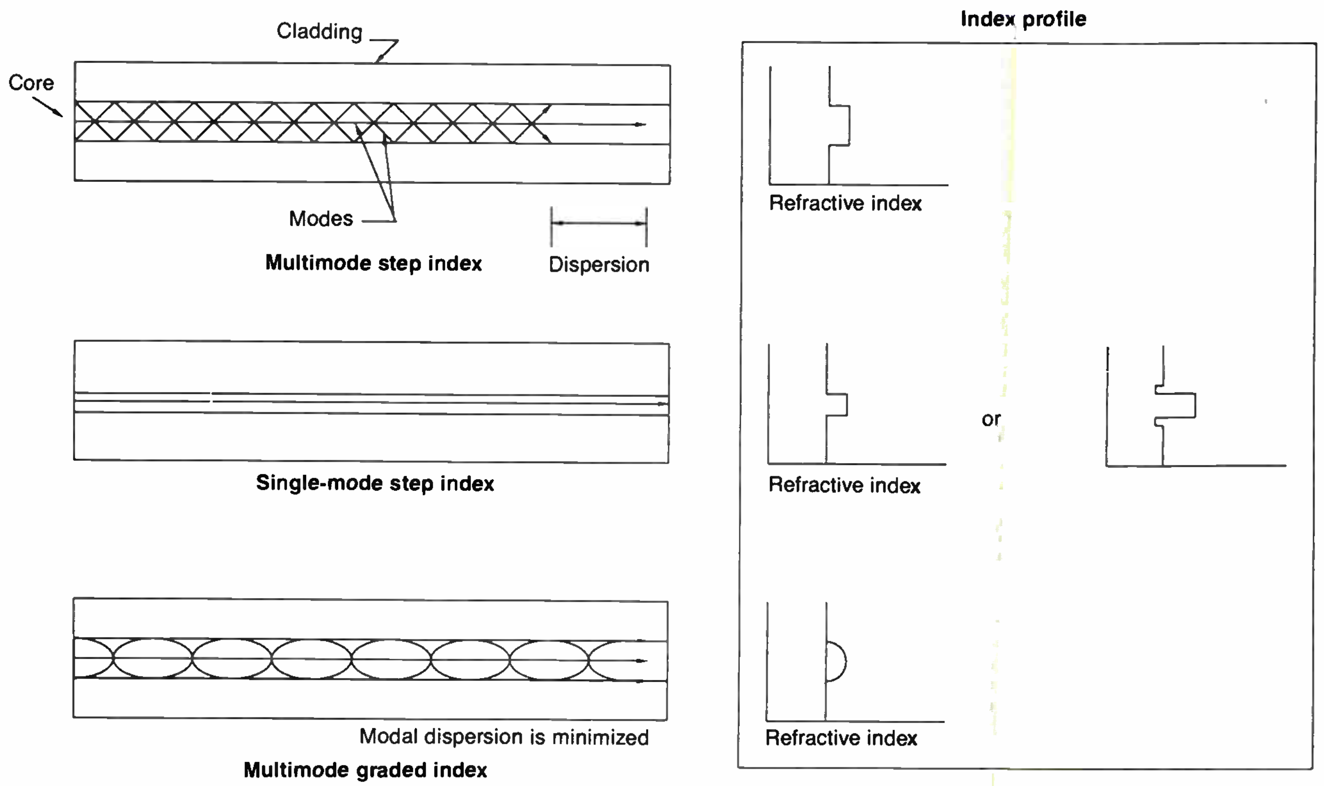
Types of fiber

Optical fibers are made of either plastic, glass or a combination of both. Since plastic or plastic-clad silica (PCS) are not commonly used in communications, only glass fibers shall be discussed. Optical fibers can be classified into two different categories, *multimode* and *single-mode*. Multimode fibers have core sizes of 50, 62.5, 85 and 100 μm. Cladding diameter is 125 or 140 μm. Multimode fibers allow multiple modes (light rays) to enter and travel through the core. Single-mode fibers have core sizes of 8.3, 8.7 and 9 μm. Cladding diameter is 125 μm. Single-mode fibers allow only one mode to enter and travel through the core.

Fiber also is supplied with two different types of index profiles, *step* and *graded*. In a step-index fiber the refractive index changes abruptly at the core-cladding boundary. A step index is supplied in either multimode or single-mode fiber. In a graded-index fiber the refractive index is smoothly varied across the core to enable all modes to travel through the core at the same speed. A graded index is only used in multimode fiber to minimize modal dispersion. Single-mode fibers do not use graded index because only one mode is present in the core. Figure 4 shows each fiber type with its corresponding index profile.

Fiber optics is here to stay in the cable business. As this technology grows in the industry, understanding the concepts presented in this article will provide you with the foundation to grow with it. □

Figure 4: Fiber types



Training today prepares for impending fiber future

By Jim Hartman
Project Manager and Trainer, FiberLite International

You can bolster your company's productivity with the right fiber training regiment. Is it presently a top priority? Does your company have a strategy that includes a comprehensive management system for fiber training? Take a few moments to read the following, and I think you will agree that the proper training of your staff will be rewarding and profitable. Even if you have competent people throughout your organization, you don't want to leave your "star center" without "second string" talent. He might be injured, need a break or up and quit on you. Both personal and team depth are essential to a smooth professional operation.

Fiber training will pay

Companies of good repute with sharp, knowledgeable and experienced staff will seize the opportunities in fiber optic's bright future. According to a Bell Communications Research study, fiber will be deployed to the home around the years 2010 to 2025. The accompanying figure shows that we foresee 50 percent penetration in 12 to 20 years. It will be quite a task to install and maintain that fiber network.

Fiber deployment in cable TV, sensor systems and local area networks is accelerating at the same rapid pace. To handle the expected growth, the average cable technician today will need to be prepared to install, troubleshoot and repair fiber-optic cable. With the rapid pace that technology is generating, managers, designers and end users will do well to keep up with the myriad of technical advances and product options.

If the amount of money spent for training is any indicator of effectiveness, the case for training is strong. In the computer industry over 10 percent of the total $100 billion hardware, software and peripherals market went for training. According to a recent study by Nolan, Norton and Co., businesses spent $1,300 per employee annually for training on their personal computer. This is a significant amount of money to put a PC on an employee's desk.

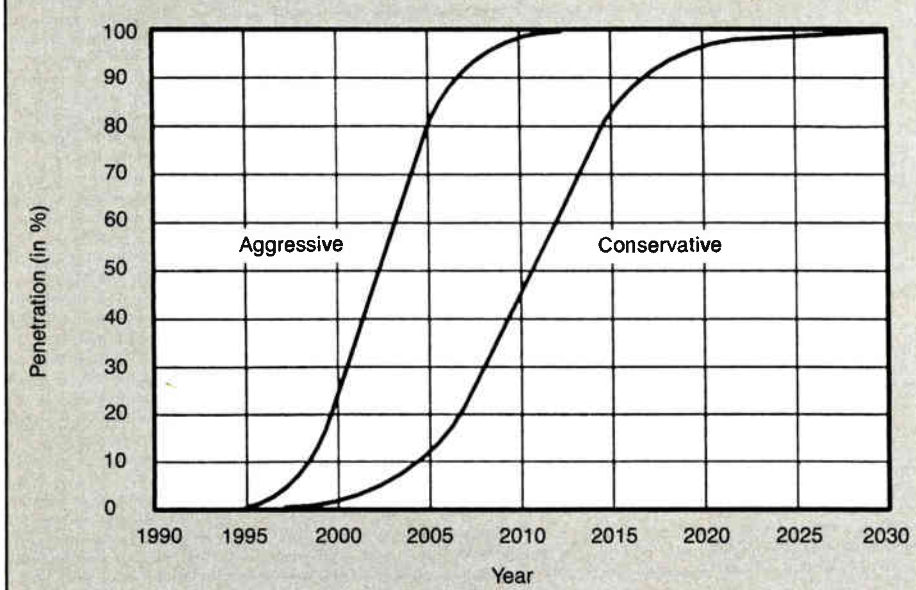
The costs of designing, installing and maintaining a fiber network has become a major factor. Since the price tag on fiber installation equipment is high, personnel need to be proficient in its use, and a certain level of expertise is necessary to maintain a fiber system. On the other hand, component and cable costs have decreased substantially over the last 10 years. Fiber has fallen from $3 to 15 cents per meter while data rates skyrocketed 100 fold in the last decade according to Kessler Marketing Intelligence. Certain types of lasers have decreased in cost from several thousand dollars to several hundred dollars and less. As production volume increases, the complex E/O (electro-optical) components will decrease in price, becoming less of a factor. Because the cost of installation can be 25 percent or more of a total project bid, training will increase production and reduce this percentage.

Mistakes can be expensive. A large electrical contractor I consulted with bought the wrong type of optical time domain reflectometer (OTDR) for its first large project. "It was tense for a while, but fortunately the manufacturer decided to work with us," recalled the owner of the firm. Another major installer had to fly in outside installers at a premium price to replace his unseasoned veterans in the middle of a project. His conclusion was succinct: "To avoid proper training, even if it cuts immediate costs, is foolish in the end."

I could tell of other companies that ended in disaster due to lack of timely knowledge. The end user needs people trained to evaluate designers, installers, techniques and approaches. If your company is involved in fiber in any capacity, then everyone from secretary to installer, designer to bidder, needs some level of expertise. Employees that most affect the bottom line where productivity and reputation are pivotal, should be first in line to receive the most effective training.

Training options fall into the following three main camps: classroom instruction, media-based training and seminars/conferences. Hands-on classroom training offers the most comprehensive solution but all choices have their place.

Fiber-optic penetration



Hands-on classes

There are many advantages to classroom training. Live interaction with an instructor keeps students alert, allows for spontaneous questions and rephrasing of difficult concepts. An instructor with proper communication skills can bring the topic alive and indelibly etch concepts into students' minds.

There is no substitute for hands-on training. Book knowledge can only begin the learning process. The individuals who will be installing or maintaining the fiber network need practice opening cable and preparing fibers as well as splicing,

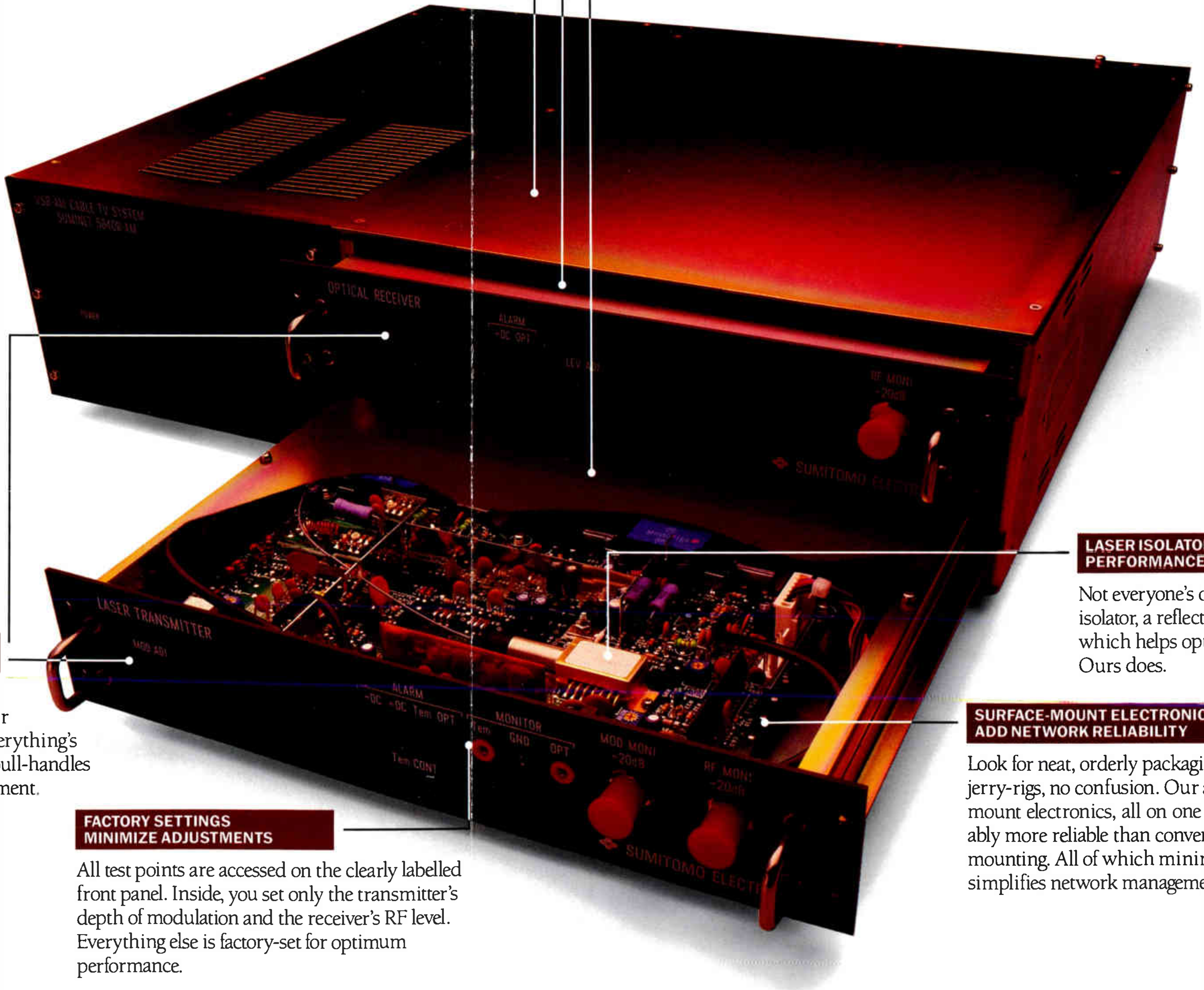
(Continued on page 64)

Rack Up Major Advantages From Sumitomo Electric.

Optical transmitters and receivers are not created equal. Sumitomo Electric has long been a leading designer and manufacturer of VSB-AM optical transmission equipment. One result is our new-generation Series II. It's transparently compatible with coax cable TV systems of up to 550 MHz, with built-in advantages like those shown here.

Uniform Specs Save Management Headaches

Anyone can give you best-of-the-bunch "hero" lasers that squeeze out an extra dB or so. But what happens when you face real-world maintenance, repair and replacement needs? Sumitomo Electric offers a saner approach: *lasers that meet uniformly high performance specifications in every unit we make.* Result: you get consistent high performance, plus components that are interchangeable throughout the network. Which makes for low-cost spare stocking — and makes managing the entire system a lot easier.



TOUGH STEEL COVERS PROTECT EVEN THE SUBSYSTEMS

Our philosophy: everything matters. Such as steel housings for added rack-unit durability. The assemblies have a carefully finished look about them, inside and out. It reflects good workmanship: the care and thought we put into every detail.

QUICK-CHANGE MODULES CUT DOWNTIME

If the need ever arises, you can swap out a subsystem to put your unit back on line in seconds. Everything's plugged or connectorized. The pull-handles help speed removal and replacement.

FACTORY SETTINGS MINIMIZE ADJUSTMENTS

All test points are accessed on the clearly labelled front panel. Inside, you set only the transmitter's depth of modulation and the receiver's RF level. Everything else is factory-set for optimum performance.

LASER ISOLATOR BOOSTS PERFORMANCE, STABILITY

Not everyone's optical transmitter has an isolator, a reflection-cancelling device which helps optimize laser performance. Ours does.

SURFACE-MOUNT ELECTRONICS ADD NETWORK RELIABILITY

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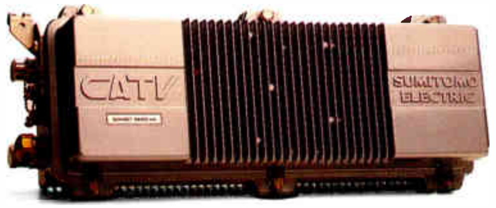

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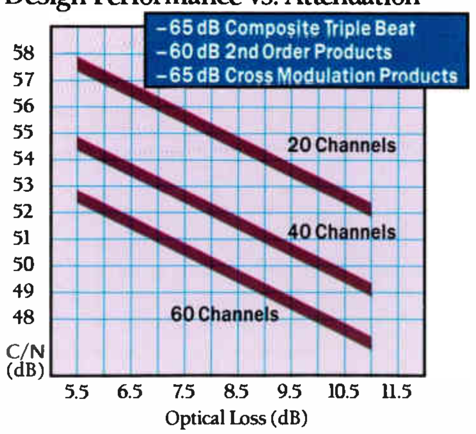

SPECIFICATIONS — SUMINET 5840 SERIES II

RACK UNIT	COAX RF		OPTICAL	
Transmitter	IN		OUT	
	Bandwidth	50-550 MHz	Source	DFB-LD
	Level	25±5 dBmV	Wavelength	1310 nm
	Impedence	75 ohms	Isolator	Yes
	Return Loss	14 dB Min	Avg Power	4 mW (set)
	Connector	F-Female	Output	Pigtail (5 m)
Receiver	OUT		IN	
	Bandwidth	50-550 MHz	Detector	PIN-PD
	Level	25±5 dBmV	Wavelength	1310 nm
	Impedence	75 ohms	Performance	SEE GRAPH
	Return Loss	14 dB Min	Input	Pigtail (5m)
	Connector	F-Female		

NOTE: Rack Mount Chassis Accommodates Two Units — Either Transmitters or Receivers or one of each.

STRAND UNIT	COAX RF		OPTICAL	
Transmitter Forward	IN		OUT	
	Bandwidth	50-550 MHz	Source	DFB-LD
	Level	30±5 dBmV	Wavelength	1310 nm
	Impedence	75 ohms	Isolator	Yes
	Return Loss	14 dB Min	Avg Power	4 mW (set)
	Connector	Standard ⅝ x 24	Output	Pigtail (2 m)
Receiver Forward	OUT		IN	
	Bandwidth	50-550 MHz	Detector	PIN-PD
	Level	25±5 dBmV	Wavelength	1310 nm
	Impedence	75 ohms	Performance	SEE GRAPH
	Return Loss	14 dB Min	Input	Pigtail (2 m)
	Connector	Standard ⅝ x 24		
Transmitter Return	IN		OUT	
	Bandwidth	5-30 MHz	Source	DFB-LD or FP
	Level	30±5 dBmV	Wavelength	1310 nm
	Impedence	75 ohms	Isolator	Yes
	Return Loss	14 dB Min	Avg Power	4 mW (set)
	Connector	Standard ⅝ x 24	Output	Pigtail (2 m)
Receiver Return	OUT		IN	
	Bandwidth	5-30 MHz	Detector	PIN-PD
	Level	25±5 dBmV	Wavelength	1310 nm
	Impedence	75 ohms	Performance	SEE GRAPH
	Return Loss	14 dB Min	Input	Pigtail (2 m)
	Connector	Standard ⅝ x 24		

NOTE: Strand Housing accommodations: Up to 4 receivers or one transmitter (Forward or Return) and two receivers or two transmitters. Also, it can be configured as a repeater with one receiver and transmitter.

GENERAL	RACK UNIT	STRAND UNIT
Power	110/220 VAC 50/60 Hz 30 W/unit	30/60 VAC 50/60 Hz 30 W/unit
Operating Temperature	0° C to 40° C	−20° C to 50° C
Operating Humidity	Max 85% RH	Max 100% RH
Dimensions	EIA 19″ Rack Mount 3⁵⁄₁₀″ High (2 RU)	18¾″ L x 8″ H x 7″ D
Weight	25 lbs Max	25 lbs Max
Splice Ctr	—	3 Tray (12 Fibers)

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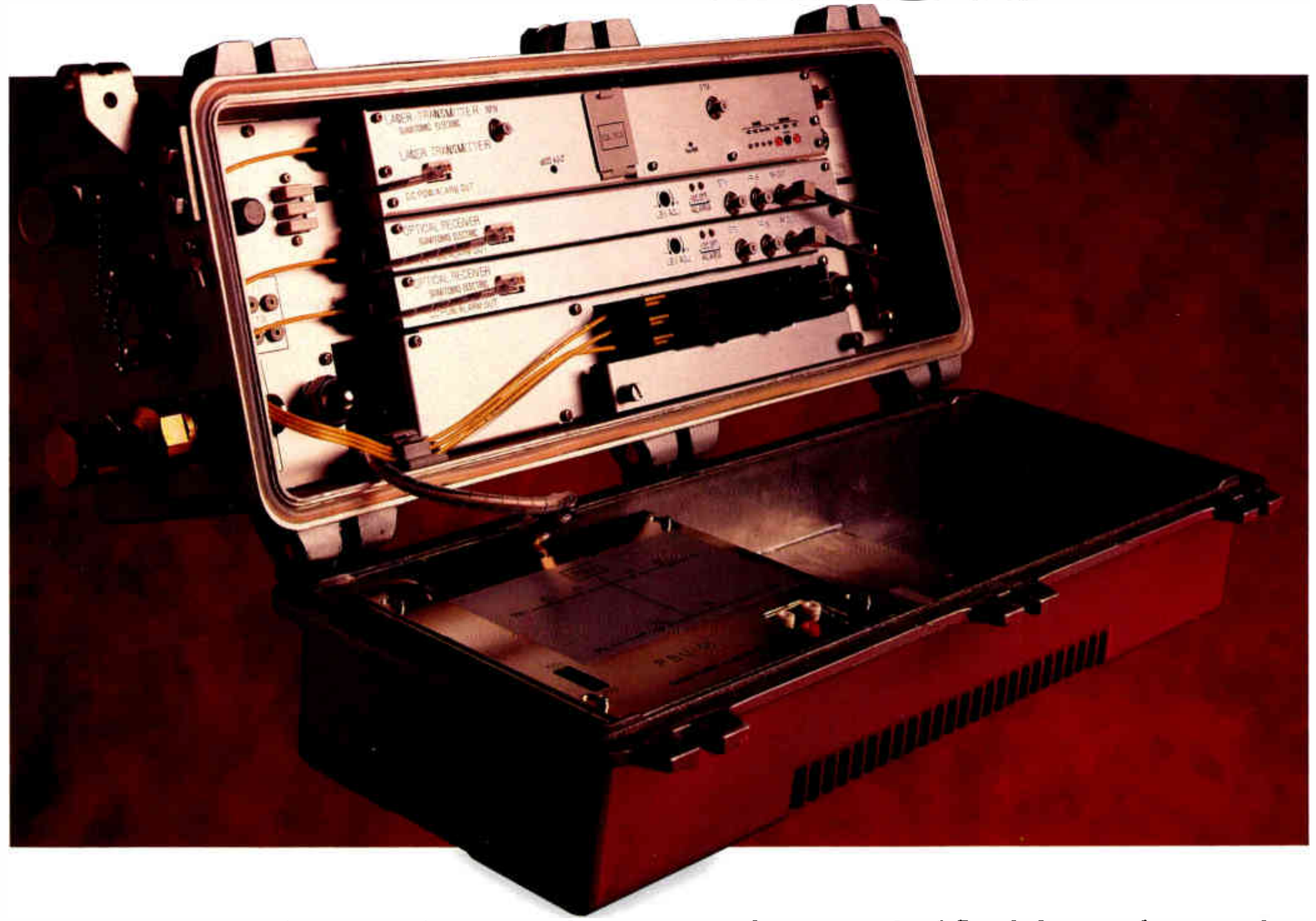

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CONTINUED ►

Victors United: Cable Games '90 company winners Mark Gidley, Shawn Huston, coach Ron Upchurch, Shawn Bargas and Randy Longstrom were awarded the traveling trophy from Wendell Woody.

Technicians at play

Story and photos by Rikki T. Lee
Special Correspondent

After a hard day's work in the field or the lab, nothing relaxes a technician better than playing an all-American sport. Softball? Golf? Bowling? No, the Cable Games; specifically, the Second Annual Cable Games held July 11 in Breckenridge, Colo., during the Colorado Cable TV Association (CCTA) convention. While over 100 attendees sipped beer or wine and munched on snacks, they watched as techs from the Rocky Mountain region vied for medals and that much-coveted traveling trophy.

Conceived by CT Publications last year, the Cable Games took flight under the guidance and supervision of the SCTE Rocky Mountain Chapter. The 1989 games were played July 20 at the CCTA Show in Vail, Colo. Because of the success of that event (see "Games technicians play," *CT*, September 1989), the chapter planned this year's games to run much smoother and provide more excitement for a non-technical audience.

But first, let's drop some names. Just like last year, the 1990 games got help from some industry heavyweights, such as the following:

- games sponsored by Comm/Scope, CT Publications, Jerrold Communications, National Cable Television Institute and United Video and coordinated by Rocky Mountain Chapter board members and the CCTA.
- awards sponsored by Jones Intercable, Tele-Communications Inc. and United Cable of Colorado (now known as United Artists Cable).
- participating companies providing equipment and/or judges: Trilithic (with judges Greg Marx and Gregg Rodgers), ATC National Training Center (Dennis Musser), NCTI (judge Jerry Neese and scorekeeper Tom Brooksher), LRC, Gilbert (Bill Down) and Winfield Scott & Associates (Scott Webb).
- guests intrigued and instructed by Anixter Cable TV's Wendell Woody, Charles Fusco and Gary Eldore at the fiber-optic splicing exhibit.
- games co-emceed by Magnavox CATV's Eric Himes and ATC Training Center's Ron Wolfe (they were also Cable Games Committee co-chairmen).

Before the spectacle actually kicked off in Cable Games Stadium (located inside Beaver Run Resort), tables were arranged as three sides of a square. Vendors placed equipment at separate workstations along the tables; each station became part of a

(Continued on page 56)

Overall games winner Randy Longstrom of United received a handshake from SCTE President Wendell Woody plus an expenses-paid trip to Expo '91.

Basic RF system design

This is the first in a series of articles that will sequentially build on each other and address the following topics: basic RF design, basic AC design, expanding RF system topology (design considerations with fiber) and other alternative architectures (designing with interdiction).

By Mark Bowers
Owner, CableSoft Engineering Services

Basic RF system design is complex, yet very simple and elegant in its definitions and application. People have struggled over the years with the concepts involved, particularly cascade arithmetic or the combining of distortion components and system noise over multiple amplifiers and systems. This article will take a new look at the separate elements and combine them in several small design applications. This is meant to be neither detailed nor superficial, but rather a back to basics look that examines concepts rather than delving into a myriad of complexities and formulas.

Basic components and areas of concern in RF system design and layout are:

- system strand mapping
- basic system architecture (tree-and-branch)
- trunking system layout
- feeder system layout
- system distortions including noise
- cascade arithmetic (the combination of distortion components)
- selection of system operational levels
- system design parameters and choices
- basic tree-and-branch design layouts

"A good computer program is a tremendous asset and tool for an accurate design (but does not) replace... basic knowledge and theory behind such activities."

Map it out

Basic system design begins with proper *strand mapping*. Most modern mapping techniques involve field measurements of distances between poles or underground property lines; inspection of pole attachment and midspan clearances for cable attachments and lines; determination of special needs such as makeready (work necessary by other utilities to ensure ade-

Table 1: CATV system distortions worksheet

Equipment Type	SA 372397	MAG T440	MAG T440	MAG 5MLE	SYSTEM TOTALS
BW (Mhz)	4				
Noise Figure	10	9	9.5	10	
CTB Output Cap	33	30	46	46	
CTB Rating (-dB)	-99	-87	-61	-64	
XMOD Output Cap	33	30	46	46	
XMOD Rating (-dB)	-96	-90	-64	-64	
2nd Output Cap	33	30	46	46	
2nd Rating (-dB)	-92	-87	-72	-70	
Channel Capacity	62	60	60	60	
Manufacturer Tilt	3	6	8	8	
Desired Tilt	3	6	8	8	
Amplifier Input	11	9	17	17	
Gain or BR DC Loss	25	22	-14	27	
Amplifier Output	36	31	44	44	
Channel Loading	54	54	54	54	
Cascade Length	15	19	1	2	
C/N	-48.4	-46.4	-66.7	-63.2	-44.2
CTB	-71.0	-60.6	-66.2	-63.2	-52.4
XMOD	-67.7	-63.4	-68.9	-62.9	-53.3
2ND	-77.2	-73.2	-74.0	-69.0	-66.3
HUM	-46.5	-39.4	-65.0	-59.0	-35.3
AMPLIFIER INPUT LEVEL	11	9	17	17	
AMPLIFIER GAIN	25	22	27	27	
AMPLIFIER TILT	3	6	8	8	
AMPLIFIER OUTPUT LEVEL	36	31	44	44	

quate clearances are maintained); street and boundary areas to be built; all available or potential tie points for the system; underground ties or runs; best and alternate trunk routes; if known, the headend or hub sites; all guy, anchor and slack spans; all pedestal locations; and determination of house count or the actual homes passed during the design and build.

Actual CATV system construction guidelines are governed by various national, state, industry and local codes. In general, the *National Electrical Safety Code Handbook (NESC Handbook)* covers requirements and guidelines for outside plant construction including grounding and bonding requirements. The *NESC Handbook* is published by the Institute of Electrical and Electronic Engineers and is available to order by phone or in writing. The *National Electrical Code Handbook (NEC Handbook)* in general covers inside wiring guidelines including bonding and grounding. The *NEC Handbook* is published by the National Fire Protection Association.

For outside plant construction, both aerial and underground, the *NESC Handbook* should be considered your bible. Almost all franchise agreements and attachment agreements with utility companies specify adherence with this document. If you intend to build, rebuild or upgrade your plant, obtain this book and become familiar with its contents.

Figure 1 illustrates typical information on a strand map. Basic information includes utility poles and distances between them (small circles with lines drawn to others), streets and easements, and house count numbers (large circles with numbers, typically one through eight, or actual home locations with each address. Several homes are shown along Fawn Lane.

Current cable system coaxial distribution topology is called *tree-and-branch* (T&B). It is so named because the branching and splitting of coaxial lines emanating from the headend or signal origination point resembles the trunk and branches of a tree. Telephone system architecture is called star or switched star (ST) because service lines leaving the residence are routed to a central switching point. In a small system this central point might be the telephone central office; in larger systems this point would be a remote terminal or switch. Signals are routed to the remote switch via a multiplexed trunking technique, then to each home with an independent switched line. In contrast, T&B simply splits and branches as necessary and as makes sense in the distribution layout.

Table 2: Cable design report

STARTING POINT: line extender (High output).

LEG I.D.> Start- Ridge Rd START> 36.000 | 44.000 | 0.0000 | OK

NO.	FEET	CBL	DEVICE	TAP	LOLVL IN	HILVL IN	REV LOSS	ERRORS
1	0	1	4-WAY-TAP	29.00	36.000	44.000	0.0000	OK
2	0	1	2-WAY-SPLIT	0.000	35.700	43.500	0.3000	OK

0.00000 FEET IN THIS LEG
PARENT LEG> NONE
LEFT SUB LEG> South Leg(tap)
CENTER SUB LEG> NONE
RIGHT SUB LEG> East Leg(tap)

LEG I.D.> South Leg START> 32.100 | 39.700 | 3.9000 | OK

NO.	FEET	CBL	DEVICE	TAP	LOLVL IN	HILVL IN	REV LOSS	ERRORS
1	130	1	4-WAY-TAP	23.00	31.398	37.997	4.4200	OK
2	120	1	2-WAY-TAP	23.00	30.250	35.825	5.4000	OK
3	170	1	4-WAY-TAP	20.00	28.832	32.998	6.5800	OK
4	180	1	2-WAY-TAP	17.00	27.260	29.840	7.9000	OK
5	180	1	2-WAY-TAP	14.00	25.688	26.682	9.2200	OK
6	130	1	2-WAY-TAP	11.00	24.086	23.879	10.640	OK
7	155	1	LEXT-HI	0.170	21.849	20.049	12.660	OK
8	0	1	4-WAY-TAP	29.00	36.000	44.000	0.0000	OK
9	145	1	2-WAY-TAP	26.00	34.917	41.601	0.8800	OK
10	155	1	8-WAY-TAP	26.00	33.780	39.070	1.8000	OK
11	185	1	4-WAY-TAP	23.00	32.181	35.847	3.1400	OK
12	140	1	2-WAY-TAP	20.00	30.925	33.413	4.2000	OK

1690.00 FEET IN THIS LEG

The primary advantage of T&B is economics. ST advantages lay in the direct routing of signals to and from the home to other locations. This is not to say that two-way signal routing cannot take place in the T&B layout, only that doing so presents some problems. It also should be pointed out at this juncture that T&B architecture better supports information distribution in the "broadcast" or forward direction (information distributed from the central point to homes or multiple points), whereas ST better supports true bidirectional information transfer as in telephone conversations and some data transfer.

The next primary task of the designer using T&B topology is to determine the basic *layout for trunk cable and system.* The purpose of the trunk system is to maintain absolute picture quality and integrity (best amps, good automatic slope and gain control, etc.) while routing the signals from the headend close to all homes and residences served by the franchise. Trunk system levels are normally kept low (in the +27 to +33 dBmV range) to keep distortion components at a minimum. Optimal levels are always a tradeoff between noise and distortion component addition.

"Close to all homes" is defined as within the distance or reach of the feeder system layout. The feeder system's typical reach is dependent upon many factors such as the size of cable used, design levels out of the multitap and the feeder amps, and overall bandwidth of the system. This reach is therefore typically 2,000 to 3,000 feet but will vary significantly by the previous parameters.

The trunking system takes the signals combined at the headend or central signal processing facility, then routes them around the community close to all areas to be served and maintains the highest picture quality standards while doing so. The trunk cable normally is not tapped for signals to be fed to homes.

Overall system integrity is absolutely maintained by keeping splitters, directional couplers, connectors, splices, etc., to an absolute minimum given routing and design limitations. The signal is then sampled in each trunk amp station by a

(Continued on page 87)

TVRO requirements for ATV signal reception—Part 2

This is the final installment in this two-part series (see the August issue of "CT" for part 1) on the requirements that satellite transmission of advanced TV (ATV) signals will place on television receive-only antennas (TVROs).

By Marvin Freeling
Manager, Advanced Studies, GE American Communications Inc.

And Krish Jonnalagadda
Group Head, Transmission Systems Research, David Sarnoff Research Center

The antenna diameters required in Ku-band for the reception of the HDTV systems previously described are determined in this section. The antenna diameter required for the reception of the ACTV production standard also is shown.

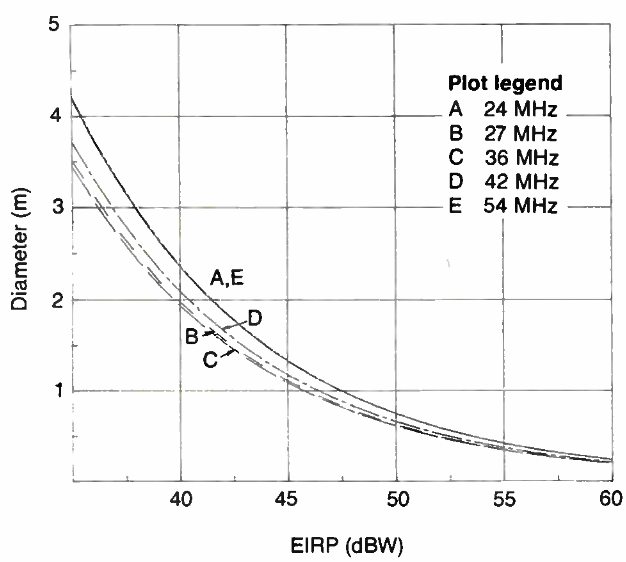
For satellite transmissions in Ku-band, the following parametric values are appropriate for use in the link equation defined in last month's installment as Equation 1:

L = link or path loss = 206.5 dB
T = receive system noise temperature = 100° K

Although the present state-of-the-art in the fixed satellite service portion of Ku-band is a receive system noise temperature of approximately 130° K, it is anticipated that advances in technology will result in a 100° K temperature in the time period of the implementation of advanced television systems (1992-1995). Therefore, the 100° K value has been used in the analysis in this article.

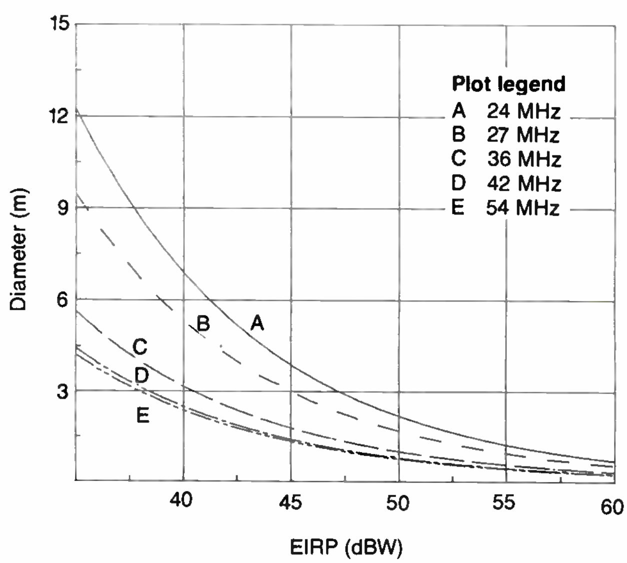
In the determination of antenna diameter required in Ku-band,

Figure 2: Required diameter vs. EIRP in Ku-band. NTSC, ACTV (broadcast standard), MUSE, SC-HDTV



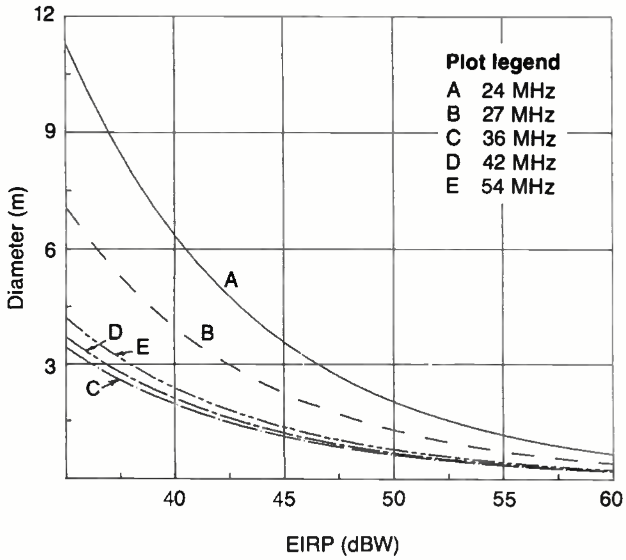
To take the effects of interference into account, the diameter values shown must be increased by 25 percent.

Figure 3: Required antenna diameter vs. EIRP in Ku-band; ACTV (production standard)



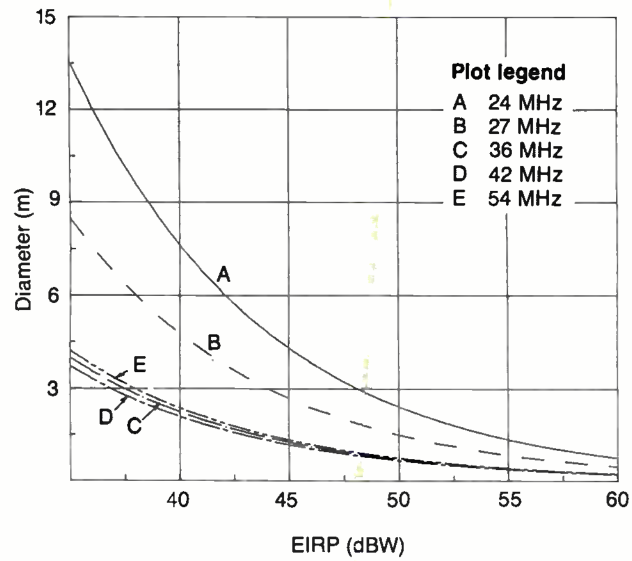
To take the effects of interference into account, the diameter values shown must be increased by 25 percent.

Figure 4: Required antenna diameter vs. EIRP in Ku-band; HDS-NA (25 percent overdeviation)



To take the effects of interference into account, the diameter values shown must be increased by 25 percent.

Figure 5: Required antenna diameter vs. EIRP in Ku-band; HDS-NA (50 percent overdeviation)



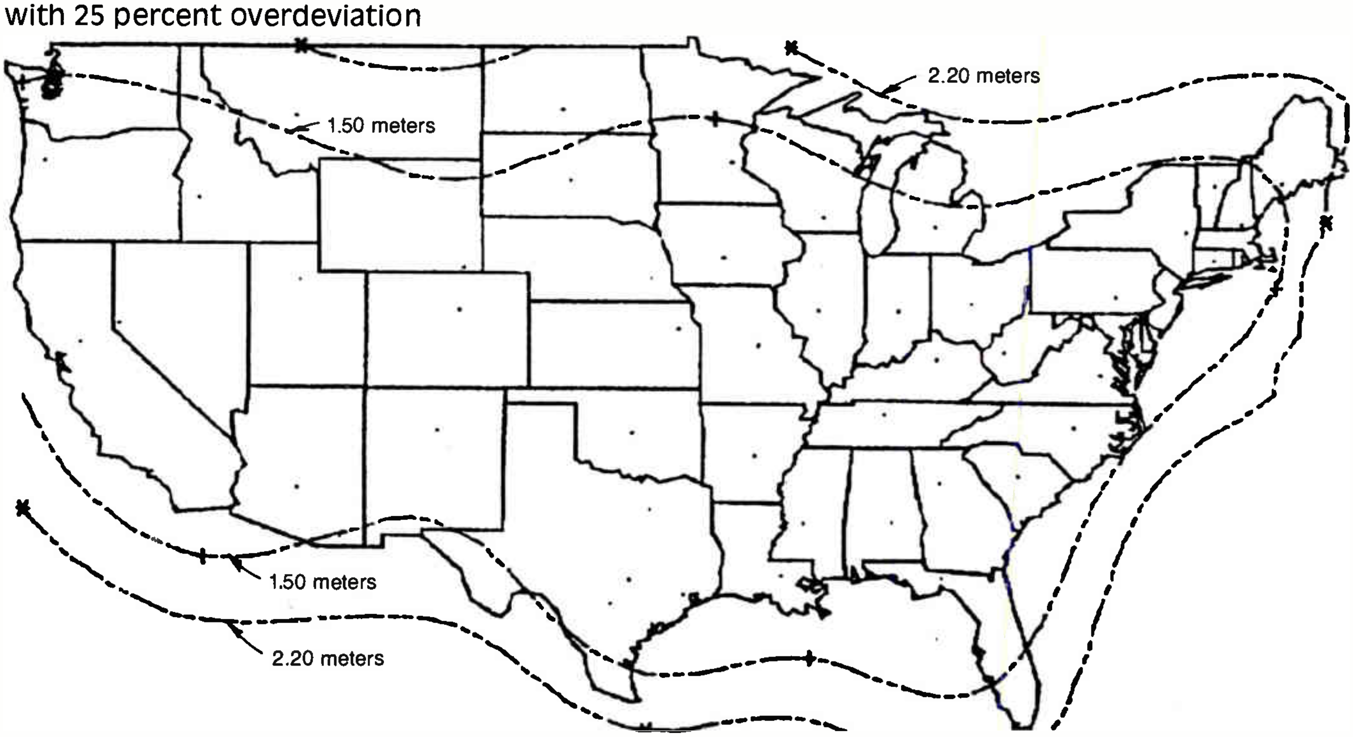
To take the effects of interference into account, the diameter values shown must be increased by 25 percent.

the assumption was made that the antenna would always have to support the reception of NTSC signals. This requirement imposes two performance criteria on the satellite link for cable applications:

CNR $\geq$ 12 dB
Weighted SNR $\geq$ 50 dB

Even though the CNR at impulse noise threshold for programming material is about 10 dB, a CNR of 12 dB will ensure additional margin for rain fades as well as allow impulse-free reception of highly saturated hues, as in color bars. Figures 2 through 5 show the diameters required to satisfy both the CNR and SNR constraints for NTSC, ACTV broadcast standard (same as for NTSC), ACTV production standard, HDS-NA for 25 percent

Figure 6: Isodiametric contours for the reception of ATV in Ku-band; format transmitted in HDS-NA with 25 percent overdeviation



Clear weather conditions. Interference effects included in the determination of antenna diameters.

overdeviation, HDS-NA for 50 percent overdeviation and MUSE. Unlike the situation in C-band, there is no universally accepted standard for transponder bandwidth in Ku-band. Therefore, the required antenna diameters presented in Figures 2 through 5 are shown as a function of channel bandwidth. The results of analysis presented in Figures 2 through 5 do not include the effects of interference. When interference effects are taken into account, the diameter values shown must be increased by 25 percent.

The plots shown in Figures 2 through 5 are applicable to cable transmissions. For DBS systems, the performance criteria for the satellite link may be able to be reduced by 2 dB from the requirement for cable operation:

CNR $\geq$ 10 dB
Weighted SNR $\geq$ 50 dB

As far as computing the required dish size is concerned, this reduction in performance criteria is equivalent to increasing the satellite EIRP by 2 dB. Therefore, the curves shown in Figures 2 through 5 also may be used for DBS applications.

Figure 6 shows a map of the continental United States on which are superimposed isodiametric contours for the transmission in Ku-band of HDS-NA with 25 percent overdeviation. Channel bandwidth in Figure 6 is 36 MHz.

Rain degradation

In contrast to the situation in C-band, attenuation due to rainfall has a great impact on satellite system performance in Ku-band, particularly in the eastern and southeastern regions of the United States. In addition to increasing the uplink and downlink losses, rainfall raises the noise temperature of the system, since the rain is at 290° K, substantially higher than the background temperature of space. Increase in receive noise temperature of the system results in a decrease in the G/T of the receive earth station.

The three effects of rainfall at Ku-band—namely, increase in uplink and in downlink losses and reduction of G/T—result in a faded CNR: a signal that is smaller than it would have been in clear weather. Stated differently, the diameter of a receive antenna required to achieve a given picture quality or SNR under rain fade conditions is larger than the diameter required to achieve the same goal in clear weather using EIRP typical of the GE Americom K1 or K2 satellites with 45 watt tubes. Figure 6 shows isodiametric contours for clear weather. Figure 7 shows the corresponding situation under conditions of fade due to rain. The system availability in Figure 7 is 99.5 percent. That is, the weighted SNR is greater than 50 dB except for 0.5 percent of the time (43.8 hours/year).

ATV and next-generation satellites

It has been shown in this article that all of the major ATV systems presently under development could be successfully transmitted by satellite in both C- and Ku-bands. All of these ATV transmissions would be received with good quality at cable headend earth stations equipped with antennas that are 3.0 to 4.5 meters in diameter. That is, it will not be necessary for cable operators to replace with larger receive dishes the antennas that are now in use. This conclusion is based on the assumption that next-generation satellites, equipped with at least 16-watt amplifiers and providing 37 to 40 dBW of EIRP to the continental United States, will be in operation at the same time that ATV service

(Continued on page 66)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Los Angeles, CA 800 762-4113
Phoenix, AZ 800 782-4566

load as a reference. The 80-channel system described previously is 4 dB worse with respect to CTB than the 60-channel system would be; likewise 110-channel performance is 11 dB worse than the 60-channel reference. While the bandwidth expansion from 450 MHz to 550 MHz was accomplished with a 4 dB improvement in integrated circuit (IC) technology for an equal cascade, the move from 550 MHz to 750 MHz will require a 7 dB improvement. Although not shown in Figure 3, expansion from 750 MHz to 1 GHz (151 channels) will require an improvement of an additional 7 dB, yielding a total performance improvement of 14 dB to advance from 550 MHz to 1 GHz.

The semiconductor manufacturers have development programs underway to reach this goal, but the task is significant. At the least, the advance must traverse two new generations in die technology. This must be coupled with amplifier design approaches relying more heavily on parallel gain blocks to achieve the required amplifier performance. Both the new hybrids and amplifier designs will yield higher operating temperatures requiring improved heat dissipation from housings and an increased power requirement.

To build a distribution system for the 1990s with 1 GHz of bandwidth or 150+ conventional NTSC channels will require significant improvements in amplifier chip technology as well as changes in the basic circuits to incorporate those ICs in amplifiers. The architecture of systems will require changes including the use of fiber optics to shorten cascades and the higher bandwidth will lead to increased equipment usage on the RF portions of the network. The positive note is that the technology that has served CATV for the last 40 years can be enhanced to be a part of the future architecture.

Compression

With discussion of direct broadcast satellite (DBS) activity, there has been a lot of press given to digital compression. Regardless of the technique, there are several common results of any compression technology. First, required bandwidth is reduced. Various compression proponents are claiming twofold to tenfold reductions are possible. A corollary is that more information can be accommodated in a given bandwidth, which makes any movement to HDTV much more tolerable. Second, digital transmission makes signals much more tolerant of noise and distortion than analog signals. Extremely high freedom from errors is achieved with C/N of only 20-25 dB. This yields performance well in excess of 50 dB signal-to-noise ratio (S/N) for the recovered video signal.

International markets

The emerging European and Asian markets are driving CATV technology along a somewhat different path because of some unique characteristics. With few exceptions, the international markets are new-build environments where the cable operator is not constrained by the characteristics of and investment in existing plant. The amount of programming available also is significantly less than in North America although satellites are now changing the situation.

In many countries, UHF broadcasting is the norm and many, if not most, TV sets tune UHF only (470-860 MHz) mandating the use of converters even for basic service if VHF (conventional CATV) distribution is used. Outside North America, channel bandwidths of 7 or 8 MHz each are common resulting in fewer carriers in a given system bandwidth. Some international markets also incorporate authorization for telephone service into the CATV franchise.

To accommodate these conditions, some specialized architectures are being

Table 2: Economical implications of optical splitting

	2-way	4-way	8-way
Node station unit cost	$ 10,000	$ 10,000	$ 10,000
× node quantity	× 2	× 4	× 8
Node station cost	$ 20,000	$ 40,000	$ 80,000
Transmitter unit cost	$ 30,000	$ 30,000	$ 30,000
Terminal equipment cost	$ 50,000	$ 70,000	$110,000
÷ node quantity	÷ 2	÷ 4	÷ 8
Average link cost	$ 25,000	$ 17,500	$ 13,750

employed. To interface with UHF TV sets, some systems employ distribution equipment that functions up to 860 MHz. The amplifiers used will accommodate only limited channel loading and operate over short cascades because of the state of the present 860 MHz hybrid amplifier technology.

The reduced channel loading has most often not been a major source of problems since less programming is available than in the United States and the 7 and 8 MHz channel spacings common outside North America result in reduced loading. The need for reduced cascades has been ameliorated through the use of fiber-optic technology, which more readily accommodates the wider bandwidth. In fact, the new-build environment in both Europe and Asia has led to a rapid incorporation of fiber-optic technology as a central part of system architecture at all bandwidths.

The legal authorization to provide telephone service has been a factor in driving portions of the CATV system to a star architecture. Such architectures incorporate clustered taps with 32, 40 or more tap ports at a single location. The drops then emanate from this tap point to the homes. The approach can result in drop lengths of over 500 feet. Drop cables incorporating one or more twisted pairs for telephony also have been introduced to certain European markets.

The CATV system architecture is undergoing an evolution to greater capability. The architectures and equipment that have been developed over the last 40 years are being proven by many to be capable of expanding, evolving and being augmented to handle future requirements. The electronic platforms capable of supporting extended bandwidth are now available and in some cases have been available for several years. Coaxial cable is now being sold that is capable of 1 GHz operation and fiber-optic cable is bandwidth unlimited for all practical purposes. Because the low loss of fiber-optic cable, links are passive in nature and an upgrade in the future consists of changing the electronics located at the ends of the link.

The RF components themselves are modularly upgradeable and the hybrid development to accomplish this upgrade is underway. The incorporation of fiber optics in trunk and supertrunk applications lessens the design constraints on the hybrid manufacturers such that the system design goals are achievable in the not too distant future. Such fiber deployment may ultimately extend into the feeder, but it is likely that RF distribution into the home will remain a preferred distribution technology for another 20 years or more.

Cable's future

(Continued from page 24)

fairly small part of our investment, so it won't have a major impact.

The other target is trunk, and that really is a bottleneck. We all know it is a result of the fact we have so many trunk amplifiers in cascade, all adding noise. The answer to that part of the problem is pretty obvious and that's why so many of us are beginning to use fiber.

Time to upgrade

Conventional CATV plant has two "layers" (Figure 2). One layer is the trunk network, which is designed to go long distances from the headend into the system. The other layer is our feeder cabling, which wires each neighborhood. That's how we have always built cable plant. We have done it this way for some very good, very practical reasons. It keeps the number of amps in a trunk to a minimum and yields the best possible signal at a decent cost. We kept feeder separate because it has lots of taps and lots of connectors in series in order to provide service at each pole.

When it comes time to upgrade this kind of system, if the cable is sound it makes sense to reuse the existing cable and simply feed the system a little differently. And that's what we call fiber backbone. Another layer is added (Figure 3), which is the optical fiber trunk coming in from the headend. By doing this, you can break the trunk up into very small pieces with very good performance and you can operate your feeder the same way you always have. If necessary, you can upgrade the actives and passives in the coax network. With this kind of technique you can take a 220 MHz system and upgrade it to 550 MHz at a pretty reasonable price. The fiber equipment to do this is available, the costs are coming down and performance is increasing almost monthly. If you have sound coax this is the obvious way to get substantially better performance at substantially less cost than a complete rebuild.

The coax dinosaur

But this is not a particularly smart way to build a new plant or to do a complete rebuild. And we have all seen plant that *must* be rebuilt. The cable may be unsound for any number of reasons—age, corrosion, etc. It needs to be rebuilt, but building a three-layer system does not seem to make very much sense.

"If we box ourselves in and build brand new, all-coaxial systems, I think we are really missing the boat."

We think what does make sense is a two-layer system, where we forget about coax trunk (Figure 4). It is something of a dinosaur and no longer serves a purpose if we can take fiber deep into the system. What my company refers to as fiber trunk and feeder (FTF) is an attempt to do exactly this: eliminate trunk amplifiers, eliminate trunk cables and use the savings to buy more fiber equipment. It's not meant to cut trunk cascades to eight or 10 or 12, but to get rid of trunk cascades completely and connect to the feeder plant directly.

Even if you have a little deeper feeder than we are used to (maybe three or four line extenders), I think this is a sensible way to build plant today, either in a complete rebuild or in an extensive new-build. I think that means that we are rapidly approaching the time when trunk is going to be obsolete. The rules have changed. The

Figure 3: Architecture for coax with fiber backbone

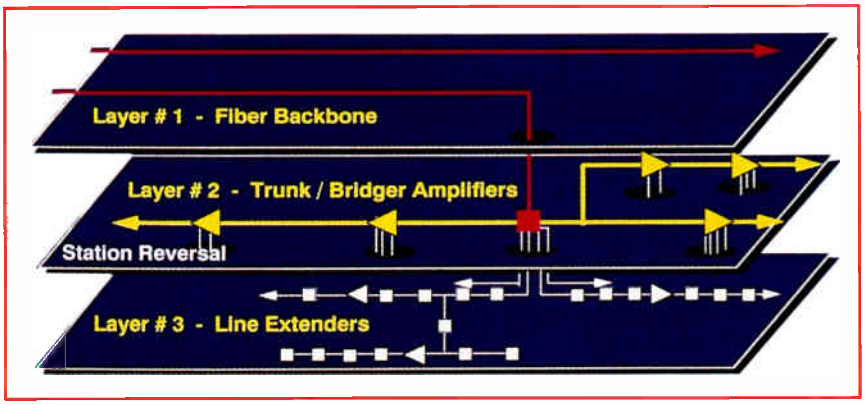
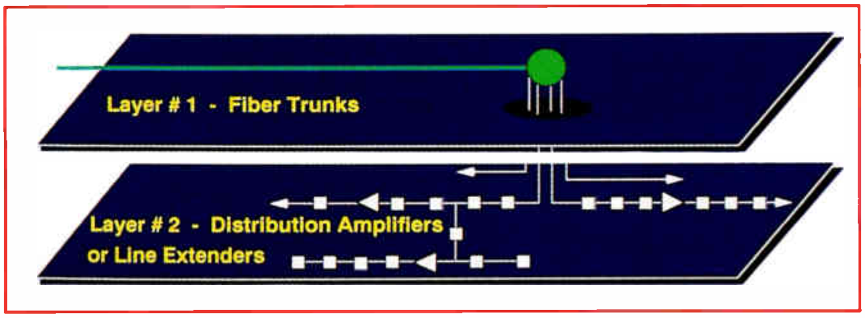


Figure 4: Fiber trunk and feeder architecture



rules of designing cable plant are evolving and we need to rethink how we do these things. Fiber has very low loss, so let's use it for trunks and keep the coax for the feeder where it is very cost-effective. In most cases the cable is already in place, so we can use that for the last mile to the home.

Star-and-bush

This leads to the following type of architecture. There are numerous fiber trunks leaving a headend and branching out into each neighborhood. One term for this type of architecture is star-and-bush. This does an interesting thing for us—it gives us direct access to each neighborhood from the headend. We need to think how we are going to use that. The first thing that happens it that fiber lets us cost-effectively make our plant play a lot better. It lets us add channels to our systems and makes a more reliable system. And that's something that we need right now.

Each of us have systems out there that need this kind of upgrading in the near term. But where we need to go next is the very high capacity system. A system like this isn't going to stop at 550 MHz. It doesn't have to. It can go to 650 or 870 or 1,000 MHz. I'm not sure how far it can go. The cables we have in place (even the cables we put in 20 years ago, in many cases) can carry frequencies far in excess of what we've ever asked of them. And even though they may have a little higher return loss at those higher frequencies than we like, in short trunk cascades and in feeder, it won't really be a problem.

What will we do with a 1,000 MHz system? Let's discuss what may be the "spectrum analyzer display" of the future (see Figure 5). There are 70 broadband AM channels (the ones we're all used to). Beyond 600 MHz there is a single carrier, centered at 800 MHz. It is 400 MHz wide and that single carrier could possibly carry a digital signal of 1,000 megabits per second. That's a lot of information, depending on the kind of coding we use. And that opens up some interesting possibilities.

More capacity

There's a way here for us to begin to think about where we're going to go in the next century—the next millennium. We can keep our broadband signals in the present form and at the same time add more capacity, which can be digital. And if the hardware comes along at a reasonable price, it can be compressed. You could put a lot of channels in that kind of a single signal, but using the kind of technology that has been discussed by Sky Cable and other companies working on video compression. That could be 40, 60, 80 or 100 high-quality digital channels and it could include high definition TV (HDTV).

This does not have to be *the* way we would use a 1,000 MHz system. But it is *a* way we could use it and is a way that we could begin to move into some new technology. So, if we get to this point, we could have a hybrid plant—a hybrid fiber/coax cable plant; a hybrid analog/digital plant.

Let's do it! But what are we actually going to deliver? And how? I have attempted to define what kind of terminal might receive the signal I mentioned before. This could be on the pole or it could be on the side of the home. It would have a broadband path that could include signal interdiction for the spectrum from 50-550 MHz. The digital channels could be demultiplexed, decompressed, decrypted and the channels selected could then be added to the broadband channels going into the home.

So, from the point of view of the subscriber, we could go from the 70-channel system to a 71-channel system. But the 71st channel would be one of many choices. It could be one of 80 pay-per-view channels, for example. I'm not sure that we know yet how we would use 80 pay-per-view channels. I think it would be a little more complicated and have a little more opportunity for our customers than just offering a few movies that they might order. It might be movies that begin every 15 minutes for viewing convenience. It might be things besides movies.

Think of the magazine industry. It wasn't too long ago that having just a few general interest magazines in your home was what was expected. But today, people have magazines on virtually every subject—coin collecting, fishing, etc. There's a big market out there for special interest information. And in a high capacity cable system it may be that there are very specialized services that we could deliver to our customers using this kind of technology.

It could be that we would deliver the general interest channels on broadband and specific interest channels on a transactional basis using digital technology. From the point of view of the subscribers, this is now a system with 150 choices and 71 channels. The customer's cable-compatible TV set can still work, and yet if we simply add an ordering mechanism for the

71st channel, you could choose between 80 additional programs at any given time. That's an intriguing possibility.

Taking it further

But we can go beyond that. Let's say at this point we've already got a 150-channel plant in the system, we've got a device at the home that can select any one of those 80 pay-per-view channels and we merely add a few things to the headend (some switching). Instead of just sending 80 channels out to the whole system, we can send a different 80 channels to each neighborhood. But, if you've got 300 homes on every fiber trunk and you've got a different 80 channels you can send to every 300 homes, I think you can send a different channel to a whole bunch of people—80 people in each neighborhood. And then you just need a little load engineering.

This leads to the question of how often will more than 80 people want to watch different transactional services simultaneously and therefore get a "busy signal?" When that happens, you simply overlash more fiber and feed 150 homes with 80 different channels.

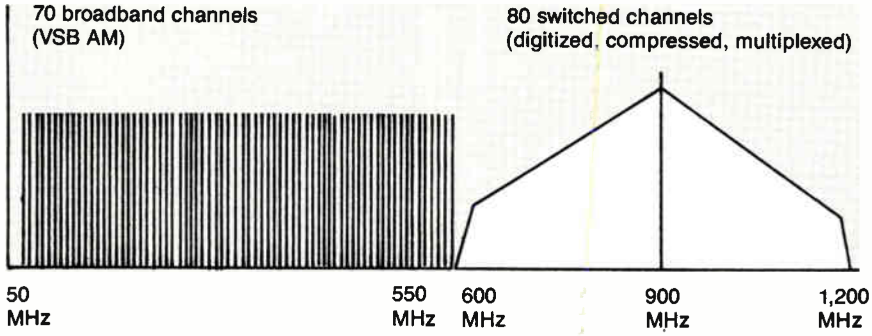
This is one approach and I am not going to claim it is the only approach. But this is one way we can take technology that all of us can envision today and go a step at a time, spending money now on upgrading the trunk with fiber. Then we make an investment in upgrading our feeder plant, and we think about using and going out and finding taps that will pass 1,000 MHz and paying another dollar or two for them.

A little later we add a lot more pay-per-view choices and we do that because we can get additional revenue. And then there's a final step, with another investment (not a terribly small investment): we add switching. And we do that because we find that there is a business in video-on-demand (in switched video).

From the customer's point of view, we go from today's 30 channels to tomorrow's 70 or 80 and then beyond that by adding another 80 transactional channels. The choices for the subscriber keep getting greater and greater as we gradually evolve from lots of pay-per-view into a switched video network.

This is a direction in which I believe we can move. We all need to put a lot of thought into where we should go. Our industry needs to reach some consensus to give our vendors guidance about where this is all going. I think they'll respond by developing pieces we need. □

Figure 5: Spectrum configuration for 1 GHz plant



AM fiber

(Continued from page 26)

optimum internal device coupling.

The power incident on the receiver of a system is obviously a function of the transmitted power and the sum of all optical losses in the path. While limits on launched power do exist due to nonlinearity in the fiber medium itself, typical CATV devices have substantial room for improvement. In a companion paper[2] Roxlo and Flynn review the efforts and progress in increasing the optimum operating power level in lasers.

Noise sources

Noise sources listed in Equation 1 include shot, front end and total RIN. Let's look separately at the current state of the art for performance in each area. The accompanying figure shows a model of AM receiver performance and the various noise sources.

Shot noise—The conversion of light energy, which arrives at the detector (PIN) junction in photon "packets," each at a particular energy level, to an electrical current flow involves the generation of hole-election pairs in the intrinsic junction region as the photons are absorbed. The effectiveness of this conversion is a statistical function and the deviation from perfect conversion is referred to as quantum or shot noise on the detected signal. It is given by:

$$\overline{i^2_s} = 2e\,I_p \quad A^2/Hz \qquad (4)$$

Where:
e = charge on electron
Ip = detected current

This noise is assumed to be spectrally flat over the CATV region of interest. Shot noise represents a fundamental limit on overall noise performance, to be asymptotically approached as other noise sources are reduced through improved device performance. For calibration purposes, the accompanying table gives typical shot noise currents for detected CW carrier powers typical of AM lightwave systems. It should be noted that shot noise is a function of the average of "DC" current flow in the detector. This implies that a laser-based system running at relatively lower index of modulation will experience a higher component of shot noise in the total receiver noise calculation.

Relative intensity noise—Carrier-based intensity noise, commonly referred to as RIN in laser-based systems, may be looked at as the sum of two noise generation mechanisms. The first mechanism, or collection of mechanisms, is related to the specifics of the laser design. Processing techniques, packaging techniques, degree and adequacy of isolation all affect the "component" part of RIN. Additionally, there are noise generators external to the laser that also must be considered by the system implementor. We will discuss these areas separately.

- Laser source—There are several excellent references in the literature [3,4] discussing RIN at the component level. Component RINs, measured at the output pigtail under well-controlled conditions, typically are in the region of −152 to −155 dBm/Hz (mean) with a tight distribution, on the order of $\sigma \approx 2$ dB. Many units on the best side of this distribution are within a few decibels of the quantum noise limit for the lasers. The quantum limit[5], on the order of −160 dBm/Hz, is similar to shot noise in origin and represents the fundamental limit on laser noise performance. Excellent RIN performance is achieved with proper device design, low reflectance packaging and effective isolation of the output pigtail with an internal or external isolator.

RIN performance for devices is often specified for AM lasers at the component level. Typically, minimum specifications are given under excellent but realistic reflection conditions.

- External effects—A second significant degradation associated with reflections, which from the receiver's perspective appears as RIN, is the interferometric conversion of laser phase noise to intensity noise[6,7]. In the limit where the distance between reflectors is much larger than the coherence length of the laser, it can be shown that the carrier-to-noise ratio is limited by the following inequality[8].

$$C/N < \frac{\sqrt{2\pi}}{8}\,\frac{m^2}{R^2}\,\frac{B_1}{B_s} \qquad (5)$$

Where:
R = geometric mean of the reflectivities
B_1 = spectral width of the laser due to chirping (HWHM)
B_s = noise bandwidth of an individual TV channel
m = modulation index per channel

Taking typical values for B_1 (4 GHz), B_s (4 MHz) and m (0.04), we find that:

$$C/N < 55\text{ dB if } R > -29\text{ dB} \qquad (6)$$

Additionally, it is observed that the distributed backscatter of a long length (>12 km) of single-mode fiber will exhibit a reflectance equivalent to point reflectors at R ≈ − 32 dB, for which the C/N floor is −58 dB.

For lasers exhibiting RIN in the −150 dB/Hz region that is a secondary effect. It must be considered as unavoidable "implementation degradation" (i.e., beyond the component specification) for laser components with very low RINs (−155 dBm/Hz or better) and for systems where very narrow line width lasers (B_1 < 1 GHz) are employed. For direct modulated solid-state lasers, it should be noted that the modulation current itself induces significant chirp (> 4 GHz).

Front end noise—Noise to electrical sources in the front end amplifier or integrated optical receiver represents a significant opportunity for creative RF circuit design. The performance of most existing digital lightwave receiver devices presently in use for 1 Gb/s and up and having the required bandwidth for CATV applications generally falls significantly short of the requirements for overload and linearity. Typically, the average received power in a CATV AM link is 25-40 dB greater than a state-of-the-art digital system.

First generation AM receivers had equivalent input noise current in the range of 12 to 14 pa/√Hz. These levels were achieved with high performance, high gain CATV hybrids that also had the

Shot noise currents

Detected current (mA)	Shot noise current (pa/√Hz)
2.0	25.5
1.25	20.1
1.0	18.1
0.75	15.5
0.5	12.8

"While limits on launched power do exist...typical CATV devices have substantial room for improvement."

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necessary power handling and intermodulation performance. At this level, front end noise current was comparable to the typical RIN current and shot noise current for typical 5 dB links[9].

Recent device developments have shown that reducing these noise current levels to the 4 or 5 pa/$\sqrt{\text{Hz}}$ range is both practical and manufacturable. One approach uses a passive impedance matching network to achieve "noiseless" gain between the PIN detector and the amplifier device. A second approach is a conventional low noise transimpedance amplifier design optimized for the low noise, high bandwidth, high output power requirements of CATV. The test results to date on both units have revealed similar results.

Further reduction of input noise will yield marginal results. From a comparison between the 5 pa/$\sqrt{\text{Hz}}$ level and the table of typical shot noise and RIN current levels, it is apparent that front end noise can now be a less significant but still measurable degradation. Still lower noise active circuits, higher "noiseless" gains or the addition of noisy gain between the PIN and amplifier with an avalanche photo diode (APD) are possible, yet none exhibit significant potential and may be beyond the current state of the art.

Summary

Deployment of AM lightwave systems has generated a series of in-depth studies of fundamental mechanisms and provided a substantial base of actual field data. This accumulated experience also highlights areas for cautious optimism on improvements as well as providing practical guidance for field implementation engineers. [ ]

References

1 A.A.M. Saleh, "Fundamental Limit on Number of Channels in Subcarrier-Multiplexed Lightwave CATV System," Electronics Letters, vol. 25, no. 12, June 1989.

2 E.J. Flynn, K.M. Lee, C.B. Roxlo, L.C. Upadhyayula, J. Lipson and T.A. Corser, "Performance and Reliability of Laser Devices for CATV," SCTE Fiber Optics 1990 proceedings, March 1990.

3 H. Temkin, N.A. Olsson, J.H. Abeles, R.A. Logan and M.B. Panish, "Reflection Noise in Index Guided InGaAs Lasers," IEEE *Journal of Quantum Electronics*, QE-22, 286 (1986).

4 T. Sugie and M. Saruwatari, "Distributed Feedback Laser Diode to Single-Mode Fiber Coupling Module with Optical Isolator for High Bit Rate Modulation," IEEE *Journal of Lightwave Technology*, LT-4, 236 (1986).

5 Y. Yamamoto, "AM and FM Quantum Noise in Semiconductor Lasers—Part 1: Theoretical Analysis," IEEE *Journal of Quantum Electronics*, Vol. QE-19,34 (1983).

6 A.F. Judy, "Intensity Noise from Fiber Rayleigh Backscatter and Mechanical Splices," 15th European Conference on Optical Communications, (ECOC '89), Gothenberg, Sweden, Sept. 10, 1989.

7 M.M. Choy, J.L. Gimlett, R. Welter, L.G. Kazovsky and N.K. Cheung, "Interferometric Conversion of Laser Phase Noise to Intensity Noise by Single-Mode Fiber-Optic Components," Electronics Letters, 23,1151 (1987).

8 T.E. Darcie and G.E. Bodeep, "Lightwave Subcarrier CATV Transmission Systems," MTT and JLTE joint issue, April 1990.

9 C.J. McGrath, "Multichannel AM Fiber-Optic CATV Trunks—From Lab to Reality," NCTA 1989 proceedings, Dallas.

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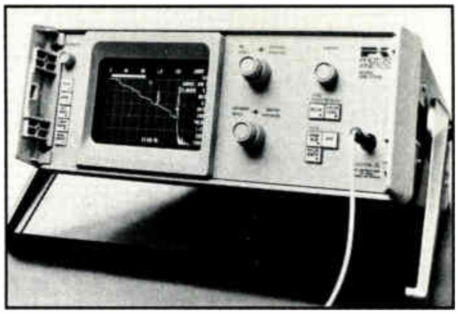
Surviving fiber

(Continued from page 28)

nector (or splice) and at the receiver input can be measured and these numbers used to calculate the cable plant loss. From these two numbers then, the primary operating parameters of the link can be determined. These basic tests should be performed at installation and the data recorded for later reference in case of trouble. Also during the installation phase, an OTDR should be used to test optical return loss to make certain it meets system specs.

Troubleshooting problems

The system is having problems, what do you do? The first place to look is at receiver optical power. If the receiver has its own power monitor, check the warning light. If the receiver has no power monitor, you must use a fiber-optic power meter to test the power. This is done either by going into the link directly or through a tap installed in the link that can be used as a test point. If power is adequate at the receiver, the problem is either in another part of the system after the receiver or inside the receiver itself. Troubleshooting then must be done either by using more



The OTDR gives a "picture" of the fiber along its length.

sophisticated test equipment or by swapping fiber-optic equipment to find the faulty component.

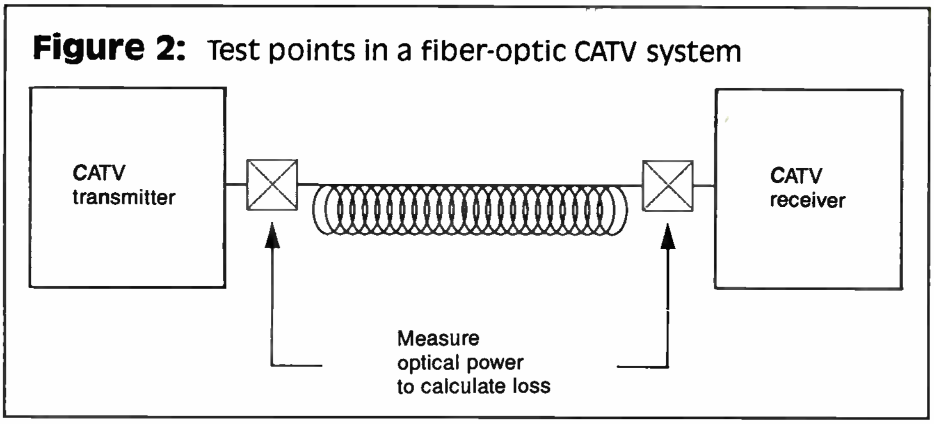
If the receiver power tests low, either there is a problem with the transmitter output or the cable plant. By next measuring the transmitter power, the problem area can be quickly isolated. If the transmitter power is low or zero the transmitter is obviously the problem and must be replaced. If transmitter power is within normal limits the cable plant is the problem.

If the cable plant is the problem, an OTDR or cable fault locator is needed to find the trouble. These instruments work like radar, shooting a high power pulse down the fiber and analyzing the return signal. They will tell you where high loss points in the cable are, whether the cable has been broken and finally, spot points of poor optical return loss.

Sometimes the cable problem is too close to the end in the "dead zone" of the OTDR. Then a HeNe laser visual cable fault locator is used. This unit puts a visible light into the fiber that actually will show breaks, bad connectors and splices as a visible glow, even through the yellow cable jacket of single fiber cables. You just connect it to the cable, turn it on, turn out the room lights and look for faults.

If the cable plant has a problem, call an

The optical fault finder is a low-cost alternative to the OTDR to find cable faults.



The HeNe laser visual cable fault locator allows troubleshooting fiber-optic cables in the OTDR's "dead zone."

installation crew and go fix it. If a splice or connector with poor optical return loss is spotted, it needs resplicing or cleaning and reconnecting with new index matching jell to get rid of the back reflection that is bothering the laser transmitter.

Preparing for survival

How does the system operator prepare for surviving emergency outages? First consider training. Maintenance personnel need to be well versed in fiber-optic technology, testing and troubleshooting. Besides training classes, several good video training tapes are available. If a large system is being supported by system personnel, more sophisticated training, including splicing and use of OTDRs would be advisable.

Adequate fiber-optic test equipment needs to be available at key locations. A simple power meter "survival kit" should be placed in every building housing fiber equipment and given to all field personnel troubleshooting problems. Many systems will have their own OTDR or cable fault locator, unless they rely on a contractor to provide diagnosis of cable plant problems. Likewise with splicing equipment; big systems will have their own, smaller ones will use contractors for emergency restoration. And don't forget to stock some replacement cable for the plant, in case of a major break, since 10- to 100-meter sections are sometimes needed for replacements where splices are made. And spares of any jumper cables are cheap insurance if a cable is broken.

In conclusion, maintaining a fiber-optic CATV system is as easy as any other system. One must merely transfer the thinking from copper to glass, train personnel and acquire some test and repair equipment to be ready. If the experiences of current users of fiber systems is any indication, you won't need it very often!

Fiber training

(Continued from page 34)

testing, connectorizing and installing. Classroom training is only an initial step. On-the-job training experience is essential in developing competent technicians. Hands-on training is important to system designers and managers. It gives a proper perspective on what is and isn't important in designing a system and what can be expected of their personnel.

Large corporations can afford to provide their own training centers. For smaller companies that can't justify a separate training division, third party training companies are their link to increased productivity.

If you are considering outside training, shop around. Ask about equipment, instructors and training aids, and get referrals. A student/instructor ratio of three-to-four students per instructor is ideal for hands-on training. Find a company that covers subjects from an unbiased comprehensive perspective. Vendor training companies offer good training but anticipate a promotion of their equipment. Some manufacturers and vendors offer free training or training as part of the sales agreement. Have them train you on their equipment.

"To handle the expected growth (in use of fiber), the average cable technician today will need to be prepared to install, troubleshoot and repair fiber-optic cable."

In-house or on-site training has its advantages. Your company can request customized course content to fit your needs. You can be trained on the equipment that you will be using. Also, in-house training reduces travel expense, time and inconvenience. The financial break-even point for considering in-house training may be as low as three individuals. (Now I'm not supposed to mention this, but there are those who choose their training location in luxurious vacation hot spots—a good idea if you can slip it past the manager.)

Media-based training

Although classroom training is effective, other less expensive alternatives should not be ignored. New inexpensive technology allows for shared training media in the price range from $10 to $1,000. You might want to consider videotape, audio tape or correspondence course training.

Video training has become an alternative to the classroom setting. For the price of just one video training course you can send the course to each employee to watch at their convenience and the information is on hand to review whenever. A $200 video can go a long way. Most of the fiber-optic and related videos put the liveliest of us to sleep, but they do carry useful information if you don't mind grinning and bearing it. I expect continued improvement in this arena. Many manufacturers loan or donate brief videos marketing their products and services. They are limited in depth but do have some training value.

Audio tapes fall into the same category as videos, with the same strengths and weaknesses. They do have one unique advantage, which is they can be played just about anywhere. You can even listen to it in your automobile if you're sick of the 5 p.m. rush hour news. Building a catalog of various technical tapes that can be checked out is a good move for any company desiring to upgrade the technical level of its personnel.

Some companies offer correspondence courses on fiber and related subjects. These are good for learning theory, but won't take you much farther. If your employees wish to gain college credits in job related courses, this is a good option. Also, evening courses at vocational colleges can provide credits and may be a good investment for both employer and worker.

Shows and trade journals

Conference programs and trade shows are in abundance and provide opportunities for inexpensive quality training. Vendors are always eager to provide whatever information they can. The Optical Fiber Conference (OFC) on the West Coast provides the newest developments in design and components of fiber systems and Fiber Tour of Boston zeros in on the practical aspects. SCTE conducts conferences focused on fiber as it relates to the CATV industry. There are conferences on sensors, ISDN, FDDI, LANS, electronics and communications that pertain to the fiber field. You choose the topics of interest cafeteria style. There are also satellite link training programs such as NTU, which may be watched on a pay-per-view basis. Some companies pay a set fee to receive these broadcasts for their personnel. Peruse various publications for dates and locations of these conferences and training programs. Other options include traveling seminar programs, ranging in cost from $600 to $1,500 each. Quality instructors flood you with facts for two to four days in a group of about 25 people.

Another element that should not be downplayed are trade journals, publications and books. Consider paying for home subscriptions of these for your co-workers. They will be appreciated and well read. Don't neglect to receive the many free publications. The standard's committees provide a good source for reference materials. Books also are an alternative, but they act best as a resource and not a tutor. Establish a company library where books can be checked out.

Training is not without drawbacks. It can be expensive. The average fee for communications industry training is $250 per day. This does not include wages, travel and hotel expenses and training aids (such as golf clubs, etc.). In addition, small businesses constantly face recruiting and training difficulties because they regularly lose trained workers to larger firms who can offer more benefits. Each time you provide training for individuals you make them more valuable to someone else. Because of these problems, I advise companies to evaluate their training needs carefully. "Assess the extent of the skills problem and consider options for mitigating it," notes Anthony Carnevale, chief economist and advisor for the American Society of Training and Development. Make it known that it is the responsibility of those who receive the benefit of special training to pass it on to their co-workers.

"Training lets employees know what is expected of them. It lets them know that they are important enough for an employer to invest time and money. And it boosts morale and increases productivity," says Karen Dunn, CEO of Sterling Consulting Group, in Sausalito, Calif.

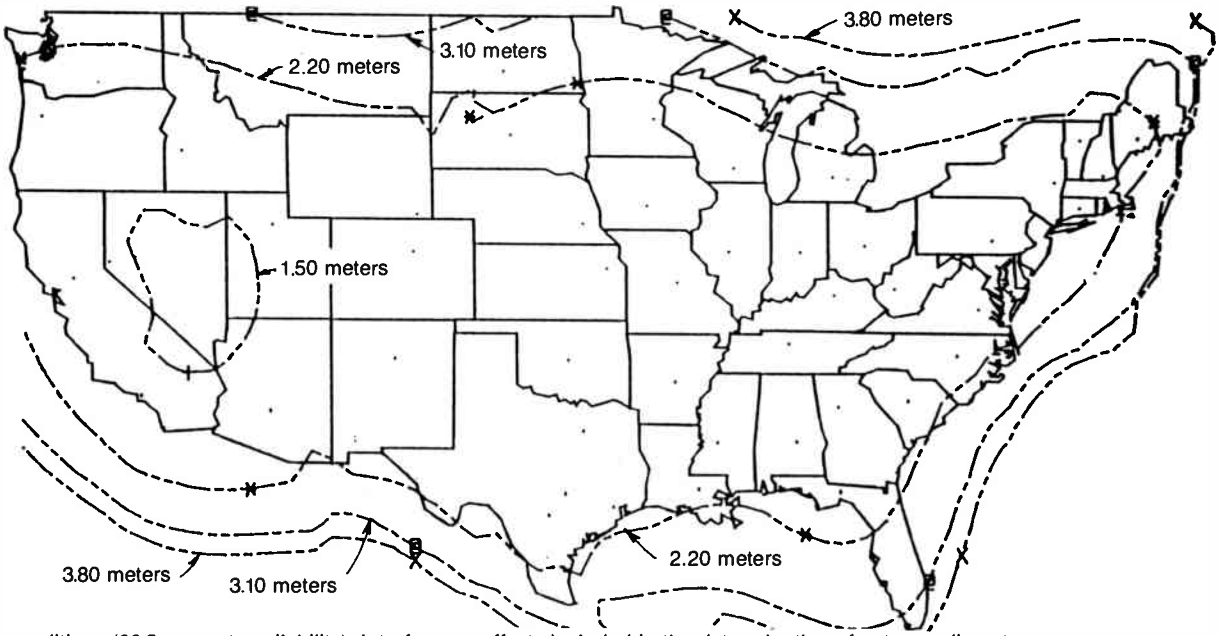
For the right individual, training increases loyalty. Individuals stay motivated and positive when they have the opportunity to better themselves. Stagnancy sows discontent. Balance is the key. Providing the right training to the right individuals at the right time will produce depth, open unexpected doors and bring many financial rewards for the future of your firm.

ATV antennas

(Continued from page 44)

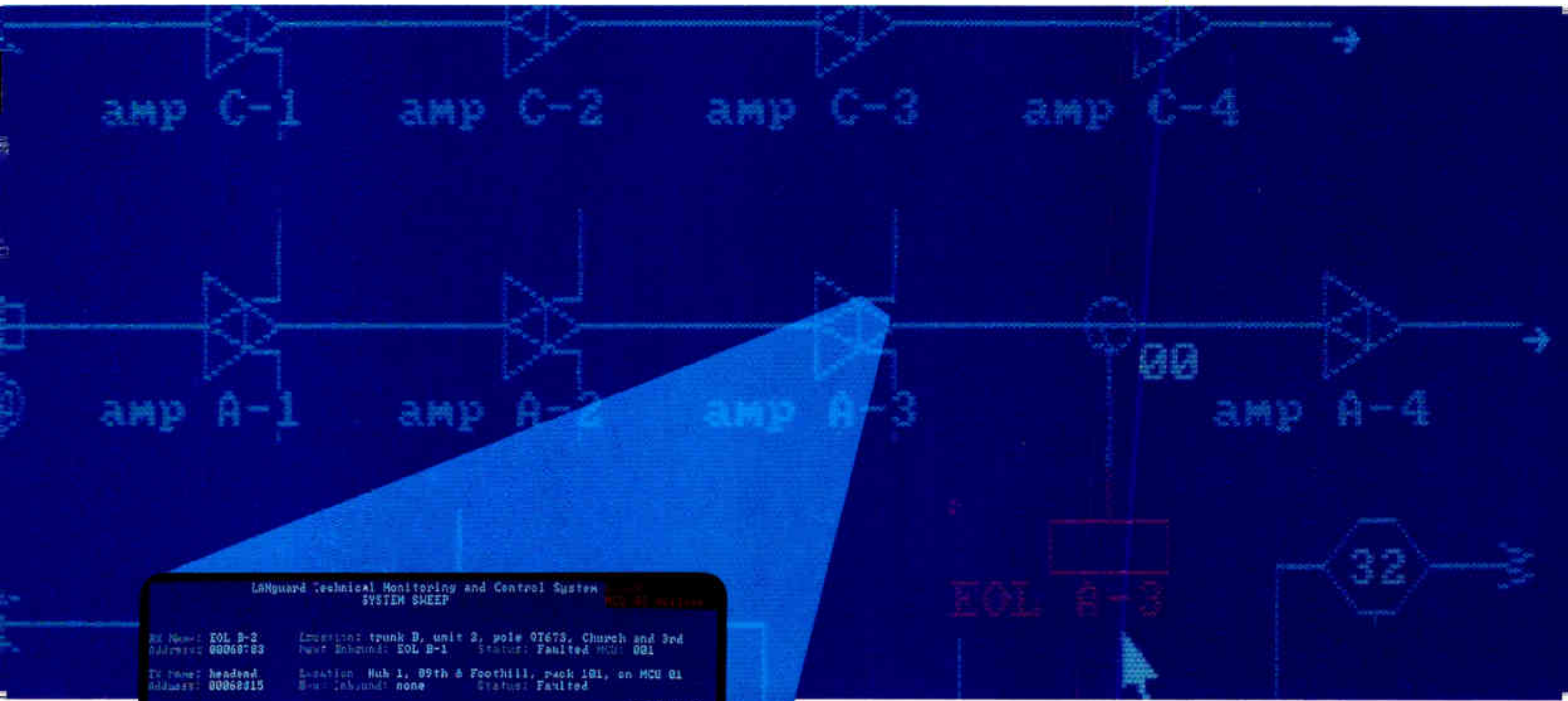
is inaugurated. Several such satellites are now under construction and will be launched in 1992. Transmission of ATV channels through lower power satellites would, of course, require larger diameter receive antennas. For example, for a transponder amplifier power of 8 watts (and corresponding EIRP of 34 to 37 dBW), the required earth station antenna diameter would increase to the 4.5- to 6.1-meter range.

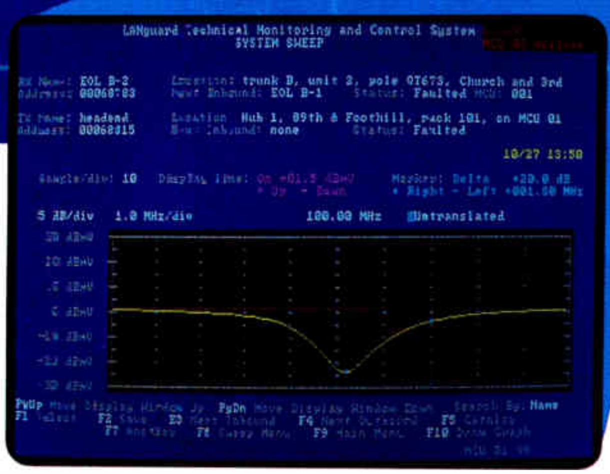
Figure 7: Isodiametric contours for the reception of ATV in Ku-band; format transmitted in HDS-NA with 25 percent overdeviation



Rain fade conditions (99.5 percent availability). Interference effects included in the determination of antenna diameters.

Pinpoint Potential Problems *Before* They Happen...





Actual screens from the LANguard™ system depict topology and sweep analysis displays.

...With LANguard™ Status Monitoring

Using LANguard™ can mean the difference between facing irate subscribers due to prolonged service down time and having satisfied customers enjoying quality reception with minimal interruptions.

LANguard's™ ability to spot trouble before it becomes a problem is due to its many sophisticated, yet easy-to-use features including:

- ❑ Support For *All* Amplifiers and Power Supplies
- ❑ Auto Sweep and Spectrum Analysis
- ❑ Agile Frequency Monitoring
- ❑ Ability To Monitor Multiple Systems Simultaneously

plus much more...all without interrupting your signal.

With regulation on the horizon, you realize the importance of service excellence...and you can see the savings potential that comes with knowing exactly where breakdowns occur. More importantly, you have the peace of mind knowing that you can catch problems before they occur as LANguard™ watches each of your signals in relationship to the specifications *you define*.

LANguard™ status monitoring has a proven track record with many large corporations that depend on their network's integrity (downtime can literally cost them thousands of dollars *per minute*).

If you would like this kind of quality assurance for your CATV system, call us at (215) 536-1354 today. A FREE demo diskette is available that shows you, first hand, how powerful and how simple LANguard™ is to use for status monitoring excellence today... tomorrow...and for many years to come.

AM is vendor independent, providing components for virtually every CATV configuration.

Reader Service Number 83.

AM Communications, Inc.
1900 AM Drive
P.O. Box 9004, Quakertown, PA 18951-9004
Phone: (215) 536-1354 Fax: (215) 536-1475

the INTERVAL
SCTE

September 1990

FOCUS ON:

THE INSTALLER CERTIFICATION PROGRAM

SCTE

Society of Cable Television Engineers

INSTALLER MEMBERSHIP CARD

Name: Vincent J. Adragna
I.D. Number: I 1058
Expiration: 08/01/91

The above individual has successfully completed the areas indicated:

Cable Preparation   Meter Reading
Written Examination

The goals of the SCTE Installer Certification Program are to establish minimum skill requirements for installers and installer/technicians in the cable TV industry. Once they have mastered the elements of the program and successfully completed the required examinations given by SCTE, the Society will award them a certificate indicating their competence in this area.

Local SCTE chapters and meeting groups, under the guidance and direction of SCTE national headquarters, will conduct the training and examination of all candidates. Installer training workshops and certification examinations also may be given by any national SCTE director, members of the national SCTE staff, or other individual designated by the Installer Certification Program Committee.

Installers and installer/technicians applying for certification will be charged a $25 registration fee. This fee will entitle the applicant to one full year's installer membership in SCTE, as well as covering the cost of the installer manual and the initial certification examination fees. Annual dues for renewing the installer level of SCTE membership will be $20. Additional copies of the manual alone are available at $15 each.

Installer membership in the Society entitles the individual to all of the discounts afforded SCTE members at conferences, meetings and seminars, as well as discounted prices on all products, publications, materials and videotapes sold by the Society. Installer membership does not include voting privileges, holding an SCTE office at national or local chapter and meeting group levels, insurance coverage or any other active membership benefits that require an expenditure of Society funds. A special membership card will be issued for installer members.

The certification program will consist of training conducted by local chapters and meeting groups using the installer manual as the basis for classroom training as well as "hands-on" training in proper drop cable preparation and fitting installation and signal level meter reading.

Upon completion of the training program, a 50-question written examination provided by SCTE national headquarters will be administered to the candidates. Chapter and meeting group presidents will be authorized to proctor this examination. Other local chapter or meeting group members may also receive approval to act as proctor following application to the certification committee. Prerequisite requirements for proctors include national membership for at least three years and a statement of ability from the chapter or meeting group. Written examinations must be scheduled with SCTE national headquarters at least 45 days prior to the examination date. The number of examinations and answer sheets required must be submitted two weeks prior. All tests and answer sheets must be returned to SCTE national headquarters within two days following the examination date. The results and certificates will be returned within 30 days. In addition, an endorsement will be placed on the installers' membership cards indicating their certification by the Society. In order to reimburse groups for their training and testing efforts, each chapter and meeting group will receive $5 for each full certificate issued through their group.

In addition to the written examination, two practical examinations will be conducted. The areas covered under the practical examinations are:

1) proper drop cable fitting preparation and installation, and

2) signal level meter reading.

Each of the practical examinations, when successfully completed, will be recognized with special seals that are to be attached the certificate. Proctors for the practical examinations also must be approved by the certification committee.

Installer Certification by the Society is valid for a period of three years. The triannual recertification process will be announced at a later date.

SCTE and its local chapters and meeting groups are expected to seek support for the program from state cable TV associations and cable system management. It is our hope to convince industry management that every installer and installer/technician working in their systems should be certified—both in-house installers and contractor personnel.

The following are the Society's installer members listed by their employer. SCTE congratulates these companies for their recognition and support of the training of technical personnel at the installer level.

<u>ATC Appleton</u>
Corry Fenske
Steven Melchior

<u>Adelphia Cable Communications</u>
Loren Bradshaw
Wayne Porter, Adelphia Corp.

<u>Allegan County Cablevision</u>
Patrick Gibson
Earl Miller
Randy Miller

<u>Alpine Cablevision</u>
John Campbell Jr.
John Linkous
Ronnie Whaley Jr.

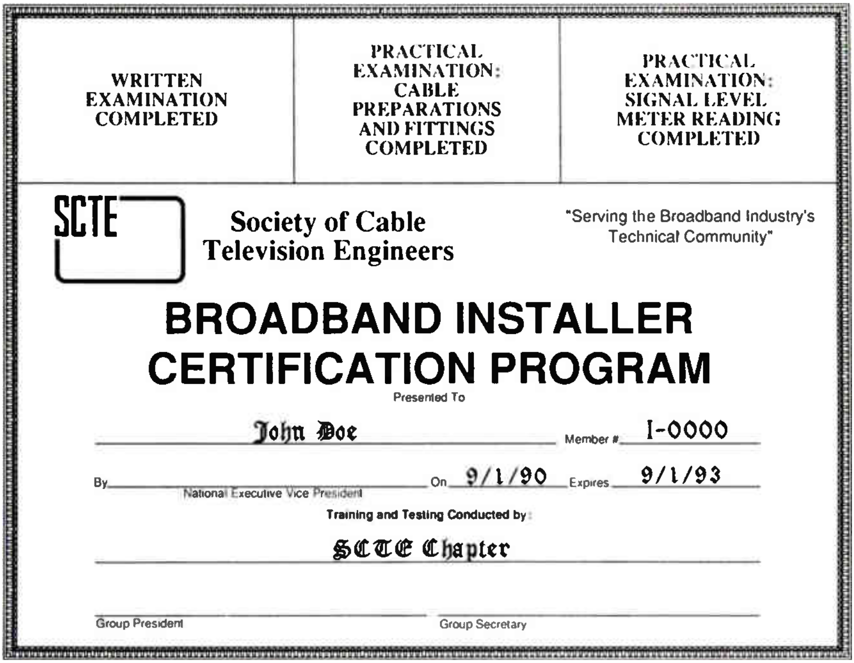
<u>Baldwin Telecom</u>
Tim Kusilek
Jeffrey Segelstrom

<u>Bingham County Cable</u>
Hal Truman
Kim Truman
Dennis Whitehead

<u>Cable TV Montgomery</u>
Robert Armstrong
Rayoldean Baker
Reggie Barksdale
James Barnes
William Beacht
Aaron Beckett
Wallace Bell
Julie Blank
William Bowles
Gregory Chaplin
Thomas Chase
Brian Covington
Carl Crawford
Samuel Cruz
Mohamed ElRafi
Vichael Fairchild
Anthony Fitzgerald
Roosevelt Green
Steve Groce
Sean Guihen
James Hammons
Marvin Harris
Denon Hopkins
David Hurt
Collis Johnson
Sam Kisseleff
Ken Laroche
Edward Lesser
Charles Mazaleski
Jonathon Newmann
Lester Parker
Douglas Patton
Jammie Poindexter
Reginald Primas
William Sheffield
Frank Shultz
Jeff Singer
Anthony Smith
Michael Smith
Peter Smith
Calvin Spruill
Timothy Steffish
Ron Sutton
Mike Swaney
Christopher Uher
Keith Wilkins
Errol Williams
Sean Winkfield
Allen Witherspoon
Robert Youger
Robert Young
Mark Younger

<u>Cable Vision</u>
Jeff Brisson
Jane Chevalier
William Dufresne
Guy Harnett
Mark Hennessy
Keith Luedtke
R.A. Nelson
Jeff Zentner

<u>Cablesystems of Watertown</u>
Milton Alexander
Patrick Amelio
Timothy Ames
Gregory Castro
James DeLong
William Gerkins
Gary Hemenway
Michael Peto Jr.
Thomas Rexford
Robert Scharf
Gary Schloop
Paul Tate



WRITTEN EXAMINATION COMPLETED

PRACTICAL EXAMINATION: CABLE PREPARATIONS AND FITTINGS COMPLETED

PRACTICAL EXAMINATION: SIGNAL LEVEL METER READING COMPLETED

SCTE

Society of Cable Television Engineers

"Serving the Broadband Industry's Technical Community"

BROADBAND INSTALLER CERTIFICATION PROGRAM

Presented To

John Doe

Member # I-0000

By ______ National Executive Vice President On 9/1/90 Expires 9/1/93

Training and Testing Conducted by:

SCTE Chapter

Group President ______ Group Secretary ______

Carolina Cable Contractors
Rodney King
Boyd McKenzie
Paul Sabot
Donald Yakey

Cencom Cablevision
William Deel
Tommy Lambert

Charles TV Cable
Jon Barrows
James Dempsey Jr.
Harry Lines
Thomas Newlen

Coeur d'Alene Cablevision
Charlie Bell
Jim Gregg
Bruce Hathaway
P.J. Mondine
Celeste Vaneation
John Webb

Columbia Cable
Michael Avery
Jim Bowen
Robert Pippen

Complete Cable Services
James Beavers
Tom Humphrey
Danny Quinn
Dave Wilson

Continental Cablevision
Joe Ballard, Continental Cablevision
Michael DeBello Jr.
Gerald Ludescher
Harry Roush

Cox Cable
Frank Antonovich
Gary Charlton
Eric Isaacson
Jim Stuchell

Cox Cable of Spokane
Mike Berklund
Paul Cota
Robbin Gard
Paul Grayhek
Randy Melius
Carl Sherwood

D&D Cable Contractors
Robert Collar
Thomas Dietzen
Sean Ebert
Russell Epperheimer
Gary Ewer
Steve Nelson
Paul Prokash

John Rodriguez
Kevin Zaidel

Dimension Cable
Mary Emmenderfer
Kathy Rollins

Durand Cable Co. Inc.
Lee Anderson
Patrick McManus

Excalibur Cable
David Devane
Jeff Lindamood

4-K Cable Service
Kevin Logan
Terry Turnmire

Gauthier Cablevision
Charles Gauthier
Frank Gauthier

H.B. Cable Construction
Charles Cantrell
Charles Harden
Clifton Heal
Jimmy Leach
Jeffrey McLaren
Loyd Messer
Jimmy Phillips

Harron Cable
Dennis Dougherty
Craig Ellis
Ken Fordham
Robert Hicks
James Mellon
Sam Teague
Bill Watson

Henkels & McCoy Training Services
Bryan Bowling
Clifford Cogdill
Callie Coplan
Kathryn Hughes
Kevin King
James Lyles
John May
Robert Mowles
Lonnie Neal
Robin Rollins

Howard Cable
Brian Cornell
Charles Sparrow

Jones Intercable
Andrew Gordon
Mike Martino

King Video Cable
Thomas Candelaria
Matt Crider
Jannel Cyr
Jeff Gabree
Karl Johnson
Dave Nay
Jeff Rankin
Don Sims
Bruce Williams
Jeff Yeggy

Marcus Communications
Thomas Guzy
Kevin Schmock
Douglas Smith
Duane VonHaden

Metrovision
Victor Gates
Don Guarisco
Paul Oelerich
Clint Post
John Schaefer

Moscow Cablevision
Clarence Cook
Dale Floch

Multivision
Charlie Bridge
Terrance King
Keith Williams

N.E.T. Cable
Ken Kabara
Elmer Rabideau

NaCom Corp.
Mark Baumgardner
James Bay
Victor Ray Beckner
James Bornemann
William Bradley
Lee Burwell
Joseph Conn
Jeffrey Connell
Steve Connell
Raymond Courtemanche
Tom Cunningham
D.A. Curtis
Bill Drury
Jimmy Drury
Craig Falkner
Kevin Gathiff
Lester Goods
Brian Hunkeze
Michael Kibuuka
Steve McClanahan
Robert McMillan
Robert Mooney
Hugh Morgeson III
Edward Murtha
Jeff Pennington
Darrow Smith
James Smith
Steve Sutherland
Brooks Thompson
Jason Williams
Paul Wooten
James Young

New Media Cablevision
Mike Harris
Paul Jansen

Oconto Falls Cable TV
John Quade
Carl Vonwinkel

Paragon Cable
Michael Adams
Larry Anderson
Gerry Becker
Gary Berry
Gary Bowlin
David Christianson
Julie Copeland
Patrick Cosgrove
John Deary
John DeLalley
Lance DeMarco
Lane Devereux
Bernie Doffing
Jeffery Doums
Jim Drobinski
Tom Dulebohn
Greg Elkerton
Edward Eysaman
Dan Fischer
Richard Flanders
Patrick Galazen
Robert Gangl
Mark Gill
John Glogowski
Brian Goodroad
Ronald Gullberg
Lon Hall
Ralph Hanson
Stephen Harris
Matt Haviland
Richard Henkemeyer
Larry Hildebrandt
Frank Holmes
John Hortman
Terry Irvin
Warren Johnson
Terrance Jones
Daniel Kaiser
Steve Keeley
James Koll
Dan Kozak
Kurt Krueger
Michael Laughlin
Michael Lloyd
Michael Loats
Jerome Lund
Mike McCarthy
Ronald McDermott
Daniel McVicker
Fred Mecklenburg
Daniel Miller
Patrick Minelis
Mark Miskowiec
Ronald Moran
Scott Olson
Jamie Owens
Robert Peters
Michael Petska
Perry Phillips
Michael Ramsey
Thomas Schnell
Scott Schoeder
James Schulz
Alberto Serrano
Frank Servedio
Randy Siemers
Ryan Snyder
Penny Spence
David Thompson
Craig Teetzel
Paul Thies
Joseph Thill
Luis Torres
Joseph Viens
Mark Vinnes
James Waldemarsen
Curt Westburg
Raymond Weaver

Raystay Co.
George Gardner
Rod Sollenberger

St. Croix Cable
Bernard Gibs
Robby Hassell
Ralston Nicholas
Abraham Ortiz
Victor Otero
Russell Ramsingh
Paul Ruiz Jr.
Jesus Saldana
Jaime Santos
Lincoln Smith
Joseph Torres

St. Maarten Cable
Ralph Boirard
Albert Richardson

Southern Wisconsin Cable
Curtis Thomas
Matt Varney

Star Cablevision
Michael Bigsby
Ken Gary
Donald Helms
David Hendrickson
James Raven
Bruce Ruffalo
Kevin Sabel
Dave Senz

Staten Island Cable
Vincent Adragna
Carlos Astudillo
Jim Byrne
Robert Crowe
Mark Dandrea
Kevin English
Steven Evensen
Kevin Hogan
Charles Philpott
Pete Schwad

Kenneth Shepard
Richard Sheridan

Storer Cable
Charles Cutson Jr.
William Sachs

Sun Valley Cablevision
Brian Brown
Victor Halstead

TCI Cablevision
Jack Betty (Pocatello)
David Brown
Michael Kempert (Greensburg)
Mike Mason (MT)
Russell Pendo (Greensburg)

TKR Cable Co.
Albert Day III
Peter Luscombe
Kenneth Malloy

TV Cable of Carlisle
Richard Alexander Jr.
Don Beatty Jr.
Michael Dilger
Alan Hostetter
Alan Jumper
Norman Landry III
David McCoy
Toby Monismith
Robert Moyer
Joe Myers
William Nickey
Calvin Roth
Scott Smith
Robert Stephens Jr.
Ronald Witherow

TV Cable of Muncy
Keith Bamonte
William Evelhair

TV Cable of Waynesboro
Larry Crouse Jr.
Brian Fawks
Rick Fawks
Daniel Lyons
Donald Mays
William Mays
Earl Rowe Jr.
Johnny Wolford

Thorp Telephone
Richard Dallas
B. Arthur Stolp

UAE-Boise
Dennis Mark
Rick Mick
Brad Stalling

United Artists
Frank Gadberry
Hal Young

United Cable
Carl Frandsen
Mark Harrigan
Stephen Kolarik
David Lockwood
John Morton
Arce Paquing
John Pruett
Gerrald Timmons
Donald Travis
Richard Whatley

Upper Valley Telecable
Jeff Bowman
David Rhoades
Ron Rhoades
Heinz Schreier
Michael Walters

Viacom Cablevision
Wayne Bronikowski
James Ellis
Marlon Frizzell
Billy Goodwin
William Hall
Tim Harris
Kevin Killets
Paul Mansfield
Clayton McKenzie
Steve McNaron
Thurl Noonkester
Chuck SanAgustin
William Stanton
Calvin Valentine Jr.
Michael Weisbeck

Vision Cable
Mark Boltz
Ron Gildea
Paul Holliday
Terry Kepley
William Lerdo
Abel Perez
Troy Rambone
Joseph Whalen
Gregory Wilson

W.W.C.C.
Arne Olson
Thomas Windjue

Warner Cable
Brian Gray
Donald Moore

Waymaker Co.
Clarence Appleby
Richard Forsyth
Douglas Hair
Ronald Perocchi

Wittenburg CATV
Dave Frigen
David Schmidt

Companies with one listing
Matthew Anderson, Amery Telecom
Edgar Ardon, American Cable Systems
Trent Bergman, Stan Cablevision
Charles Brand, West Boca Cable
Vincent Coletta, Coletta Cable Installations
Tod Dean, Alert Cable
Michael Frazier, Manawa Telecom
Adriano Gabriel, Advanced Communications
Ben Gregory, Bend Cable
Michael Guitter, Stanley Electronics
Matthew Gunderson, Casco Televideo
Troy Johnson, Cablevision Fox Cities
Dan Klebold, Cable Masters
Bill Kohrt, Kohrt Communications
Jeffrey Lake, Howard Lake
S. Lipoff, Arthur D. Little Inc.
R. Steve Mays, Nelson County Cable
Steven Miller, Wisconsin CATV
James Mills Jr., Media General Cable
Marshall Money, Summit Cable
Ralph Olson, N.R. Cable
Walter Pruitt, CATV Services
Gene Robinson, Robinson's CATV
Steve Rodella, Liberty Cable
Robert Runchey, Cablevision of Chicago
Joseph Schladweiler, Information Resources
Mark Schroeder, New Richmond Cable
Jay Shank, Midwest Cablecom
Michael Stubbe, Dowden Cablesystems
Darrell Suchomel, Wayside Telecom
Theodore Taylor Jr., Asheville Cablevision
Reilly Welsh, Summit Cable
Terrance Wenman, Cypress Comm.

Company not listed
Lawrence Christian
Eustace Crump
Robert Fields
Johnny Free
John Geis
Vance George
Michael Gibbs
Tony Howe
Craig Liotta
Danich Lusk II
Troy Phillips
James Pope
Roy Pope
John Purvis Jr.
Scott Stockwell
Joseph Leo Strehl III
Cliffy Taylor
Ronald Walker
Johnny Westerman
James Wiley
Delano Williams
Donald York

SCTE Issues Call forPapers and Workshops forExpo `91

To get a head start on the planning of next year's expo, SCTE is currently soliciting proposals for technical papers and/or workshops to be presented at Cable-Tec Expo `91 in Reno, Nev. Technical papers that are accepted will be presented at the Society's 15th Annual Engineering Conference on June 13, 1991.

Proposals for workshops also are being solicited. Expo workshops are "hands-on" sessions that will provide attendees with in-depth instruction on technical procedures that are used in everyday practice.

Submissions, which should include a brief abstract of the proposed paper or workshop, should be sent to

Bill Riker, Expo '91 chairman, no later than Dec. 1. For further information, please contact SCTE national headquarters at (215) 363-6888.

SCTE Calendar

The "SCTE Calendar" is an *Interval* feature incorporating Satellite Tele-Seminar Program listings(*), news of upcoming national events and announcements of upcoming local SCTE chapter and meeting group seminars.

Dates for 1990

Sept. 6 New England Chapter, Upper Valley Meeting Area—Holiday Inn, White River Junction, Vt. Topics: "Fiber Optics" and "Headend Consolidation." Contact: Matt Alldredge, (203) 328-0640.

Sept. 10-11 Dakota Territories Chapter—Golden Hills Resort, Lead, S.D. To be held in conjunction with the South Dakota Cable TV Association show. Topics: "HDTV" and "Installer Certification Training." Contact: A.J. VandeKamp, (605) 339-3339.

Sept. 11 Central Illinois Chapter—Sheraton Normal Hotel, Normal, Ill. Topic: "Vehicle Maintenance." Contact: Ralph Duff, (217) 424-8478.

Sept. 11 New England Chapter—Sheraton Inn, Boxborough, Mass. Topics: BCT/E Category III, "Transportation Systems" with Randy Karr of Channel Master and BCT/E Category V, "Data Networking and Architecture" presented by Anixter. Contact: Jeffrey Piotter, (508) 685-0258.

Sept. 12 Michiana Chapter—Signature Inn, South Bend, Ind. Topic to be supplied. Contact: Russ Stickney, (219) 259-8015.

Sept. 12 Razorback Chapter—To be held in Little Rock, Ark. Topic to be supplied. Contact: Jim Dickerson, (501) 777-4684.

Sept. 13 North Country Chapter—Sheraton Midway, St. Paul, Minn. Topic: BCT/E Category V, "Data Networking and Architecture." Contact: Rich Henkemeyer, (612) 522-5200.

Sept. 13 Big Country Meeting Group—Sweetwater, Texas. Information to be supplied. Contact: Albert Scarborough, (915) 698-3585.

Sept. 16-17 Old Dominion Chapter—Holiday Inn, Richmond, Va. Topic to be announced. Contact: Margaret Davison-Harvey, (703) 248-3400.

Sept. 19 Appalachian Mid-Atlantic Chapter—Holiday Inn, Chambersburg, Pa. Topics: "Digital Fiber Optics" and "1 GHz Distribution" with Dave Jordan and Jim Parker of C-COR. BCT/E testing to be conducted in Categories I, II and III. Contact: Richard Ginter, (814) 672-5393.

Sept. 19 Greater Chicago Chapter—Location to be supplied. Topic: BCT/E Category III, "Transportation Systems." Contact: John Grothendick, (800) 544-5368.

Sept. 19 Razorback Chapter—To be held in Little Rock, Ark. Topic to be supplied. Contact: Jim Dickerson, (501) 777-4684.

Sept. 22 Rocky Mountain Chapter—Location to be announced. Topics: "Connectors and Cable" and "NEC Rules." Contact: Rikki Lee, (303) 321-7551.

***Sept. 25** Satellite Tele-Seminar Program, *"Cable vs. the Telcos (Part Two)."* Plus *"Local Origination Equipment and Its Use (Part One)"* with Jay Dorman of MCPS Video Industries Inc. and Lenny Melamedas of UA Columbia Cablevision of New Jersey. Videotaped at Cable-Tec Expo '89 in Orlando. To air from 12-1 p.m. ET on Transponder 2 of Galaxy III.

Sept. 25-27 Atlantic Cable Show—Atlantic City Convention Center, Atlantic City, N.J.. SCTE-coordinated technical seminars. BCT/E and Installer testing to be administered Sept. 26. Contact: SCTE national headquarters, (215) 363-6888.

Sept. 26 Great Lakes Chapter—Information to be supplied. Contact: Daniel Leith, (313) 549-8288.

Sept. 26 North Country Chapter—Edina Community Center, Edina, Minn. BCT/E testing to be administered in Categories I, IV, V and VII. Contact: Rich Henkemeyer, (612) 522-5200.

Sept. 26 Piedmont Chapter—Location to be supplied. Topic: "Safety, System Grounding and Bonding." Contact: Rick Hollowell, (919) 968-4631.

Sept. 27-29 Dixie Chapter—To be held in conjunction with the Alabama Cable TV Association convention. Contact: Rickey Luke, (205) 277-4455. Information to be supplied.

Oct. 8 Greater Chicago Chapter—Information to be supplied. Contact: John Grothendick, (800) 544-5368.

Oct. 10 Delaware Valley Chapter—Information to be supplied. Contact: Dan McMonigle, (215) 265-4233.

Oct. 11 Chesapeake Chapter—Holiday Inn, Columbia, Md. Topic: "Video and Audio." Contact: Keith Hennek, (301) 731-5560.

Oct. 17 Palmetto Chapter—Information to be supplied. Contact: Rick Barnett, (803) 747-1403.

Oct. 17 Penn/Ohio Meeting Group—Location to be announced. Topic: "Fiber Optics." Contact: Bernie Czarnecki, (814) 838-1466.

Oct. 24 Ohio Valley Chapter—Columbus, Ohio. Topic: "Service from the Technician's Point of View." Contact: Jon Ludi, (513) 435-2092.

***Oct. 30** Satellite Tele-Seminar Program, *"Local Origination Equipment and Its Use (Part Two)"* with Jay Dorman of MCPS Video Industries Inc. and Lenny Melamedas of UA Columbia Cablevision of New Jersey. Videotaped at Cable-Tec Expo '89 in Orlando, Fla.

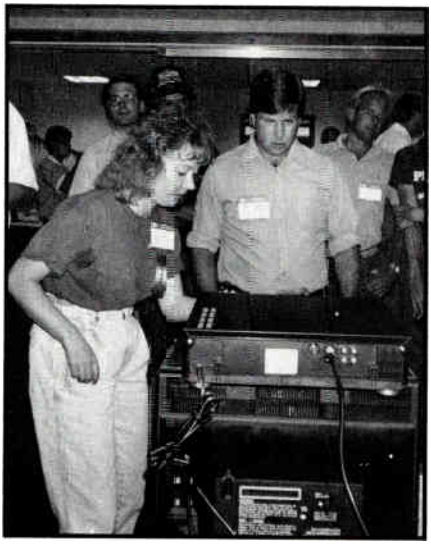
*Tele-Seminar Programs may be downlinked by any cable system and recorded for immediate and future employee training purposes. All Tele-Seminar Programs will air from 12-1 p.m. ET on Transponder 2 of Galaxy III.

Second Annual Cable Games held

By Rikki Lee
Media Director
Rocky Mountain Chapter

Ten technicians representing three Colorado systems (Columbia Cablevision of Fort Collins, United Cable of Colorado and Jones Intercable of Broomfield) competed for medals and a traveling trophy in the SCTE Rocky Mountain Chapter's Second Annual Cable Games, held in cooperation with the Colorado Cable Television Association (CCTA). The event drew an audience of 100 people on the evening of Wednesday July 11 at the CCTA's annual convention at the Beaver Run Resort in Breckenridge, Colo.

Co-emceed by Magnavox CATV's Eric Himes and the ATC National Training Center's Ron Wolfe, the games were sponsored by Comm/Scope, Jerrold Communications, CT Publications, the National Cable Television Institute (NCTI) and United Video. Participating companies that supplied equipment and/or judges included the ATC National Training Center, Gilbert, NCTI, Trilithic and Winfield Scott & Asso-



Rikki Lee

Jones Intercable's Pam Nobles tests United Cable of Colorado's Mark Gidley at the distortion identification event during the Second Annual Cable Games at the 1990 Colorado Cable Television Association convention.

ciates.

Each contestant faced a test of knowledge, skills and speed at four events—cable splicing, system troubleshooting, distortion identification and general cable knowledge. During each of four rounds, contestants were required to perform one task, receiving scores based on a scale specific to each event.

New to this year's games was a fiber splicing exhibit courtesy of Anixter Cable TV. During the games and between rounds, several audience members practiced fusion and mechanical splicing.

Totals were tallied from scores calculated by the judges after every event. Medal winners were announced as follows:

Cable Splicing
1st-Gold: Shawn Huston, United Cable
2nd-Silver: Randy Longstrom, United Cable
3rd-Bronze: Mark Gidley, United Cable

Troubleshooting the System
1st-Gold: Romeo Battazzi, Columbine Cablevision
2nd-Silver: Jim Dyke, Jones Intercable
3rd-Bronze: Shawn Huston, United Cable

Distortion Identification
1st-Gold: Mark Gidley, United Cable
2nd-Silver: Shawn Huston, United Cable
3rd-Bronze: Shawn Bargas, United Cable

General Cable Knowledge
1st-Gold: Randy Longstrom, United Cable
2nd-Silver: Mark Gidley, United Cable
3rd-Bronze: Jim Dyke, Jones Intercable

The traveling trophy, which goes to the top company based on its representative's aggregate score, was awarded to United Cable of Colorado, headquartered in Englewood. The expenses-paid trip to Cable-Tec Expo '91 (based on an individual's total score) went to Randy Longstrom of United.

Howard Whitman

Appalachian Mid-Atlantic Chapter Second Vice President Lee Burkholder monitors the progress of the feast at the chapter's annual pig roast and golf tournament held July 25 in Scotland, Pa.

Chapter and Meeting Group Spotlight

"Chapter and Meeting Group Spotlight" is an *Interval* section that focuses on recent SCTE chapter or meeting group events noteworthy for their topic, attendance numbers or innovative approaches to technical training.

The Appalachian Mid-Atlantic Chapter held its annual golf outing and pig roast July 25 at the Scotland Community Center in Scotland, Pa. Held each year in appreciation of the chapter's members, this year's event began with a golfing session at the Penn National Estates Country Club. Following a heatedly competitive outing on the course, the attendees convened at the community center to enjoy a roasted pig prepared by the chapter's second vice president, Lee Burkholder and his family.

The Central Indiana Chapter held a meeting June 7 at the Holiday Inn Airport in Indianapolis that featured Wendell Bailey of the NCTA. Chapter First Vice President Gregg Nydegger reports that in his presentation on "Engineering Management and Professionalism," Category VII of the BCT/E Certification Program, Bailey said that on a national level about 70 percent of all BCT/E candidates pass the tests for Categories I-VI, but 70 percent fail the

Howard Whitman

Tom Carbaugh of Jerry Conn Associates and Telecommunication Products receives a putter (donated by ComSonics) from Gary Selwitz, president of the Appalachian Mid-Atlantic Chapter, in honor of his achieving low net at the chapter's July 25 golf tournament.

Category VII. "He said that SCTE is looking to see how a student thinks about a problem," Nydegger reports, "and professionals will not use excuses in place of making decisions. He also stressed that the ramifications of those decisions must be taken into account."

Bailey also spoke on industry trends and possibilities for the future, including reregulation and must-carry.

The meeting also featured a presentation on "Customer Service" by Ron Breedon of Indianapolis Power and Light. Nydegger reports that he said that even though his company had a monopoly, it tried not to let that affect the attitudes of its employees. Breedon reviewed measures his company has undertaken to improve customer service, such as friendlier office hours and a well trained staff.

The chapter elected the following new officers at the meeting: Joe Shanks, president; Gregg Nydegger, first vice president; Kent Vermillion, second vice president; and Robert Ralston, secretary/treasurer. Nineteen people attended the event.

The Chattahoochee Chapter met July 10 at the Perimeter North Inn in Atlanta for a technical seminar on safety and related issues. Speakers at the event included Tom Harvey of OSHA on "Safety Requirements," Dudley Ellis of the Georgia Department of Transportation on "Roadside Operations," Stanley Word of Liberty Mutual on "Accidents and Hidden Costs" and George Hayes Jr. of G.E.S. on "Hazardous Communication Problems."

"System Maintenance" was the focus of the **Great Plains Chapter**'s July 25 meeting, held at the Regency Best Western in Omaha, Neb. Ron Hranac of CT Publications spoke on "Preventive Maintenance" and reviewed BCT/E Category III, "Transportation Systems." Barry Smith of Times Fiber spoke on "Drop Maintenance." Gary Williams of Channell Corp. gave a presentation on "Heat Dissipation."

The Heart of America Chapter reported that its June 14 meeting, held at the Holiday Inn in Kansas City, Mo., featured a variety of presentations on important topics facing the industry today. Ron Ramage of the FCC discussed signal leakage and CLI. Mike Beach and Roy Siechepine of Kansas City Power and Light spoke on safety. Skytek's Wes York gave a presentation on flyover CLI mapping and invited attendees to come along on a live demonstration of a Skytek flyover. Don Henry of ATC in Kansas City discussed ground-based CLI.

The results of the chapter's election of officers are as follows: Don Gall, chairman; Nathan Brewster, president; Ken Covey, first vice president; John Giesch, second vice president; Rand Reynard, secretary; Larry Douglas, treasurer; and board members Alan Tschirner, Dennis Davis, Bill George, Don Muths, Tom Schulte and Hal Mathews.

The Iowa Heartland Chapter held a seminar on BCT/E Category IV, "Distribution Systems," June 15 at the Best Western Bavarian Inn in Des Moines, Iowa. Chapter Secretary/Treasurer Mitch Carlson reported that speaker Chris Frederick of General Instrument "covered testing procedures and discussed block diagrams of amplifiers, converting volts to dBmV, various distribution calculations, distribution terminology, and modulator and processor design and operation. Twenty people were in attendance.

The Mount Rainier Chapter held a meeting July 11 at the St.

For the second year in a row, the Prime Time Cable team won first place at the Southern California Chapter's May 19 softball tournament.

Andrews Church in Bellevue, Wash. The chapter's secretary and media director, Sally Kinsman, reports that "While not as scenic as the site of our last meeting on the salt water, this site certainly was inspirational, and hot. We covered construction at this meeting, which began with Timothy Wicks of the Washington State Department of Transportation. He provided the group of 45 attendees with valuable information about the permit process from the state's point of view.

"Ed Schenck of Schenck Construction followed with a discussion of construction from a contractor's viewpoint, and gave hints to the audience on how they could help the contractor with certain items that would help their projects speed up and flow smoother. He also gave examples of his past jobs that did not go well and provided reasons why.

"After a lunch break we resumed to hear John Jacobson of Viacom cover construction from the operator's point of view. The group enjoyed and benefitted from all of the speakers, although one attendee (namely me) was caught with her eyes closed due to the heat.

"Before the meeting started, our winner of free registration and trip to Cable-Tec Expo '90 registration, Ken McKeehan of Viacom, gave the group a short synopsis of what he learned at the event. He was very enthused about the expo and definitely learned a lot from the sessions. He also had a good time and brought back plenty of 'stuff' from the exhibit floor, which he proceeded to give out to attendees who could not attend the expo.

"We later had a drawing for three national SCTE memberships paid for by our chapter. The winners were Ed Schenck, Brad Archibald of Summit Communications and Steve Jambor of Viacom."

The North Central Texas Chapter billed its June 20 meeting as "A Program of Interest to Managers and Technicians." Held at the Ramada Inn in Hillsboro, Texas, the event drew 23 attendees. Roy Kraft of Park Cities Cable TV discussed new customer standards for service, what customers appreciate, how the industry is trying to meet these needs and how this will impact your system. Bill Arnold of the Texas Cable TV Association talked about easement problems, right-of-way, right-of-entry and similar areas. He also fielded questions about pending legislation in Congress, telco involvement and items affecting Texas systems.

The Old Dominion Chapter held its "You're Appreciated" membership celebration July 29 at Busch Gardens in Williamsburg, Va. All chapter members received free admission to the park.

"Cable System Rebuilds and Upgrades" was the theme of the seminar presented by the **Piedmont Chapter** July 25 at the Holiday Inn in Hickory, N.C., and July 26 at the Palace Motel in New Bern, N.C. The chapter held the seminar in two locations in an effort to bring them closer to more members in different parts of North Carolina. Fred Rogers of Quality RF led the technical sessions.

Anixter CATV presented a full-day program on "Fiber Optics" at the July 18 meeting of the **Razorback Chapter** held at Howard Johnson's in Little Rock, Ark. Twenty-two people were in attendance to hear technical presentations by Anixter's John Herndon and Wendell Woody. The president and Region 5 Director of the national SCTE, Woody began the event with a slide presentation of the Society's programs and events. Herndon followed with a discussion on the manufacturing and specifications of light guide cable, and Woody covered the evolution of fiber, application architecture and test equipment.

The New York City Meeting Group participated in a joint meeting with CTAM, Women in Cable and Minorities in Cable, held June 7 at the Omni Park Hotel in New York. The group presented the seminar "Our Issues and Challenges: 1990 and Beyond," which was moderated by Rich Fevola of its board of directors. Panelists for the session were the group's Vince Pombo of Paragon Cable and Bob Tenten of Manhattan Cable TV. Topics discussed included CLI, state and city legislation, plant usage and competing media.

One hundred and five people were in attendance at the April 16 meeting of the **Penn-Ohio Meeting Group**, held at the Airport Ramada in Coraopolis, Pa. Ted Hartson of Post-Newsweek Cable and Robert V.C. Dickinson of Dovetail Systems were speakers at the event, which concentrated on CLI and signal leakage. The event also featured vendor displays from Wavetek, Augat, Trilithic and ComSonics.

SCTE

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Editors—Howard Whitman
Bill Riker

RF design

(Continued from page 41)

directional coupler and fed to a bridger amp. The bridger amp increases the operational levels for routing signals to the last two or three amps to each home or business to be served.

The *feeder system* takes the signals preserved and routed by the trunking system, raises them much higher (typically in the +40 to +52 dBmV range) and then distributes them past each residence to be served. The higher levels make for a more efficient method to tap off signals (using a device called a multitap) and route them to the home. Higher levels are a recognition that each home needs a certain amount of signal to feed the devices present (TV sets, VCRs, stereos, etc.), and that allowances must be made for signal loss in the service line to the home, and the losses associated with the feeder cable itself and the various tapping devices inserted. Although the higher feeder system levels create significant distortion levels, the short cascade of two to three amplifiers holds the distortion levels within manageable limits.

System distortions

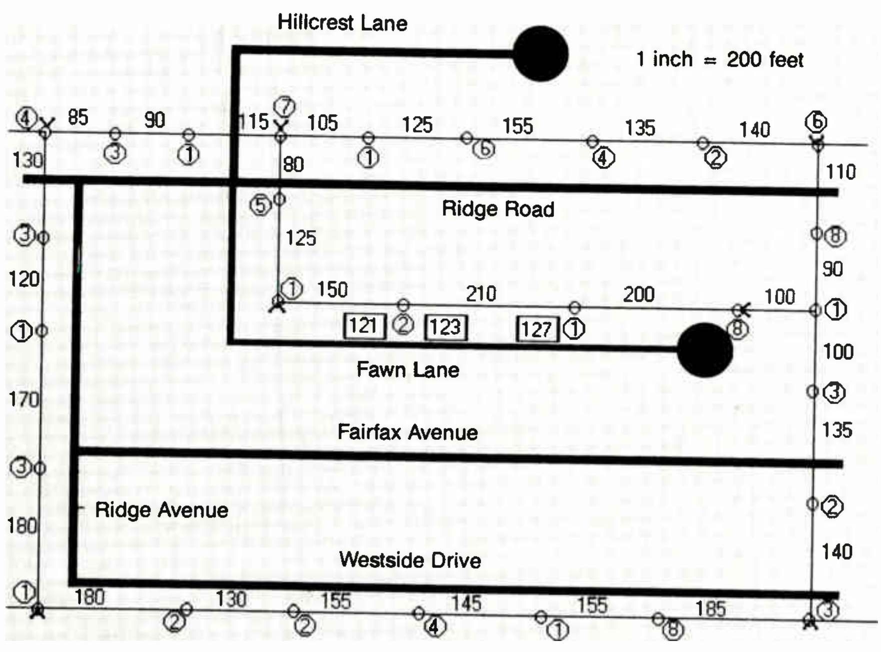
Before going further in our examples of system distortion level analysis, amplifier level selection, and some sample calculations and design layouts, a brief discussion of amplifier distortions is in order. The main categories of picture degradation due to active amplification of signals are noise addition and intermodulation distortion. By definition and the law of physics, there are no perfect amps. Each amp in a system will add some amount of noise to each picture (carrier plus information sidebands) and some distortions to each picture. Distortions of primary concern in a CATV system are second and third order.

Amplifier noise and noise figure: By definition, noise figure (NF) is a measure of each amp's quietness or an indication of how the noise produced by an amplifier compares with the noise produced by a 75 ohm resistor at room temperature into a matched load. The important thing to remember is that the lower the NF the better the amplifier, and less input signal will be required to achieve a given carrier-to-noise ratio (C/N). C/N is the ratio, at any given point in the system, between the power of the system noise floor (measured in a 4 MHz bandwidth) and the power of the referenced carrier. C/N combines in a 1-to-1 fashion in a system. Stated differently, each time the number of identical amps (unity gain and well-behaved) is doubled in your design, C/N worsens by approximately 3 dB.

Amplifier output capability vs. distortions: The output capability of an amp is simply an indicator of the decibel per millivolt output level that can be achieved with a given number of channels at a given second or third order specification. It is usually stated as so many decibels per millivolt for a (spec) rating of −XX dB. As an example, a typical output level specification might be a +45 dBmV for −57 dB cross-modulation (XMOD).

It should be noted here that while most third order distortions theoretically hold a 2-to-1 reduction ratio with output level (more on this in a moment), this may not hold true in all instances, so try to obtain from the manufacturer the distortion level at your exact operating levels. Also be aware that NF is a function of design of the amplifier's input stages, second order ratings are a function of output levels only, but third order distortions are a function of output levels *and* the number of carriers or channels on the system. For example, a given output capability for an amp with 12-channel loading will be reduced by 3.7 dB when using 27 channels. Due consideration to amplifier tilt must be given as

Figure 1: Basic strand map



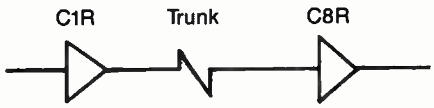
well when using derating techniques. Output capability is therefore normally stated with the number of channels in operation, at least for third order (and higher) distortions.

Second order distortion is normally produced when a non-linear stage in an amp combines two carrier frequencies to produce a third frequency. In the days of 12-channel operation, CATV amplifiers could be designed ignoring their second order distortion characteristics because the second order beats fell outside the bands of interest.

Another problem or concern is that second order beats, unlike third order, do not grow on a 6 dB per doubling basis, but rather somewhere between 3 dB and 6 dB per doubling. It is therefore difficult to predict just what level of second order beats there might be in various parts of the system. This is because carriers that mix to produce harmful second order beats are far apart in frequency. This provides more opportunity for a phase shift of the carriers to exist such that the second order beat generated in Amp 1 is likely to be out of phase with the second order beat generated in Amp 2. This is not the case in third order products, which are created in a more orderly fashion and are indeed more predictable in the system. Second order distortions therefore add somewhere between a 1-to-1 and 2-to-1 fashion. Stated differently, each time the number of identical amps is doubled in your design, the second order distortion worsens by somewhere between 3 dB to 6 dB.

Third order distortion occurs when a non-linear stage in an amp combines two or three carrier frequencies to produce a

Figure 2: C/N calculations



NF = 10 dB
Input = + 10 dBmV
C/N at cascade output = So − G − NF (10logN) + 59

third frequency. Third order beats have been with us for a long time. In fact, many of us old-timers observed triple beats creating a "wormy" or "busy" effect in the XMOD background of older CATV systems, when triple beat was barely discussed or recognized.

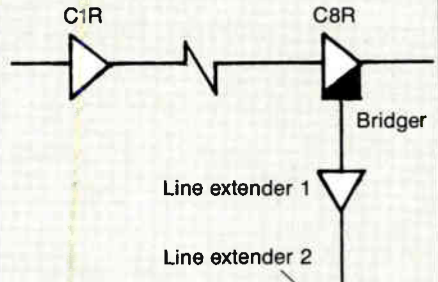
Many interfering triple beats are produced by carriers near the same frequency. For example, Chs. 9, 10 and 11 will beat together to produce an interfering carrier beat (zero beat) on Ch. 10's video carrier. Simple calculations demonstrate that: Ch. 9 video carrier plus Ch. 11 video carrier equals 386.5 MHz; 386.5 MHz minus Ch. 10 video carrier then creates a zero beat at exactly 193.25 MHz or back on Ch. 10! Third order distortions add in a 2-to-1 fashion in a system. Stated differently, each time the number of identical amps is doubled in your design, the third order distortion worsens by approximately 6 dB.

Do the math

The concept of *cascade arithmetic* is built upon several basic principles. The first is called unity gain. In a typical CATV system, if we examine the output of the headend, we see signals set at a desired level to be transmitted down the coaxial cable. If there were no losses in the cable we could then transmit these signals as far as we desired and no amps would be necessary in the system. However, since we do not have losses in the cable (and splitting devices), amps are inserted to compensate for the cable and other losses.

If the gain of the first amp in the system *exactly* compensates for the preceeding cable and passive loss, we have restored the signal level to its desired point again. Then successive amp-to-amp spans can do the same thing. Therefore, the combination of one span of cable and associated passives plus the gain of the next amp has unity gain since the signal output of the next amp is the same as the output of the last, and the gain of each amp equals the loss in front of it. This concept can be used and will apply regardless of whether the amp is flat or sloped. Most of the design techniques we employ relate, in one fashion or another, to this very basic principle.

Figure 3: Third order calculations

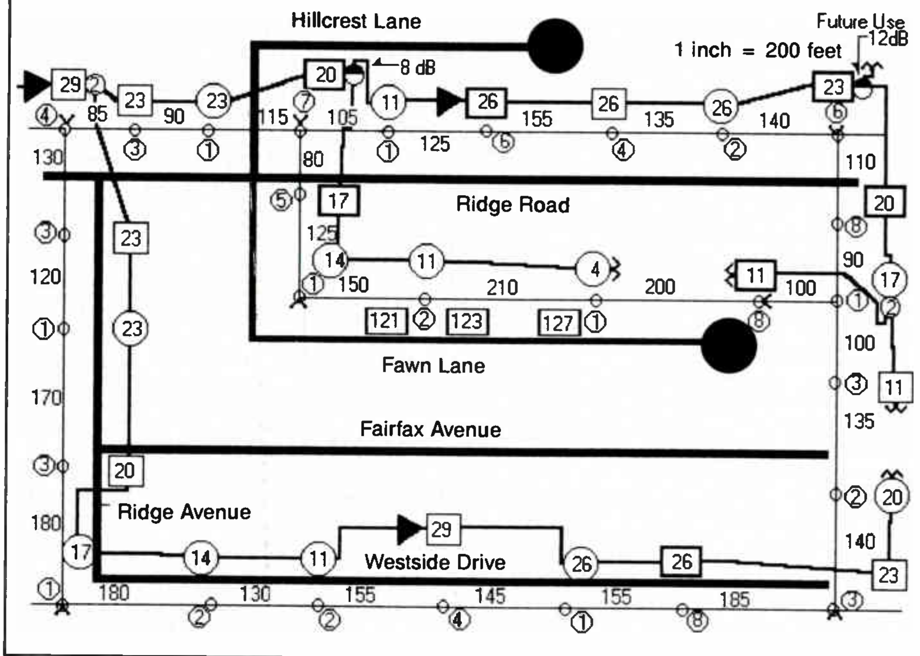


Trunk XMOD = −70
Bridger XMOD = −67
Line extender XMOD = −67

$$XMOD = 20\log_{10}\left(\frac{-A}{20} + \frac{-B}{20} + \frac{-C}{20}\right)$$

Cascade arithmetic assumes a unity gain system. The numbers and answers are only correct when unity gain principles are employed. With that in mind, let's take a closer look at combining and calculating C/N, and second and third order distortions. (Editor's note: Performance calculations for non-unity gain designs are possible, but are very complex and time-consuming. In any event, unity gain concepts

Figure 4: Drafted design



are good engineering practice.)

C/N calculations are shown in Figure 2. Calculations are basically done computing the C/N for a single device, then taking the cascading into account with the 10logN formula for identical amps. For example, if eight amps are in cascade, the C/N of a single amp is calculated using the formula shown in Figure 2. If a single amplifier has a calculated input level of +10 dBmV and a 10 dB NF, then the C/N for the single amp is +59 (thermal noise floor) – 10 (NF) + 10 (dBmV input) = 59 dB C/N.

The previous cascading example is for eight amps, all identical and well-behaved. The 10logN formula then becomes 10log8. The $\log_{10}$ of 8 is 0.903. Final cascaded C/N is therefore the C/N of the single amp, 59 dB minus the cascading factor of 9.03 (10 × 0.903), for a total trunk C/N of 49.96. This number also can be computed in your head as follows: Each time the cascade or number of amps doubles, the C/N becomes approximately 3 dB worse. If a single amp has a C/N of 59 dB, then two identical amps in cascade is 3 dB worse or 56 dB; four amps is 3 dB worse again or 53 dB, and eight amps is 3 dB worse again or 50 dB (hence our 49.96 answer).

Third order is calculated similarly to C/N. The specification for a single amp is generally provided by the manufacturer. The number is then adjusted if necessary for the output level of system amps. Third order *generally* follows a 2-to-1 ratio change: If the spec is –70 dB at a +33 dBmV then changing the amp level to +30 dBmV will cause the third order spec to improve by 6 dB or to –76 dB.

Figure 3 shows some amps with third order already calculated for each group-

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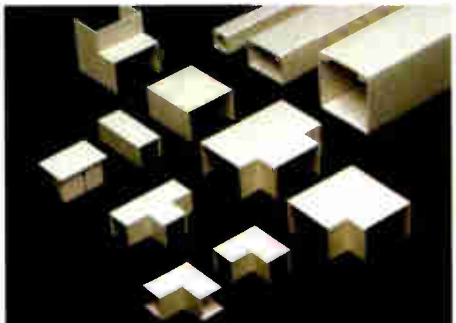

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ing of identical amplifiers; the trunk is −70 dB, the bridger is −67 dB and the line extenders are −67 dB. The separate system performance numbers are then combined using the formula shown in Figure 3. Each separate number is divided by 20, then the antilog of that number is taken (10 raised to that power yields this number). All three numbers are added, then the $\log_{10}$ number is calculated and multiplied by 20. In the previous example, −70 dB divided by 20 with the antilog is taken to yield 0.0003162. The 67 dB number yields 0.0004467. All three numbers are then added together equalling 0.0012096. The $\log_{10}$ of this number is −2.91736 times 20 equals the final combined system third order number of −58.35 dB.

Many additional examples of calculations of distortions and noise could obviously be given, but space considerations here do not allow. Suffice it to say that many good books have been written that go into this in much more detail. Again, the intent here is to provide an overview only.

Once the brand of equipment to be used in the design has been chosen and approximate cascade levels are known, overall system distortions can be calculated and *system design levels* chosen. Levels must be determined before actual design layout can begin. Table 1 is a sample distortions worksheet used to determine system design levels for a supertrunk.

In addition to system distortions, there are many *system design parameters* that must be chosen before design can begin. There are others that can be experimented with or changed/modified as one proceeds. If you're using a computer, an ideal software package will allow full and diverse changing of design parameters before and during the system design. The following are parameters that must be considered for proper design layout:

- passive values to be used and losses at multiple frequencies.
- tap values and types to be used, and losses at multiple frequencies
- cable types and insertion loss values at multiple frequencies
- trunk operational levels, input and output
- bridger operational levels, input and output
- line extender operational levels, input and output
- cascade deration for line extenders, if applicable
- signal levels from multitaps to correctly feed homes
- reverse design signal levels or maximum losses allowed if applicable

Next, the *design is calculated* using manual calculation methods or preferably a computer program that allows all footages from an entire section of design to be entered at once. Then the overall design for that area is computed, recomputed and optimized by proper selection of devices and locations. Table 2 is a portion of a sample printout showing the strand map section of Figure 1 designed to the parameters of the system distortions worksheet (Table 1).

Finally, the finished and drafted design for our strand mapped area shown in Figure 1 looks like one in Figure 4.

Basic system RF design encompasses many parameters and is not for the uninformed. A good computer program is a tremendous asset and tool for an accurate design. It does not, however, replace or supplement basic knowledge and theory behind such activities.

Next month's article will take a look at basic AC power grid layout. There are complexities here as well, but basic knowledge and proper design tools will allow for accurate design layouts.

September 1990

BACK TO BASICS

The training and educational supplement to Communications Technology magazine.

Spotlight on safety

Geri Saye

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Formerly Installer/Technician

Think safety! Who me?

By Bruce B. Habeck
Regional Product Manager, Anixter-Seattle

As professionals working in the environment that we do—driving daily in traffic, working around high voltage and climbing poles and ladders—we *all* need to *think safety.* Professionals with "desk jobs" probably don't think about safety. As long as the elevator doesn't break down and they don't burn their hands on the coffee pot, there really is no need to. However, in the field, we cannot afford not to be alert at all times.

Accidents usually happen because of one of four reasons:

- We get into habits, routines, even ruts and often take for granted the job or environment we are in. Then when we least expect it, because we are not paying attention an accident occurs.
- We become careless. It's late in the afternoon and we are behind on our work orders, so we hurry or take shortcuts. Because of our negligence an accident happens.
- Occasionally we have an audience—little children, a friend or an onlooker. We have a tendency to want to show or goof off. Unfortunately accidents happen at these times too.
- Someone else is at fault and we are the victims.

Since we cannot control the last reason, let's discuss the first three.

How many of us have ever burned a pole? It's not a pleasant experience. Besides ruining your shirt, pulling the creosote wood splinters out of your chest, arms and hands (if you weren't wearing gloves) is very unpleasant and ruins your day as well.

How many of us climb without gloves? It's bad enough taking out wooden splinters, but if you've ever run a fiberglass sliver into your hand when ascending or descending a fiberglass ladder, you know that pulling it out is a real spine tingler.

How many of us, whether we're doing routine work or repairing problems during an outage, grab phone lines, power grounds, guys, etc., with bare open palms? We know that we should rap them with the back of our hand first or wear the proper hand protection. If we grab lines with open palms we could become victims of the "lethal voltage." It's not the voltage that kills, it's the amperage. It only takes 5 milliamps to put your heart into fibrillation. However, a voltage of approximately 440 V is enough to constrict your muscles to an involuntary condition where you cannot pull away. This is what can happen to someone guilty of palming wires.

Take the time

We all have horror stories to tell about accidents that shouldn't have happened—all usually due to one of the first three reasons listed previously. When talking about safety, time is an issue. Lack of time is usually the number one complaint by all parties involved in an accident.

When climbing a pole, how many of us take the time to eliminate garbage on the pole (rummage sale signs, election posters, bird houses, basketball backboards and all of the staples, nails and thumb tacks)? People seem to think they have the right to decorate the poles just because they happen to be in their backyard. They also are not allowed to build and attach their beautiful picket fences that seem to end up below half of the poles in town. I remember working with one fellow installer who was not about to have an accident because of debris on the pole. When he was completed at the pole, nothing remained that didn't belong there. It all came down.

How much time does it take to remove our gaffs before walking around the truck, driving to the next pole or running into the 7-Eleven for a soda? How much time does it take to put on a pair of gloves and a hard hat, put a set of chocks out, throw our cones out, strap off when working on lines or sharpen our gaffs? These precautionary measures are not time-consuming, but go a long way toward preventing accidents.

We have all heard of OSHA, the Occupational Safety & Health Administration, but not many of us have had the folks from OSHA visit. Some states like Washington have instituted their own safety programs where they have taken the OSHA rules and regulations, added to and stiffened them, and now enforce them on a state level. Guess what? These states are making big bucks by fining us for our negligence.

The cable TV industry has changed considerably in the past five to 10 years; it's much more professional. Cable companies no longer have the reputation of just being some guys who hang coax on poles and bring poor pictures into your home that someone could get just as well with rabbit ears and a piece of tin foil. The "good ol' boy" days are gone. Putting on a pair of gaffs in the morning and leaving them on all day and having tough, calloused hands from climbing without gloves are out.

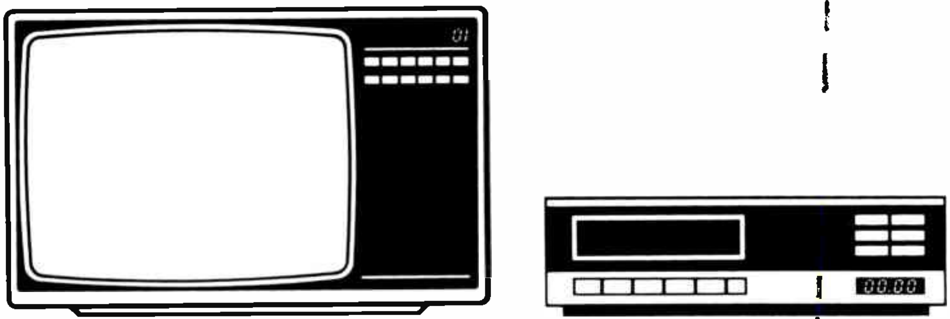
Make the time

The industry in general has made some great efforts to better educate employees, and we should all take advantage of it. Besides the specialized training programs, there are many programs that we can become involved in regardless of whether or not the cable system supports them. National Cable Television Institute courses are good learning aids and the Society of Cable Television Engineers program offers two great levels of training.

As the industry becomes much more technically advanced, we all need to stay on top through education. Power doubling and feedforward systems of 450 MHz and above just don't operate as easily as the old push-pull amp systems. Installs must be precise to get the highest frequencies to the home. Staple dents, radius bends, drop lengths and drop diameters are all factors in bringing quality pictures to the customer.

As we leave the good ol' boy days and become better educated, we become more professional. Safety is a big part of being professional. What we do reflects not only upon ourselves, but also on the company we work for. A great example is our driving record. It stays with us for a long time. Insurance rates have skyrocketed lately and companies are looking for good driving records as well as educated employees.

Safety awareness and training are around for one reason and one reason only—*you!* So make the time, take the time and *think safety.*



Testing for "hot chassis" conditions

By Alan Babcock
Technical Training Manager
Warner Cable Communications Inc.

A successful CATV connection to a customer's TV set must meet three criteria: it must work well enough to provide quality pictures, it must be as aesthetically pleasing as possible given the circumstances and it must be safe. There are many aspects to be considered in determining that the connection is safe. This article deals with only one part of a safe connection, the "hot chassis" condition found on some customer devices.

What is "hot"?

This article doesn't address those devices that are so hot they need to be handled with asbestos gloves. You'll need to talk to your local law enforcement people to find out how to handle those. This article discusses items that are electrically hot.

Most of you have had occasion to experience what you call a hot chassis on a TV set or other device. You suspect that if you see a spark jumping from the TV set to the drop connector that the set must be hot, but what is hot? At Warner Cable we have established that any TV set, VCR, converter, etc., that has 10 volts or more, or carries household current on the antenna/cable connections, is hot.

This decision was made by determining what voltage could be unsafe to our employees or a customer. We decided that 10 volts probably isn't enough to hurt anyone or cause damage to the cable system. Additionally, it has been our experience that when a TV set is hot it most likely has something close to 120 volts on the antenna lugs.

A hot chassis condition is caused by a malfunction inside the TV set, VCR, etc., that has caused the power supply inside the device to become electrically separate from the chassis ground. The chassis should be at 0 volts with respect to the incoming AC and any internal grounds inside the device. When a connection breaks or something else happens inside the device to cause a discontinuity in the ground path a hot chassis condition may exist.

The device may continue to work. Because the chassis of the device is at a different potential than the sheath of our cable system (which was grounded near the point of entry according to NEC and NESC codes) an arc or spark is seen when the cable connection is attempted. If the connection of the cable is completed, the sheath of our drop cable will provide a current path from the TV chassis to ground. This creates a potentially hazardous condition.

Testing procedure

Before connecting a cable drop to a TV set, VCR or other device it is strongly recommended that you check for a hot chassis condition. (If you are a Warner employee or contractor it's required to do this.) To test for a hot chassis do the following:

1) Make sure the device is on.

2) Use a voltmeter set in the proper mode for measuring AC voltage not to exceed 120 volts.

3) Touch one meter lead to the nut portion of the cable drop. This is the reference ground point for your measurements.

4) Touch the other meter lead to each antenna screw lug and/or threaded portion of the 75 ohm barrel. Observe the meter as you touch each point. (*Do not touch the metal part of the meter leads with your hands or fingers. If the chassis is hot your body would become the current path between the device and ground.*)

5) Remove the meter lead from the cable F fitting and touch it to the threaded "ground" portion of the 75 ohm barrel on the device (if so equipped).

6) Repeat Step 4 by checking the antenna terminal screws with the other meter lead.

7) If there is 10 volts or more on any of the positions mentioned previously, the chassis may be considered hot. (This is according to Warner policy, and your organization may think differently. Check with your supervisor.)

8) Reverse the polarity of the AC plug by unplugging the AC cord from the wall and reversing the position of the prongs. (If the plug is polarized this is not possible.) Repeat Steps 1 through 7.

If a Warner Cable employee performed this test and found 10 volts or more on any of the connections, the cable would not be connected to the TV set. The customer would be informed that the device needs to be repaired before the cable connection could be completed. While this may inconvenience the customer, the option could be an unsafe condition for the employee and/or customer.

Because experience has shown that most hot chassis have close to a full 120 volts, a household-type voltage test lamp may be used for the test. The test lamps available at hardware stores for checking household outlets are usually designed to detect voltage of approximately 90 volts or more. While not as accurate as a voltmeter, use of the test lamp will at least detect those situations where a definite safety hazard exists.

By performing the check for a hot chassis before connecting the cable drop to a device your personal safety as well as the safety of the customer is enhanced. If at any time you feel safety would be compromised by connecting the cable to a customer's device, contact your supervisor. ▯

"When a connection breaks ...inside the device to cause a discontinuity in the ground path a hot chassis condition may exist."

Installer Input

A day in the life of the chief engineer

By Steve Allen

Chief Engineer, Jones Intercable, Roseville, Calif.

It was a rainy morning and my coffee was cold. Something told me it wasn't going to be one of my best days. I was right.

My secretary rang into my office to inform me that there was a lady on the service line who was screaming to talk to whoever was in charge of the installers. "Those words again."

I quickly looked around for someone to promote to chief engineer, but all I saw were retreating backs. So I resigned myself to my fate and picked up the call.

"Good morning," I said, "this is Steve Allen. I am the chief engineer, how may I help you?"

WHAM! I got it right between the eyes.

"He did WHAT?" I said.

"Blah, blah, #@*&#", she said. "Stupid person, blah, blah, blah, I'll sue, blah, #*@§$#& blah, blah, get over here NOW!!"

Remember, maximum customer service skills here. "Yes, m'am, I'll be right over."

Upon arriving at the beautifully constructed and landscaped home of someone whose husband must be a successful litigation lawyer, I was greeted rather coldly. Outside in the entryway was my installer, covered with bits of fiberglass insulation and gypsum drywall. I introduced myself to the customer and then asked the installer the obvious question.

"OK, what happened?"

"I was pulling a wire through the attic when I slipped off a ceiling joist and stepped through the ceiling in the living room. I immediately came down and called dispatch to send over my foreman and informed the lady that we would take care of the damage. She was a bit upset, but said 'OK.' I then went back up into the attic to finish the job. I don't know how it happened, but I slipped again and fell. That's when the whole section of ceiling came down in the dining room on top of the table, with me on it. At that point, the lady kind of lost it and ordered me out of her home. Honest, it was a simple mistake, I didn't mean to do it."

"Outside in the entryway was my installer, covered with bits of fiberglass insulation and gypsum drywall."

This I have to see for myself!

Up to this point, the lady was pretty calm, but as we walked into the house, she began to wind up for the pitch.

"Yes, m'am. Yes, m'am. Yes, m'am. No, I'm sure his mother had children that lived. No, m'am, I'm sorry but I cannot let you hang him from that rafter right up there. Yes, I will get a contractor out here immediately and we will make sure that the job is done to your satisfaction. We will reschedule this install to a later date." (And I promise you we will send a different installer.)

After making arrangements to clean up the mess, I left my business card with her and escorted my installer to his truck. He appeared to be OK, just a bit shaken. "Time to get back on that horse and carry on with business," I said. "Please be more careful at your next job, and clean up or change your clothes."

I got back to the office and began looking for the number of the contractor I used last time. I poured another cup of coffee and got back to work, confident that it won't be long before I hear "those words again."

This situation was the result of a safety violation, as many of them are. The individual did not have a flashlight and was trying to work in the attic by the light coming through the attic opening. There are numerous hazards in dark locations. Having the right equipment and in working order is the individual's responsibility. This violation could have resulted in serious injury or even death.

"Those words" are so often the result of someone breaking a safety rule or company policy. □

Temperature conversion

By Ron Hranac

The cable industry uses both Fahrenheit and Celsius (Centigrade) temperature scales for measurement. The conversion between the two is relatively straightforward and can be done with a simple calculator. The accompanying charts provide conversions between the two scales; the first one covers Fahrenheit to Celsius from −40°F to +140°F, and the second covers Celsius to Fahrenheit from −40°C to +100°C. Both charts are in 1° increments. The charts were created using the following formulas, and examples of their use are on the next page.

Fahrenheit = (Celsius × 9/5) + 32

Celsius = 5/9 × (Fahrenheit −32)

Fahrenheit to Celsius

°F	°C	°F	°C	°F	°C
−40	−40.0	21	−6.11	82	27.8
−39	−39.4	22	−5.56	83	28.3
−38	−38.8	23	−5.00	84	28.9
−37	−38.3	24	−4.44	85	29.4
−36	−37.8	25	−3.89	86	30.0
−35	−37.2	26	−3.33	87	30.6
−34	−36.6	27	−2.78	88	31.1
−33	−36.1	28	−2.22	89	31.7
−32	−35.5	29	−1.67	90	32.2
−31	−35.0	30	−1.11	91	32.8
−30	−34.4	31	−0.56	92	33.3
−29	−33.9	32	0	93	33.9
−28	−33.3	33	0.56	94	34.4
−27	−32.8	34	1.11	95	35.0
−26	−32.2	35	1.67	96	35.6
−25	−31.7	36	2.22	97	36.1
−24	−31.1	37	2.78	98	36.7
−23	−30.6	38	3.33	99	37.2
−22	−30.0	39	3.89	100	37.8
−21	−29.5	40	4.44	101	38.3
−20	−28.9	41	5.00	102	38.9
−19	−28.3	42	5.56	103	39.4
−18	−27.7	43	6.11	104	40.0
−17	−27.2	44	6.67	105	40.6
−16	−26.6	45	7.22	106	41.1
−15	−26.1	46	7.78	107	41.7
−14	−25.5	47	8.33	108	42.2
−13	−25.0	48	8.89	109	42.8
−12	−24.4	49	9.44	110	43.3
−11	−23.9	50	10.0	111	43.9
−10	−23.3	51	10.6	112	44.4
−9	−22.8	52	11.1	113	45.0
−8	−22.2	53	11.7	114	45.6
−7	−21.7	54	12.2	115	46.1
−6	−21.1	55	12.8	116	46.7
−5	−20.6	56	13.3	117	47.2
−4	−20.0	57	13.9	118	47.8
−3	−19.5	58	14.4	119	48.3
−2	−18.9	59	15.0	120	48.9
−1	−18.4	60	15.6	121	49.4
0	−17.8	61	16.1	122	50.0
1	−17.2	62	16.7	123	50.6
2	−16.7	63	17.2	124	51.1
3	−16.1	64	17.8	125	51.7
4	−15.6	65	18.3	126	52.2
5	−15.0	66	18.9	127	52.8
6	−14.4	67	19.4	128	53.3
7	−13.9	68	20.0	129	53.9
8	−13.3	69	20.6	130	54.4
9	−12.8	70	21.1	131	55.0
10	−12.2	71	21.7	132	55.6
11	−11.7	72	22.2	133	56.1
12	−11.1	73	22.8	134	56.7
13	−10.6	74	23.3	135	57.2
14	−10.0	75	23.9	136	57.8
15	−9.44	76	24.4	137	58.3
16	−8.69	77	25.0	138	58.9
17	−8.33	78	25.6	139	59.4
18	−7.78	79	26.1	140	60.0
19	−7.22	80	26.7		
20	−6.67	81	27.2		

Celsius to Fahrenheit

°C	°F	°C	°F	°C	°F
−40	−40.0	21	69.8	82	179.6
−39	−38.2	22	71.6	83	181.4
−38	−36.4	23	73.4	84	183.2
−37	−34.6	24	75.2	85	185.0
−36	−32.8	25	77.0	86	186.8
−35	−31.0	26	78.8	87	188.6
−34	−29.2	27	80.6	88	190.4
−33	−27.4	28	82.4	89	192.2
−32	−25.6	29	84.2	90	194.0
−31	−23.8	30	86.0	91	195.0
−30	−22.0	31	87.8	92	197.0
−29	−20.2	32	89.6	93	199.4
−28	−18.4	33	91.4	94	201.2
−27	−16.6	34	93.2	95	203.0
−26	−14.8	35	95.0	96	204.8
−25	−13.0	36	96.8	97	206.6
−24	−11.2	37	98.6	98	208.4
−23	−9.4	38	100.4	99	210.2
−22	−7.6	39	102.2	100	212.0
−21	−5.8	40	104.0		
−20	−4.0	41	105.8		
−19	−2.2	42	107.6		
−18	−0.4	43	109.4		
−17	1.4	44	111.2		
−16	3.2	45	113.0		
−15	5.0	46	114.8		
−14	6.8	47	116.6		
−13	8.6	48	118.4		
−12	10.4	49	120.2		
−11	12.2	50	122.0		
−10	14.0	51	123.8		
−9	15.8	52	125.6		
−8	17.6	53	127.4		
−7	19.4	54	129.2		
−6	21.2	55	131.0		
−5	23.0	56	132.8		
−4	24.8	57	134.6		
−3	26.6	58	136.4		
−2	28.4	59	138.2		
−1	30.2	60	140.0		
0	32.0	61	141.8		
1	33.8	62	143.6		
2	35.6	63	145.4		
3	37.4	64	147.2		
4	39.2	65	149.0		
5	41.0	66	150.8		
6	42.8	67	152.6		
7	44.6	68	154.4		
8	46.4	69	156.2		
9	48.2	70	158.0		
10	50.0	71	159.8		
11	51.8	72	161.6		
12	53.6	73	163.4		
13	55.4	74	165.2		
14	57.2	75	167.0		
15	59.0	76	168.8		
16	60.8	77	170.6		
17	62.6	78	172.4		
18	64.4	79	174.2		
19	66.2	80	176.0		
20	68.0	81	177.8		

Examples

Problem: The manufacturer of the amplifiers used in your system specifies their performance at $-40°$F, $70°$F and $140°$F. What are those temperatures in Celsius?

Solution: Use the formula

$$C = 5/9 \times (F - 32)$$

$$= 5/9 \times (-40 - 32)$$
$$= 5/9 \times (-72)$$
$$= -40°C$$

$$= 5/9 \times (+70 - 32)$$
$$= 5/9 \times (38)$$
$$= 21.1°C$$

$$= 5/9 \times (+140 - 32)$$
$$= 5/9 \times (108)$$
$$= 60°C$$

Problem: The components in a piece of test equipment are rated for performance up to 105°C, but your replacement parts catalog lists components in degrees Fahrenheit. What is the equivalent temperature in Fahrenheit?

Solution: Use the formula

$$F = (C \times 9/5) + 32$$

$$= (105 \times 9/5) + 32$$
$$= (189) + 32$$
$$= 221°F$$

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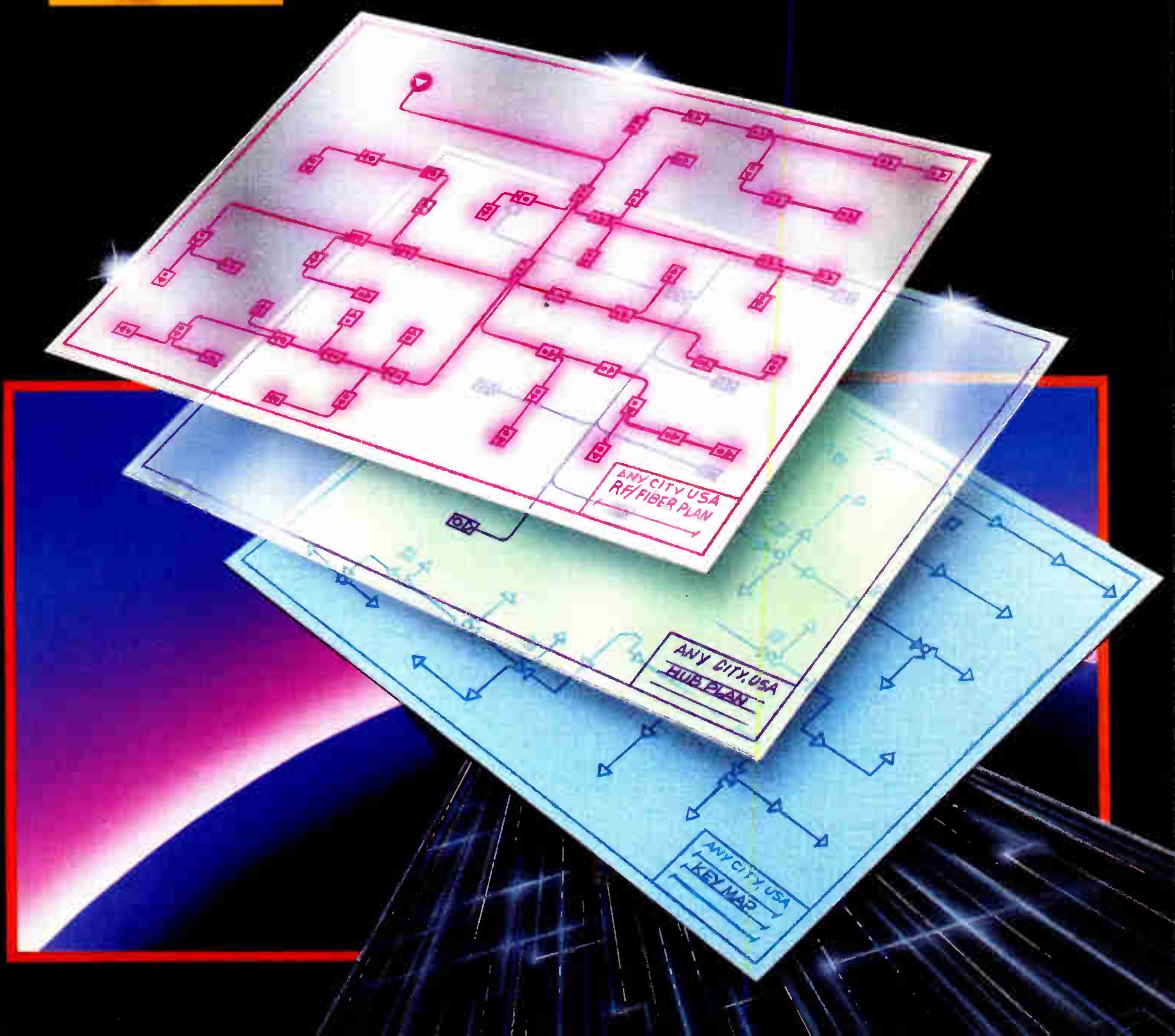

Speaking of switch-mode power supplies...

By Jud Williams
Owner, Performance Technological Products

For the last several years the trend in DC power supply regulators has been moving toward switch-mode regulators and away from linear types. As switching regulators become more firmly entrenched, there is increasing controversy concerning them. The reason for the shift over to switching regulators is their inherent efficiency, some approaching 90 percent, and also because they dissipate less heat.

Bad with the good

Along with these advantages, some very serious problems have arisen. One of the problems is reliability due in part to their complexity. This is not only a problem in the cable TV field but it also is plaguing the electronic and computer industry. In contrast to a switching-mode power supply, which may have as many as 60 or more components, a simple linear power supply may have as few as four components: an isolation transformer, bridge rectifier, filter capacitor and regulator.

Another problem is the matter of power factor, also a major concern throughout the electronics industry. Power factor is a rather difficult concept to grasp but it boils down to something akin to efficiency. The effect that power factor has on an electrical distribution system is the increased need for higher current capacity. To obtain the maximum amount of usable power from an AC line, the current should be sinusoidal and in phase with the line voltage. When it is not, the power factor is affected.

The problem is further compounded by the harmonic distortion in the current waveform. This is caused by the input capacitor of a switch-mode power supply drawing discontinuous current while being charged. Since power factor is defined as the ratio between true power and apparent power, ideally one would want the voltage waveform to be in phase with its current waveform and have the lowest possible harmonic distortion. Certain factors preclude this from always being the case. If there is a highly capacitive load (as is the situation with switch-mode power supplies), the current leads the

"To obtain the maximum amount of usable power from an AC line, the current should be sinusoidal and in phase with line voltage."

voltage. This phase shift can often reduce the power factor to something like 50 percent. If the total harmonic distortion as described earlier is something on the order of 150 percent, then we are certainly looking at a much higher current drain than anticipated. Thus, we have in effect thrown our efficiency out the window. Our primary electrical system must be increased to accommodate the extra burden put upon it. There have been efforts to correct the problem; a device called a power factor controller was recently introduced, although I am not aware of its use in the cable TV industry.

Troubleshooting

When troubleshooting switch-mode power supplies there are certain procedures to follow. First and foremost, if at all possible use a DC oscilloscope. The whole job goes much quicker since the scope will allow you to observe waveforms (a very important aspect of switch-mode power supplies) as well as measure DC voltage levels quickly and conclusively. Another valuable device to have is a DC bench supply that will deliver up to 3 amperes (A) at 30 volts (V). It also helps to have some power resistors to use as a load. A 25 ohm, 50 watt resistor will draw approximately 1 A from a power supply under test, which in most cases is adequate. Finally, a 60 V RMS source such as a ferro also is needed.

As with any electronic device your first step when troubleshooting should be a visual inspection of the circuits to locate burned, discolored, blistered or swollen components, which often lead directly to the problem. When checking fuses don't always trust your eyes. Test with an ohmmeter to be certain.

Since the most bewildering aspect of any electronic device is the presence of

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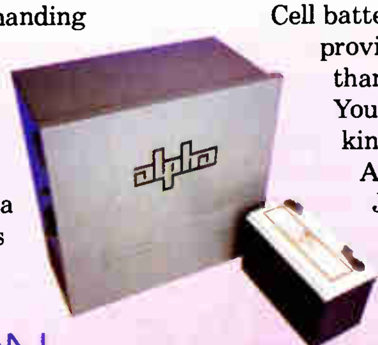

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an IC chip, the rest of this article will concentrate on troubleshooting the IC regulator. Actually they are very simple to deal with if you know which pins on the device are important to consider. When working with an analog device such as a power supply regulator, only two or three pins are significant. If there is any deviation from normal at any of these key test points, the device should be considered defective and be replaced. It would be helpful if the manufacturers would indicate proper voltages and/or waveforms for these particular points on their schematics. It would certainly relieve the world of a lot of head scratching.

Since Scientific-Atlanta's switching regulators are quite typical and have several variations on the market, we will examine the troubleshooting procedure for them. Several other manufacturers use the same regulator chips in basically the same configuration, so this explanation would apply to them also.

To begin with, you must be familiar with the numbering system used to identify the various pins on the chip. Both a 14-pin and 16-pin "dual inline package," commonly called a DIP, will be described. The pin arrangement is viewed from the top side of the chip and for orientation begin by locating a notch at one end of the package. With the chip turned so that the notch faces away from you, Pin 1 will be to the left of the notch. The rest of the pins run down that side coming toward you, then cross over the chip at the end opposite the notch and continue back up the other side. The last pin is to the right of the notch. You are, of course, viewing the IC from the component side of the PC board.

Older switch-mode power supplies use a 14-lead regulator known as the Type 723. The chip receives its power to function from a 12 V source and may be verified by checking Pin 3. The chip puts out a reference voltage on Pin 6 that may vary anywhere between 6.5 and 7.5 V. Finally, Pin 13 will have pulses riding on it. If all these voltages are present you may rest assured that the chip is good.

Newer switch-mode power supplies use a 16-lead regulator known as the Type 594. This chip receives its power to function from a 25 to 30 V source, which may be verified by checking Pin 12. The reference output is on Pin 14 and should measure between 4.5 and 6 V. Pin 5 should have a sawtooth waveform riding on it. When all these voltages are present, the chip is OK. The rest of the power supply requires traditional straightforward troubleshooting techniques and will not be covered here.

How to talk to non-techs

By Rikki T. Lee
Editorial Consultant

You feel misunderstood by your non-tech co-workers. Lately you've ignored them. You realize there's a technical language barrier between you and non-techs, but you can't tear it down. If you talk to them about your job in any detail, their eyes suddenly seek an exit. So when you're in an elevator with a friendly non-tech, the talk focuses on football scores, stormy weather or last week's company picnic (where you avoided non-techs). Now you find yourself alienated from some important people.

But if you want to, you can end your self-imposed exile—and fast. You can demolish that dreaded wall of silence and even enlist the non-techs' help in keeping it down forever. Instead of humming the tune (made famous by Rex Harrison in *Dr. Doolittle*) "If I Could Talk to the Non-Techs," you can succeed in doing so by following some simple tips.

What do you need from me?

Your main objective when communicating technical information to non-techs, either in a conversation or a meeting, is to give them what they need in order to do their jobs better. So, before chatting enthusiastically about carrier-to-noise in your system's upgrade, start out by asking non-techs, "What kind of information can I provide you?"

When you think about it, the world of non-techs is different from yours. Your job might require you to troubleshoot the plant, test new hardware in the lab or teach pole climbing. On the other hand, corporate executives expect results, system managers demand efficient operations, controllers want expenses within budget and CSRs need answers to subscriber questions. Rarely would non-techs care to know your specific methods, procedures or techniques; these things wouldn't help them out.

In a one-on-one between you and a non-tech, find out (or directly ask) what that person does on the job; then zero in on what data you can provide to fit those needs. In most cases, some thought before plus a little self-control during your answer are all that's required to give the proper amount of info at the correct technical level. You're not aiming to photocopy all of your technical knowledge and deposit it into a non-tech's brain; only a Vulcan mind-meld can accomplish that.

And when you present a proposal or progress report in a meeting with non-techs of various job titles, levels and experience, don't explain technical theories or procedures. Time is limited, so speak of results, benefits and tangibles: what equipment is needed, how much will it cost, who must be hired, how long it will take, how will it improve service, what are the alternatives and what decisions must be made.

Avoid using technical terms (including abbreviations like "MHz" and "dBmV"); non-techs don't like jargon. When people hear a word they don't understand, they search their memory for what that word means (or what it sounds like): "Did Sam say 'multiplexing'? Wait, that must be a high tech word for 'multiplying.'" Hence, people stop listening. Also, they may become angry and feel you're strutting your stuff at their expense. Deep down they might get the impression you don't care much about them.

But if you must use (or forget not to use) a technical term unfamiliar to most non-techs, explain it. Example: "The fiber upgrade will give us 550 MHz, which is the capacity for about 80 channels." Also provide visuals (slides, overheads or boards) and go to the easel to sketch a concept your audience absolutely must understand in order to make an enlightened decision. Make your visuals as realistic and action-packed as possible. Don't just flash a schematic of the guts of an OTDR; rather, show a photo of one—even better, a photo of someone using it.

If other techs are present at the meeting, what then? You can write an abstract of your report (enclosing any supporting data) for the techs in language they are familiar with. But when you speak to the whole group, focus on the non-techs. Give them plenty of things to look at—handouts, charts, etc. Keep the door wide open for questions and clarification. Seek out group participation. And every few minutes ask, "Does anyone have a question about...?" or "Would you like it if I gave an example?" In no time at all you'll be a big hit with the non-techs.

Show them a class act

To most non-techs, even the simplest technical data is hard to swallow. Here's where you come in: Widen the horizons of non-techs by teaching department or companywide seminars on topics like new technologies, how a cable system works, basics for CSRs, etc. If classes start after 5 p.m., attendance should be voluntary. Increase your audience by posting colorful flyers with trick questions to entice non-techs to find out more: "What's the mpg rating for a direct pickup?"

Here are some suggestions on how to plan course content:

- Expand their curiosity about "popular" topics (fiber, HDTV, DBS, CLI, interdiction) with some myth-shattering facts.
- Include technology of common interest, especially with sales and/or marketing groups: pay-per-view, digital audio, interactive video.
- Explore issues that affect the entire company: safety on the job, leakage, lightning protection, theft of service, customer contact.
- Avoid the "nuts and bolts" of a tech's routine day as well as complex concepts (design, headend maintenance, status monitoring).

To begin, have the class fill out a multiple choice quiz (20 questions) on what you will cover. Later, give out the same test with answers circled and explained so students can keep it for reference.

When you instruct, start your explanation at the lowest level, then work your way up. You can expect different job titles to walk away with different facts, according to their needs. While demonstrating a hand-held leakage detector, explain why it's needed and how it can improve subscriber satisfaction (for the CSR); how much it costs and who should have one (accountant); how to recognize one by sight, sound, function and operation (assistant manager); how it works (system manager); etc.

You shouldn't avoid technical words—just be sure to include definitions and examples each time. Also use lots of visuals and impromptu drawings. Throughout the seminar, review your important points and ask, "Clear so far?" If some are still confused, explain the point again. You can never be *too* basic to non-techs. Keep the floor open for questions all the time.

Non-techs will need more than one class. Plan one every month or so to review previous classes and to go further. Do this and you'll reap benefits for years to come. You'll be well-respected, non-techs will seek you out and that language barrier will come tumbling down.

Three organizations for the future

By Dr. Richard R. Green
President and CEO, Cable Television Laboratories Inc.

"Engineers must become a more integral part of the decision-making apparatus in our operating companies."

I appreciate the opportunity to speak to you today. I am especially happy to be speaking to engineers because, in this technology-based industry that pays our salaries, it is the engineers who provide for the efficient operation of existing systems and who will uncover the new features and capabilities that will lead to expanded revenues in the future.

The SCTE, as does any growing organization, has had its ups and downs. But we are all especially impressed with its recent progress. Under the able leadership of Past President Jack Trower and Executive Vice President Bill Riker, you have enjoyed phenomenal growth with current membership of more than 7,000 at the time of this convention. You all deserve a great deal of credit for the state of the Society today. It is professional without being elitist and progressive without threatening credibility. I want to come back to those points in a moment.

The SCTE has every right to be proud of its role in increasing the professionalism and level of training of cable technical personnel. The Society has admirably assumed the lead in this effort and the industry has responded very well. I commend you for your past success and, with Bill Riker's continued leadership and that of your newly elected President Wendell Woody, I know that you will continue to have great successes in the future.

Today, I want to speak to you about the current state of cable engineering practice, take stock of our collective assets and finally to suggest a path we can take to better adjust to the changing role of the cable engineer.

Why is the role of the engineer changing? The reason has been explained in numerous books, including those by Alvin Toffler, John Naisbitt and Peter Drucker. The rate of technical change is accelerating exponentially. Mankind's knowledge has doubled in the last decade and will double again in the next five years.

Three years ago the average cable engineer didn't need to care about the difference between a Fabry-Perot and a distributed feedback laser. Now that same engineer not only cares but is influencing the design of these devices and is driving a major market for analog laser components.

Pure science has been spilling over into technology and the basic scientific content of engineering is steadily on the increase. It affects not only the components and equipment with which the engineer must work but, more significantly, the methods of attack—the whole approach to the problems of design. And above all it imposes a new order of demands upon technical training. Adjustment to this new state of affairs will by no means be easy and the stress and strain of accommodation will sometimes be painful.

We have progressed from low-band to 12 channels, and so on to 20, 36, 54 and 60. We can expect to see more of the same. Those of you who attended the recent NCTA convention in Atlanta heard a clear message that the spiral of greater

capacity will continue. Not only will it continue but it is likely to accelerate. John Malone summarized it: "Introduction of analog lasers and fiber into trunking and subtrunking will give us an evolutionary way to greatly increase the channel capacity of our plants. There will be a race between satellite and fiber as to which technology will be the most cost-effective in terms of low fixed, high variable cost to the consumer. We're very optimistic that the same money we currently spend for a cable system upgrade to get 20 or 25 more channels will in the future yield three to five times as much bandwidth incrementally. The development of compression technologies and digital HDTV will allow that bandwidth to be very efficiently subdivided for a broad range of services. The incremental investment can be shifted more to the consumer who wants the broad range of choice rather than to a fixed cost burdening the entire capital structure. The end result is going to be more choice and higher quality for the consumer."

All of us in the cable industry are racing forward into a new era of technology and competition. Fiber optics, digital compression, digital transmission and HDTV are the currency of the future cable realm.

As if this were not enough, according to a recent survey of engineering executives, customer service is having the greatest impact on engineering departments, an influence acknowledged by 80 percent of those polled. I don't have to tell you that the combination of the increased importance of customer service, the pressures of emerging technology and the specter of future competition make cable engineering increasingly demanding. Engineering has become a blend of technology, customer service and even marketing: Engineering is the bridge between science and management. Our cable engineering community is therefore faced with an evolving series of new requirements.

Providing the leadership

On the one hand, we must as an industry improve our service to our customers. We have begun an extensive effort to do just that. On the other hand, we must provide the leadership to introduce the best and most cost-effective new technology to our networks. Emerging competition will drive us to fulfill both of these functions with an emphasis on superior quality. Since engineers are the central part of the system, they will be increasingly drawn into the management and planning cycle.

The pace of technical change has always been daunting. Here is what an earlier speaker had to say about it: "In my own time there have been inventions of this sort, transparent windows, tubes for diffusing warmth equally through all parts of a building, short-hand which has been carried to such a pitch of perfection that a writer can keep pace with the most rapid speaker. But the inventing of such things is a drudgery for the lowest slaves; philosophy lies deeper." That speaker was Lucius Seneca; the year was 50 A.D.

Even though Seneca didn't think much of technology or engineering, he may be right that philosophy underlies invention. We should at any rate take a few moments to reflect: to take stock of our professional assets, to look at the support structures that are developing to assist the engineer and to make some suggestions on a plan to address the emerging new roles of the cable engineer.

We're fortunate in cable to have a lineup of organizations that are working to support the industry's operating engineers. I like to think of these organizations as the legs of a three-legged stool—each one an essential element properly positioned in a structure that supports and assists the industry's engineering community. Each organization is uniquely constituted and qualified to accomplish a mission that is complementary to the others.

The first organization is, of course, the SCTE, whose growth is an indication of the importance and effectiveness of a professional society devoted to the needs of cable engineers. This is the biggest SCTE conference so far. The exhibit hall of this convention sold out in April and every available meeting room in the convention hotel has been converted to a tabletop display area to accommodate companies on the exhibit hall waiting list.

This year's advance registration was 20 percent ahead of 1989. The SCTE is a rapidly growing professional society open to anyone who has an interest in the technical issues that affect cable television. As a professional society representing all elements of the industry, the SCTE is perfectly positioned to set voluntary standards. The Society provides the open forum so essential to the debate and development of operating practices that are themselves essential to the future growth and development of the industry.

Our second organization, the NCTA Engineering Committee, keeps engineers informed on political and regulatory issues and supplies the all-important


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technical input into the legislative/regulatory process. The committee provides outreach to other industries, such as the EIA, in joint committee structures and provides a central forum for industrywide debate on technical issues. None of our competitors has been able to field an organization as effective as the NCTA Engineering Committee.

Third—the new kid on the block, CableLabs—provides centralized R&D facilities and funding as well as serving as the technical information provider to the industry's operating companies. CableLabs is organized to understand and capture technology for the benefit of cable operators. We provide aggressive technology assessment. As new technologies appear that may affect our industry, information on them is given to our Technical Advisory Committee and our New Business Development staff, who do further analysis. We then make investments or commission projects and work with the other departments within the labs to coordinate the introduction of technologies into the industry. We have project offices—such as HDTV, consumer interface and fiber—where major projects that require their own identity and budget reside.

We are working on problems, some of which have been a bother since the very early days of cable television. There are others that have come about more recently as unwanted by-products of technical, business or political developments. All of these are considered current problems. Some of these are conditional access, corrosion problems, direct pickup interference and other tuner design shortcomings, signal leakage, in-home wiring and so on. CableLabs has ongoing projects in all of these areas and is attempting to make current systems work better and more efficiently.

An industry that looks only at its current problems, however, is not likely to live long or prosper. CableLabs also is looking at networks of the future. We are looking at optimized system operations and architectures, advanced television systems (including high definition), standards for wiring businesses and homes, and new and innovative joint efforts with the consumer electronics industry to simplify the human interface and provide new service opportunities.

CableLabs is committed to working with the SCTE and the NCTA Engineering Committee to build a stronger and more influential engineering community to support the industry. We have hosted meetings of both groups in Boulder, Colo., the most recent being the SCTE Interface Practices Committee working group on plating.

So we have three valuable organizations on which to rest the professional growth, training and development of new technology. I see the need and desirability of closer ties between these organizations.

First we would like to work with the SCTE in its efforts to address engineering training. Bill Riker and I have discussed a joint program to support engineering education, especially those elements that relate to emerging technology.

Second, I would like to invite both the SCTE and the NCTA Engineering Committee to appoint representatives to meet with us and our Technical Advisory Committee chairmen at CableLabs to outline a plan for future cooperative ventures and to address the issue of how we might better serve the needs of engineers in the operating companies.

I also would like to make a few suggestions as to how we as individuals might cope with the demands of the new engineering role. We must actively support the professional societies and industry organizations that are trying to impose some order on the exploding technology through voluntary standards and operating practices. The needs of cable must be expressed in technical standards, because the de facto standards that will otherwise develop may not be in our best interest. Even worse, the financial burden arising from such chaos will reduce our ability to survive in the competitive market of the future.

Looking ahead to the future

I would urge you to look far ahead to the cable systems of the future. While we must continue to upgrade our service and plants to improve near-term quality, the real value of a system engineer in the future may be that engineer's ability to anticipate and communicate the technical options that will be available. Such abilities will be necessary to support the corporate strategic plans that will be an important part of the future business environment. If cable is to successfully compete in a market increasingly conditioned on technical quality, we must be looking ahead to digital plants and transmission of HDTV. The marketplace is not going to become less competitive, and if we expect to be successful we must adapt the emerging technologies so that we will be able to compete in that marketplace.

I believe that in addition to their traditional role, engineers must become a more integral part of the decision-making apparatus in our operating companies.→

We need to do what we can to reduce the distant relationship that often exists between general managers and technical managers. Doing a good job of engineering is no longer sufficient. Our technical efforts and judgments need better integration into the mainstream of organizational thought. We all need to make an effort to communicate to top management basic information of new technological developments. In today's marketplace, it is essential that the decision makers understand more of the subtleties of future technical choices. Only an informed management can make proper decisions and, conversely, the more you know about the business plans and marketing objectives of your own organization, the better you can plan technical support.

And above all let's continue to be *realistic*. The ideal of the engineer as an individual of practical action is as ancient as written history. It is a tradition handed down from those men of Caesar's legions who first pushed bridges across the Rhine. That tradition remains today in the need for credibility in the application of technology to our telecommunications networks.

The telephone companies continue to amaze me by claiming that the United States must have fiber to the home at any cost and that our national honor is at stake if we don't embark on this expensive and unnecessary course. But given the telcos' PR success, one is tempted to spin an equally incredible fantasy for America's telecommunications future. I believe that if the cable industry is to continue being held in high regard by the investment community, its use of technology must continue to be practical, its engineering sound and its technical plans credible. We must be able to deliver on our promises as we have in the past. It is essential that we face the reality of hybrid fiber extensions of capacity and digital HDTV but let's remain practical and realistic about their application.

I've been told the story of a man who was leaving his office in Manhattan to go home to New Jersey and decided to stop and have a few drinks with his pals. (This is a true story.) Afterward, he's driving on the New Jersey Turnpike at about 10-10:30 at night. The car skids and he is in an accident that involves about 12 cars. No one was hurt but it's a real mess. When the state police come, the man is standing on the side.

Somewhat inebriated, he tries to talk to the trooper. The trooper says: "Go stand over there." Standing on the side while they're cleaning up the mess, he sees that no one is paying attention to him. So he gets into the car and he goes home, puts his car in the garage, locks it up and goes to bed. The next morning at 8 a.m., there is a knock on the door—remember, this is a true story.

When he answers a state trooper asks, "Are you Mr. Thomas Turndal?"

He says, "Yes, I am."

The trooper says, "Were you on the New Jersey Turnpike last night about 10 p.m.?"

He says, "No, I got home at 6:30, like I usually do. My wife and I spent the evening home watching television."

"Do you own a 1984 Lincoln town car, license plate KBR 724?"

He says, "Yes, I do."

"May I see it?"

"Sure, it's in the garage."

They go out to the garage, open the door and there is a New Jersey State Trooper's car parked in his garage.

There are some realities you just can't ignore.

This article was presented as the keynote address at the 1990 Cable-Tec Expo Awards Luncheon.

JULY 1990

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CADCO's 362HL automatic input offset headend processor

By Ron Hranac

Part 76 of current FCC regulations requires frequency offsets for certain cable signals carried in the aeronautical bands. Specifically, §76.612 states that carriers with levels greater than 10^{-4} watts (+38.75 dBmV) in the 108-137 and 225-400 MHz bands anywhere in the CATV distribution system be offset either 12.5 or 25 kHz from aeronautical frequencies, depending upon whether the cable signals are in the communications or navigation portion of the aeronautical spectrum. The offset carriers must have a frequency stability of ± 5 kHz, and for HRC operation, a 6.0003 MHz comb generator with a frequency stability of ± 1 Hz must be used.

Most headend equipment manufacturers now provide modulators with output frequency offset capability and the necessary frequency tolerance. But what if you carry off-air broadcast channels in the aeronautical bands? Here you must deal with not only the output offset, but also the *input offset*. Broadcast TV frequency assignments include ± 10 kHz offsets. And if you are processing other cable channels (which may be offset) for carriage in the aeronautical bands, dealing with output offsets becomes even more complicated. This means that your processor input frequency converter must be specially configured for the incoming channel's particular offset, and the processor's output converter able to handle the cable channel's aeronautical offset.

CADCO recognized this dilemma and recently introduced its Model 362HL processor. It features what the company calls "automatic input offset control," and CADCO has filed for a patent on the circuitry that makes this possible. In a nutshell, the 362HL is a frequency agile heterodyne headend processor that automatically compensates for the input offset (off-air VHF and UHF as well as standard and HRC cable frequencies) and also provides the necessary output offset. We obtained a unit for evaluation and tested it in Jones Intercable's corporate engineering lab.

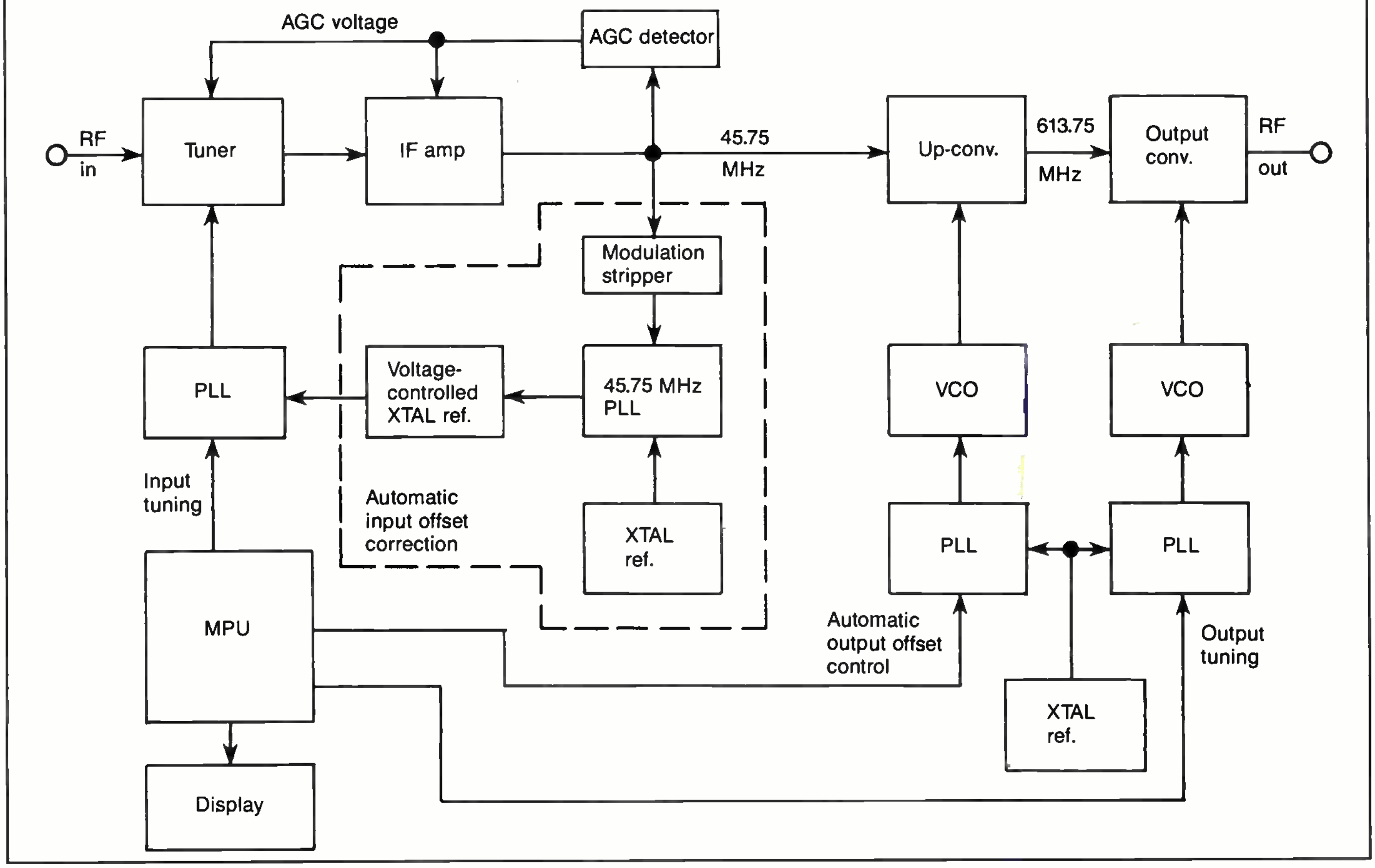

Courtesy CADCO

The product

The 362HL fits in a standard 19-inch rack, is one rack unit (1¾ inches) high and 14 inches deep. It weighs 12 pounds and is configured for 115 VAC (± 10 volts) operation. Its 40 watt power consumption is fairly typical for headend equipment, although there is no on/off switch. CADCO recommends at least 1¾ inches of spacing above and below the 362HL for proper ventilation. The processor includes an automatic shut-off feature should it overheat, but our test unit didn't get overly warm even with two other pieces of operating equipment stacked directly on top of it.

The front panel includes a power indicator LED, aural carrier level control, input source select switch (off-air, cable std. and cable HRC), input channel select switch, channel display window, output channel select switch, output level control and −20

Figure 1: Block diagram of CADCO's 362HL headend processor



Courtesy CADCO

dB output test point. The channel display also includes a frequency lock LED. On the rear panel you'll find an RF input, composite IF loop, RF output and a connector for a CADCO 50-550 frequency counter.

Operation is fairly straightforward: the RF input level should be a nominal +10 dBmV for optimum AGC operation and can be any off-air VHF or UHF channel (2-69) or standard or HRC cable channel up to 550 MHz, including 98 and 99 (A-2 and A-1). The processor's output can be any standard cable channel up to 450 MHz, again including 98 and 99. Non-phaselocked HRC output frequencies are available (corresponding to 6.0003 MHz spacing) by flipping an internal switch, but CADCO personnel

Figure 2: Swept in-channel frequency response with the vertical scale at 10 dB per division

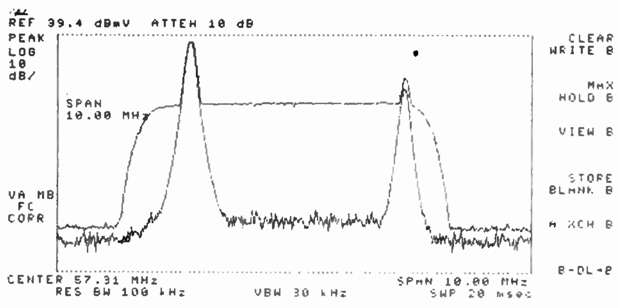
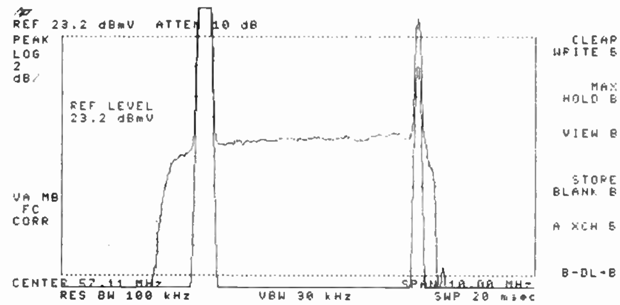


Figure 3: The same measurement as Figure 2, but with the vertical scale at 2 dB per division



indicate that HRC output operation is really intended only for backup use since there is no way to phaselock the 362HL to an external comb generator.

After connecting the RF input and plugging the power cord into a 115 VAC electrical outlet, the front panel channel display window will flash "88 88" to verify proper operation, then will display digits corresponding to the input/output channels the processor was last tuned to. Select the input source being used with the front panel switch and tune to the desired input and output channels with the respective channel select switches. After a few seconds the frequency lock LED will illuminate to indicate the unit is fully functional. A built-in non-volatile memory will retain input/output channel selections in the event of a power failure.

Connect the processor's output to a signal level meter or spectrum analyzer and adjust the aural carrier and output level controls for the required output (up to a maximum of +60 dBmV). The 362HL, which is microprocessor controlled, will automatically determine the incoming offset (if any) and convert it to a standard 45.75 MHz visual IF. The processor incorporates SAW filtering and the triple conversion circuitry uses a 613.75 MHz second IF. The output will be automatically offset zero, +12.5 or +25 kHz, depending upon the actual output channel tuned to. If you need to change channels during operation the output will be squelched while you're making the change.

Figure 1 is a block diagram of the processor and will give you an idea of the techniques involved in achieving automatic offset operation. This, like some products previously reviewed by *CT*, is one that fits in the category of "why didn't someone think of that before?" The 362HL sells for $869. →

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Lab measurements

The dynamic range (AGC) of the processor's input is specified from −20 to +20 dBmV, with a recommended input of 0 to +10 dBmV. With front panel adjustments set for +10 dBmV input and +60 dBmV output, the 362HL's AGC functioned over a −30 to +40 dBmV input range with only 0.5 dB output variation. All subsequent tests were performed with +10 dBmV input.

The output visual carrier level specification is +40 to +60 dBmV, but we found the unit capable of +22 to +68 dBmV. At +72 dBmV the output hybrids were in full compression. Spurious outputs are supposed to be 60 dB down; with the main output at +60 dBmV, the only spurious of significance was the second harmonic, which was −54 dBc. Out of band noise was measured at −78.3 dBc (−80 dBc spec). CADCO doesn't have a published specification for in-channel frequency response, but we measured it at ± 0.8 dB (Figures 2 and 3).

To test compatibility with adjacent channels operating at the same level as the desired input signal, a 54-channel input (+10 dBmV per channel) was connected to the input. At the processor's RF output the lower adjacent audio was −57 dBc and the upper adjacent video was −55 dBc; CADCO's spec is −55 dBc.

The processor should operate over normal AC voltage variations encountered in most headends. While rated for 105 to 125 VAC, the unit worked well up to 135 VAC and as low as about 95 VAC. At 95 volts the output frequency stability was maintained, but some hum was evident in the picture. At 90 volts the processor stopped working altogether.

The following table summarizes input/output frequency performance under various operating configurations. In all cases the output frequency tolerance was well within the manufacturer's spec of ± 4 kHz.

On-channel: standard to non-offset standard (Ch. 2 to Ch. 2)

Input frequency (MHz)	Output frequency (MHz)
55.24000	55.25014
55.25000	55.25014
55.26000	55.25014

Off-channel: standard to +25 kHz aeronautical (Ch. 2 to Ch. 99)

Input frequency (MHz)	Output frequency (MHz)
55.24000	115.27503
55.25000	115.27503
55.26000	115.27503

Off-channel: standard to +12.5 kHz aeronautical (Ch. 2 to Ch. 16)

Input frequency (MHz)	Output frequency (MHz)
55.24000	133.26251
55.25000	133.26251
55.26000	133.26251

Off-channel: UHF to +12.5 kHz aeronautical (Ch. 31 to Ch. 16)

Input frequency (MHz)	Output frequency (MHz)
573.24000	133.26254
573.25000	133.26254
573.26000	133.26254

Off-channel: HRC to +12.5 kHz (Ch. 8 to Ch. 16)

Input frequency (MHz)	Output frequency (MHz)
180.00000 (old HRC plan)	133.26251
180.00900 (new HRC plan)	133.26251

Comments

The 362HL processor worked flawlessly in its frequency conversions. Regardless of the combination, it did what CADCO says it will do. There is about a 10 kHz margin beyond the specified input range; for example, the Ch. 2 input could be varied −20 kHz and frequency lock would be maintained. It's questionable whether or not this processor would work well with a poorly maintained off-frequency translator, but just about any other input signal should present no problems. One feature that would be nice is a standby carrier option, although an external oscillator and switching circuit probably could be wired in via the external IF loop.

With the exception of the amplitude of the processor's second harmonic being about 6 dB higher than the manufacturer's specification, everything else was at or better than spec. CADCO has taken the guesswork out of processing offset signals. Forget the calculator or scratch paper; custom-ordered equipment isn't necessary, either. Just plug the 362HL in, flip a couple switches, set RF levels and you're in business.

For more information, contact CADCO Broadband Communications, 2405 S. Shiloh Road, Garland, Texas 75041.

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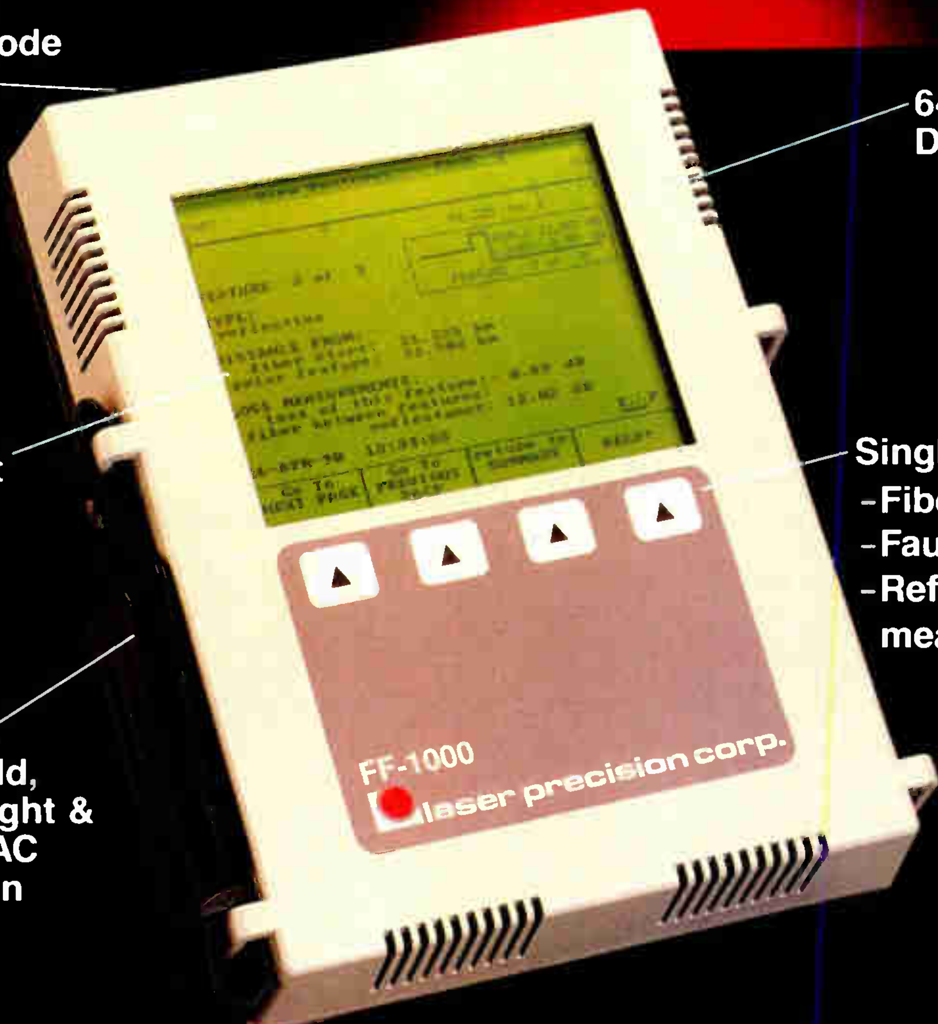

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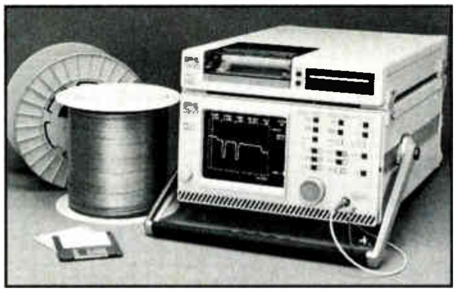


Optical module

The Model 413M6 optical module for use with the Model 4000 HiRes optical time domain reflectometer was announced by Photon Kinetics. This new plug-in incorporates Photon's electronic masking technology and initiates a new standard for high resolution measurements of multimode optical fiber, according to the company. The unit features an event dead zone of 5 meters and an attenuation dead zone of 17 meters at 1,310 nm.

The company said the product is the industry's first masked multimode plug-in with 16 masks and seven pulse widths to meet any high resolution multimode measurement challenge. The programmable masks eliminate the measurement discrepancies caused by highly reflective features and are moved easily to reduce reflections wherever they occur on a fiber span.

Reader service #133

Agile demodulator

The new AD-1 agile audio/video demodulator was announced by Blonder-Tongue. The unit has front panel switches that permit non-volatile RF tuning of any one of 395 TV channels, including broadcast UHF/VHF assignments and CATV standard/IRC/HRC assignments from 54-801 MHz.

It demodulates any NTSC signal to baseband video and audio signals for monitoring or remodulation. It also provides a 4.5 MHz subcarrier and broadband multiplex output for MTS/BTSC applications. The unit also incorporates a PLL synthesized LO, Nyquist SAW filter, keyed AGC circuitry and a synchronous video detector. It requires only 1¾ inches of height in a 19-inch rack and has no special cooling requirements.

Reader service #116

Function generator

Wavetek introduced its Model 90 synthesized 20 MHz function generator with built-in trigger generator. It operates in non-continuous modes with the internal trigger generator and has independent frequency controls located on the front panel. The unit also can be phase locked to an external trigger source and in this case, the locking frequency is automatically acquired, calculated and displayed for the operator.

The unit offers an optional high voltage capability of 40 Vp-p for special applications. The synthesized analog function generator features programmable sine, triangle, square and DC waveforms. Variable symmetry allows creation of pulse and ramp waveforms, while variable phase angle permits the output signal to be phase shifted in relation to an external locking source. The product incorporates modulation (AM, FM, SCM), sweep (Lin/Log/continuous/manual/triggered/up/down) and non-volatile storage of complete front panel instrument setups. Frequency range is 1 to 20 MHz

Reader service #132

Feature finder

Laser Precision Corp. announced the FF-1000 hand-held feature finder. It locates faults and can also locate splices and connectors, while measuring loss and reflectance of these features. It operates at 1,550 nm with single-mode optics and has a 7-inch LCD to allow for easy viewing.

Another feature is a single button fiber analysis, fault location and reflectance (ORL) measurement. Other features include 64 km distance range and hand-held battery operation.
Reader service #102

Splice closure cable-in-conduit, connectors

Anixter made several new product announcements including the GDS (Gel Drop Splice) closure manufactured by Raychem. The closure provides a fast, simple and reliable method of environmentally protecting buried drop splices. It serves as a barrier against corrosion, water and dirt. It has a tough outer housing that is impact and abrasion resistant and the housing encapsulates Raychem's gel material that conforms to and seals the splice. One size fits both RG-6 and RG-59 cable.

Also introduced was Dura-Line's new Silicore cable-in-conduit. It features a patented coextruded prelubricant around the entire inner circumference of the polyethylene conduit. The Silicore lubricant provides for a low coefficient of friction. This is said to simplify cable placement or replacement (now or later) for new-build, rebuild or joint trench applications. According to the company, the product can bend at difficult angles due to its high density polyethylene construction. Durable polyethylene resists hydrocarbon and methane gases found in soil and has low temperature properties to allow work in cold temperatures. Cable-in-conduit is said to eliminate cable pulling, reduce labor costs and equip operators with the ability to convert to other systems for upgrades.

Anixter introduced two new Raychem connectors, the EZ-Twist and the EZ Grip. The EZ-Twist is an indoor F connector that was designed to reduce service calls related to F connector problems inside the house—one of the most common causes of CLI leakage and subscriber complaints. This connector is universal for RG-59 or RG-6 cable and is color-coded for easy identification. It can be installed on all F ports. The product offers "push-on-and-lock" installation, which allows for one-hand port termination with no special tools required.

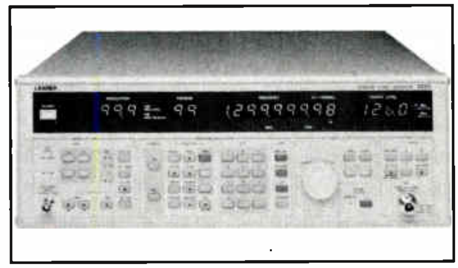
The EZ Grip aluminum connector is designed for use with Comm/Scope's Quantum Reach coaxial cable. Its small size is said to allow for greater wrench access in hard-to-reach areas. Only a few turns of the wrench are needed until the connector comes to a positive stop indicating the installation is complete. Both splice and pin-type connectors are available for .560-inch and .860-inch diameter cables. The corrosion-resistant aluminum body and circumferential seal at the cable-to-connector interface serves as environmental protection for aerial and pedestal applications. The connector maintains an operating range of 4 to 1,000 MHz, with a return loss of 30 dB or greater.
Reader service #127 (GDS), #126 (Silicore), #125 (EZ-Twist), #124 (EZ Grip)

Enclosure

CableTek Center Products introduced a new watertight marina enclosure. The product, called the Marina Box, can be produced in a variety of sizes. It provides protection for equipment from saltwater and spray.
Reader service #138

Catalog

US Electronics announced the release of its new 285-page product catalog for 1990. Some of the new lines featured are Gilbert, Klein, Leader, Cable Prep, Blonder-Tongue, Tyton and others. New products include the Leader Model 5130 half-rack NTSC color monitor and the US Electronics hand held remote control repair kits for the RC-550 and Scientific-Atlanta remotes.
Reader service #105



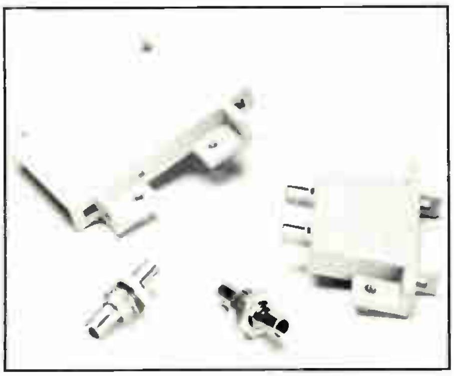
Signal generator

The Model 3220, a 1.3 GHz AM/FM synthesized RF signal generator, was made available by Leader Instruments. It has a frequency range from 100 kHz to 1.3 GHz with ±1 ppm accuracy and a resolution of 10 Hz below 650 MHz and 20 Hz to 1.3

GHz. RF outputs are selectable between dBμ or dBm with a range of +13 to −133 dBm and 0.1 dB resolution. A continuous variable mode setting key lets the output level to be varied within ±5 dB in 0.1 steps starting at any output level. Four preset levels can be set for commonly used test levels and reverse power protection to 50 W is standard.

The unit offers residual FM signal-to-noise ratio of 60 dB or better. At 500 MHz, specified single sideband phase noise is −120 dBc/Hz with a 20 kHz offset from the carrier. EMI/RFI leakage is less than 1 μV. Modulation modes are AM (0-90 percent), FM (0-99.9 kHz), AM/FM simultaneous, and DC-FM (0-5 kHz). FM deviation resolution is extended to 10 Hz for DC-FM mode and also for FM less than 9.99 kHz. Users can choose from four internal modulation frequencies.

Reader service #131



Fixed attenuator

Fotec announced its A450 series of fixed attenuators for fiber-optic systems that can be used to reduce signal levels that overload receivers in short link applications or to test systems under simulated cable loss conditions. The attenuators use the "gap loss" principle, where a fixed gap between the fiber ends induces a calibrated loss.

The technique involves building a precision spacer that can be inserted into any ST, FDDI or FC splice bushing to convert it to an attenuator. The spacers are available separately, for use with bulkhead splices, or as complete attenuators in ST-ST, ST-FDDI, FDDI-FDDI and FC-FC bulkhead splices.

Reader service #129

1 GHz cable

Times Fiber Communications presented its new T10 drop coaxial cable, featuring 1 GHz signal bandwidth and lower insertion loss. According to the company, this cable is geared for today's specifications and is ready for emerging technologies, including HDTV.

The cable is said to carry more channels with better quality than ever before. It is triple bonded to eliminate cold temperature pullout problems and provide added resistance against moisture and corrosion.

Reader service #139

Stereo generator

Leaming Industries introduced its MTS-4 BTSC stereo generator that features Bessel-null test tone for accurate installation. Typical stereo separation is greater than 30 dB and the unit features stereo switching for local ad insertion. Frequency response is flat out to 14 kHz.

Reader service #140

Telephone overflow

Orbital Technologies' COMTOR (computerized telephone overflow register) permits 24-hour daily, 365 days per year busy study surveys. The information derived addresses NCTA's Rule 1C. When a customer receives a busy signal from the cable operator, the COMPTOR's microprocessor counts, records and prints the information in "real time," scanning at 3,500 calls per minute. The unit's printed reports tell how many customer calls were lost to busy signals and the exact time the calls were lost.

Reader service #90

Catalog

Belden Wire and Cable is offering its new CATV catalog to assist MSOs and specialized distributors in the selection of CATV cable products. The 32-page publication describes the company's full line of CATV products and introduces new SuperDrop and fiber-optic supertrunk cables. The catalog also features the company's aerial drop cable series and expanded Teflon line.

Reader service #101

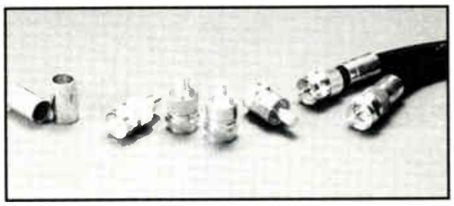
Modulator

Jerrold unveiled the Commander 6 (C6), the industry's first 600 MHz frequency agile modulator. It is 1.75 inches high, which is half the height of previous

models. It features a front panel switch to select all standard HRC or IRC channel assignments between 50 and 600 MHz.

The C6 has front panel bar graph meters to indicate video depth of modulation and audio deviation. It is said to easily interface with the company's CMTS stereo encoder and MVP video processor, simplifying the required interconnect wiring.

Reader service #137



F fitting

Signal Vision released a new CLI type F fitting. It uses compression technology forming 360° of contact between the cable braid and center post of the fitting. According to the company, this virtually eliminates all RFI leakage regardless of the conditions under which the fitting is used.

The QF fitting uses bright tin plating for weather and corrosive protection. It has a silver-plated center post for its high electrical conductivity and migrating properties.

Reader service #136

Headend switching, control

Engineering Consulting announced new products for switching and control of remote headend audio and video. The Model TPSG (touchtone programmable sequence generator) also called the Headend Manager is an EPROM program cartridge for the Commodore 64/64C and 128 computers providing timed touchtone sequences to control relays over any audio link to multiple headend sites.

The Model TSDQ/QUAD and RL4 relay boards are controlled by a single Headend Manager via touchtones. The relays operate directly from 12 to 20 V and the modules are small enough to be housed inside of existing equipment.

The Model VIDG high resolution video page generator EPROM cartridge for the Commodore 64/64C and 128 computer has been enhanced with the latest version 2.0 software. According to the company, by combining the video generator and the Headend Manager EPROM programs with the touchtone controlled relay cards, video pages can be programmed and switched from one location via local keyboard or modem. The video generator provides a real time clock, two 240-character scroll lines per page, three-letter heights, flash lines, multiple color selection of letters, screens and line by line editing.

Reader service #103

Amplifier system

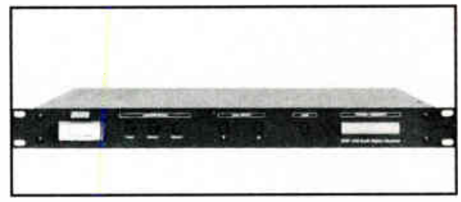
Magnavox's new amplifier line, designated the Spectrum 2000 amplifier system, includes the previously introduced 7-TH housing with ports and convection fins that optimize both aerial and pedestal installations. Also included in the new line is a 600 MHz, two-way interconnection chassis available in a variety of bandsplits for domestic and international applications.

Inside the housing, the chassis holds new amplifier modules that incorporate the latest in electronic manufacturing, including surface mounted device (SMD) technology to help ensure product integrity. These modules are available in feedforward, power doubling or push-pull versions.

Also included in the system is the new LE90 line extender that offers backwards compatibility. The units are available in push-pull and power doubling as well as a variety of gains and international bandsplits.

The Magnavox Management System completes the Spectrum 2000 System. It is a status monitoring system that helps keep CATV systems operating at peak performance by gathering and evaluating information at monitored points.

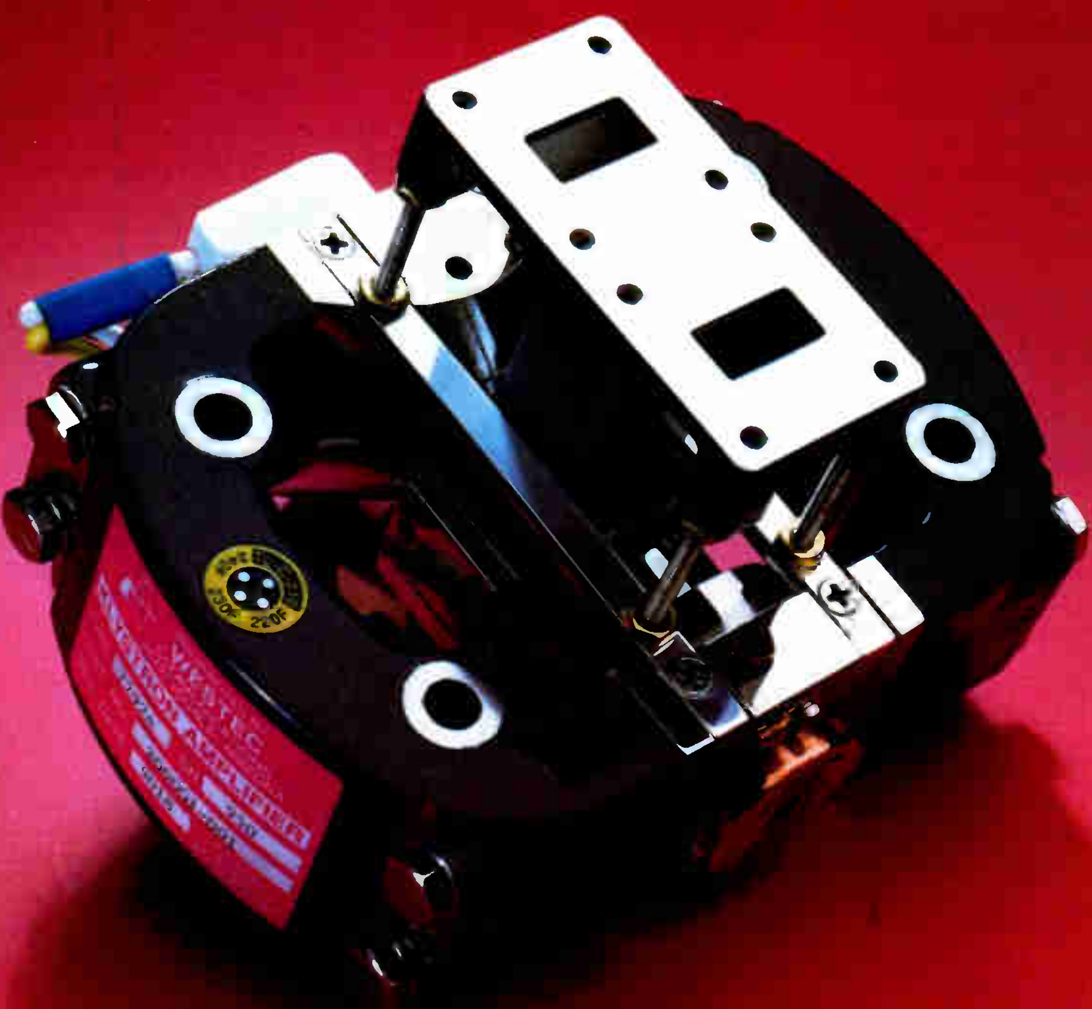
Reader service #130



Fan-out unit

The LANcast division of CaSaT Technology Inc. introduced the ENT-4360, a 13 port fan-out unit for use with IEEE 802.3 networks. The unit allows departments and LAN clusters of up to 12 workstations or PCs to be connected as either stand-alone network or to be connected to a larger network.

It features a full complement of five front-panel indicators allowing users to observe network activity on a port-by-port basis. The indicators can be used to verify pro-



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Reader Service Number 85.

per node operation. Front panel indicators include transmit, receive, collision presence and partition lamps for each port as well as information for the AUI port, which is used to interface the ENT-4360 to a backbone using a conventional AUI cable and transceiver and can be cascaded allowing up to 1,024 network nodes to be connected.
Reader service #91

Pedestal housing, enhanced conduit

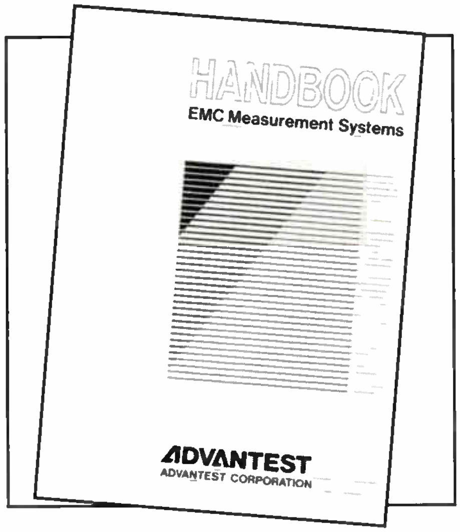
Channell Commercial announced two new products, the Signature Pedestal Housing (SPH) Line and the enhanced Cablecon line by Integral Corp. The SPH line of pedestals are designed to accommodate and mount newer CATV electronic equipment and to assure adequate room for maximizing the bending radius of RG service wires. The housings are constructed of ABS plastic that is guaranteed by the company not to deteriorate for 10 years under normal environmental conditions. Features include a captive Highfield high security locking system that prevents loss of the lock, optional trap holders, optional flame retardent materials and removable snow reflectors. The series features a flat top instead of the original dome shape, so the product is visibly different.

Integral Corp. announced its "Mirror Finish" process for its Cablecon conduit products. The process results in inner walls of ducts having a mirror-like finish, which, combined with Integral's dual lubricating system, results in improved performance and reduction of friction and pull tensions, minimizing burn through. The use of the process results in the inner wall of the conduit being so smooth and uniform that it literally looks like a mirror.

Combined with the company's "Dual Lubricating System" where a longer chain polymer emulsion is placed on the inner wall of the conduit and the outer surface of the conductor or pull rope, the problem of high pulling temperatures is said to be virtually eliminated and the surfaces of the conduit and pulling member are actually cooled. The process will become standard on all of Integral's Cablecon products.
Reader service #114 (pedestal housing), #113 ("Mirror Finish" process)

Shrink boot

Polychem introduced its F Connector Shrink Boot Poly/Chem-Shrink that uses EPDM, a material known for its weatherability features. No torch, heat or open flame is necessary to shrink. No tools are required for installation. PCS boot shrinks when exposed to air.
Reader service #88



EMC handbook

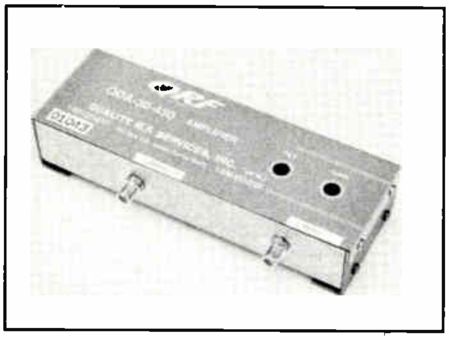
Advantest America Inc. is offering a new handbook on EMC measurement systems featuring fundamentals and case studies of EMC instrumentation to further enhance the reader's understanding of EMC testing.

The handbook is 130 pages and explores the concept of EMC instrumentation, international recommendations and standards, EMC techniques, various measurement methods and the EMC center and system engineering concept. Fold-out charts are included to highlight important factors like systems' performance, standards and software. A glossary is also included.
Reader service #94

Identifier

M.A.B. Corp.'s Identify-ZIT is designed to simplify the identifying and/or testing of either pairs of wire or coaxial cable. With the product one person can quickly test each run for line breaks, shorts and resistance problems as well as identifying.

To use the IDZ, a numbered terminal cap is attached to one end of the wire or coaxial cable and the decoder to the other end. The user presses the button on the electronic decoder and the number on the terminal cap will appear in the window. If the number does not appear it will show "OC" for open condition, "CC" for closed condition or "OO" for a resistance problem in the loop.
Reader service #87



Amplifier

Quality RF Services introduced the first of its series of indoor distribution amplifiers. Standard features include separate gain and tilt controls, selectable equalization and UL approved powering. All the QDA series are designed for maximum signal leakage integrity and conformance to all electric codes. With performance specifications exceeding most line extenders, as well as 550 MHz bandwidth, these distribution products are available in various gains and power-doubling options.

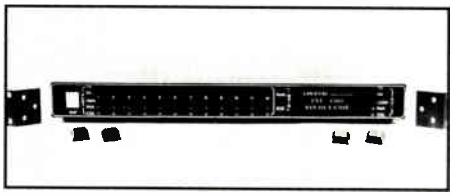
To further accommodate system CLI needs, connector choice can be either standard F or 5/8-inch entry adapters at the input and output. The series carries a year warranty.

Reader service #86

Fiber system

American Lightwave Systems announced a high performance addition to their LiteAMp AM fiber-optic product family. The LiteAMp Plus is capable of transmitting 80 channels on two fibers for a distance of 10 miles with 56 dB CNR video performance and CTB performance of 67 dB or better. It is currently available for delivery in strand-, rack- and pole-mounted versions.

Reader service #122



Receiver

R.L. Drake's Model ESR1250 is a PLL synthesized satellite receiver supplied with dual video outputs, a fixed audio channel and a modular design. Users can customize the receiver's functions to suit individual broadcast or business needs with the company's optional subcarrier demodulator boards (including those for standard audio, dual audio, wide coverage audio and data applications).

Decoder outputs provide VideoCipher II and MAC compatibility. Flexible input switching allows for C/Ku-band or horizontal and vertical operation. Commercial operators can maximize performance for channel deviation and C/N ratio by selecting IF SAW filters of 30, 25, 22 or 16 MHz from the front panel. The front panel is ergonomically designed for optimum operator convenience. The receiver accepts standard 950 to 1,450 MHz RF inputs. Frequency selection is tuned in 1 MHz steps on Ku-band and in 1 or 20 MHz steps on C-band. Its professional-grade, 140 MHz IF signal processing improves overall image rejection. The low noise IF with threshold extension provides a static threshold of less than 7 dB C/N.

Reader service #111

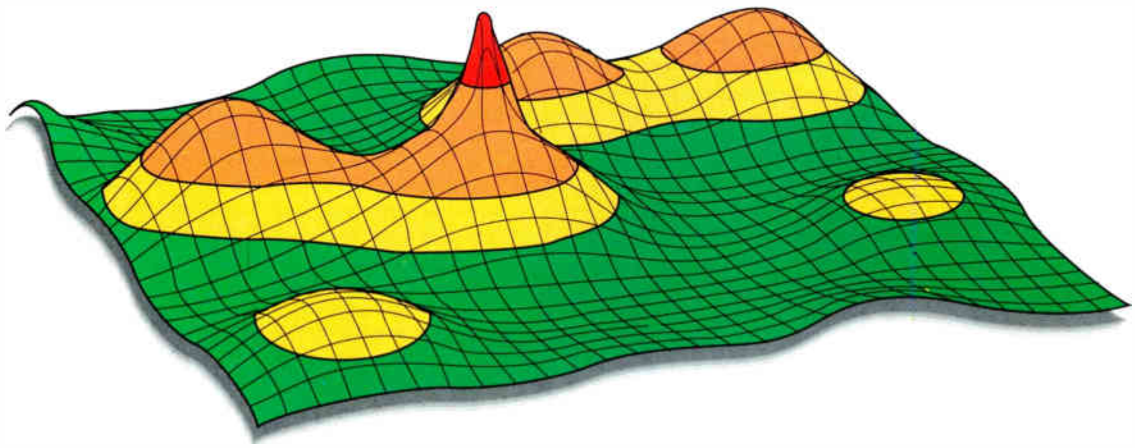
MDU trap

Eagle Comtronics' new addressable trap switch offers addressability with IPPV, consumer friendliness and total control outside the apartment. Other features include eight tiers of pay channels, complete on/off control, parental control, store and forward technology, non-volatile memory and computer control.

Reader service #141

ComSonics

CLI FLYOVER



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Reader Service Number 89.


Schreiner

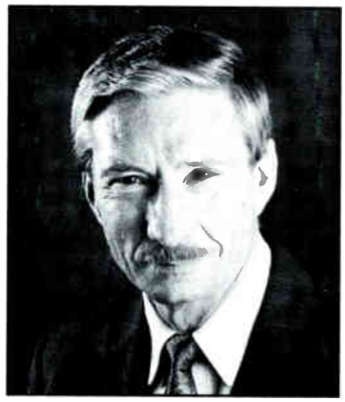
Scientific-Atlanta appointed five principal engineers, which is the highest ranking technical position in the company. The appointments went to **Peter Schreiner, Alan Wilcox, Ronald Stirling, Edward Gerhardt** and **Gary Springer**.

Schreiner works in the Atlanta instrumentation business division. Wilcox has been responsible for the design of antenna positioners for the company. Stirling manages the development activities for the design of special amplifiers for low-cost satellite stations. Gerhardt has been the principal architect for the company's complete very small aperture terminal (VSAT) system. Springer has played an important role in the design of earth station monitoring and control products.

Catel Telecommunications promoted **Ronald Todd** to vice president of engineering. Previously he served as general manager of the broadband transmission and CATV divisions.

James Caldwell was promoted from director of the CATV/telecom division to vice president of sales and marketing.

The company also added **Thomas Elliott** as marketing manager, systems. He was formerly chief engineer for the six Hearst systems in the San Francisco Bay area.


Earnest

Jerrold Communications named **James Earnest** as director of security. Most recently he was director of security for Fluor Corp.

Ron Fowler joined the company as a sales account executive in the southeast region. He was formerly a senior sales representative for Northern Telecom.

Frank Coltham, previously a member of the sales force for Cabletime Systems, was named a sales executive and will handle accounts in the United Kingdom and Europe.

John Gdovin was appointed director of service center operations for **C-TEC Cable Systems**, a subsidiary of C-TEC Corp. He has been with the company since 1979.

Pioneer promoted **Mark Spangler** to field service engineer. Previously he worked in the product service area for the company.

Eric Rowland was named northeast accounts manager for the cable TV division. Most recently he was northeast account executive with Magnavox CATV.

Eagle's Outdoor Addressable Trap System

Try One "On the House"!

Eagle's new outdoor addressable Trap system is available, **now!** After conducting our own intensive lab and field tests for over eighteen months, we discovered this system offers so many benefits to cable systems and cable subscribers that the only way you can possibly appreciate them is to allow you to field test one in **your own system.**

That's why we've decided to make this offer. For a limited trial period, **We will install an Eagle Outdoor Addressable Trap Test System in your cablesystem at no cost or obligation to you!**

If you currently use a trap system or you're looking to replace your converter/descramblers don't miss this opportunity to try the most "user friendly" addressable system ever developed for the cable industry!

A "short list" of Outdoor Addressable Trap System features includes:

- 4 or 8 tiers of negative, positive or multichannel addressable filters; 256 combinations selectable
- Consumer friendly with VCRs, cable ready TVs and remote controlled TVs
- Controls signal delivery to multiple TVs from one trap switch
- Allows you to use your present negative or positive traps
- All service disconnect capability; over 80dB isolation
- No need to enter home for audits
- IBM PC or compatible computer control
- Compatible with billing systems
- Optional **Impulse Pay per View** unit allows subscriber to order premium programming without calling cable system
- Auto-dialer transmits customer usage back to system using store and forward techniques
- Pre-authorize customers for limited amounts of pre-paid programming
- Parental control of premium channels or all service

☐ **YES!** I am currently using traps in my system or I am considering replacing my existing converter/descramblers.

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Reader Service Number 95.

Sept. 18-20: Michigan, Indiana, Illinois, Wisconsin and Ohio Cable Television associations Great Lakes Cable Expo, Hoosier Dome Convention Center, Indianapolis. Contact Trisha Biggins, (419) 470-5900.

Sept. 18-20: C-COR technical seminar on basic theory, installation and maintenance of cable TV systems, Dallas. Contact Teresa Harshbarger, (800) 233-2267.

Sept. 18-20: Magnavox CATV mobile training center seminar, Detroit. Contact Amy Costello Haube, (800) 448-5171 outside of New York or (800) 522-7464 in New York.

Sept. 19: SCTE Appalachian Mid-Atlantic Chapter technical seminar on digital fiber optics and 1 GHz distribution, Holiday Inn, Chambersburg, Pa. Contact Richard Ginter, (814) 672-5393.

Sept. 19: SCTE Greater Chicago Chapter technical seminar on BCT/E Category III. Contact John Grothendick, (800) 544-5368.

Sept. 22: SCTE Rocky Mountain Chapter technical seminar on connectors, cable and NEC rules. Contact Rikki Lee, (303) 321-7551.

Sept. 22: SCTE Sierra Chapter testing to be administered in BCT/E Categories II, III, VI and VII, City Hall, Roseville, Calif. Contact Steve Allen, (916) 786-2469.

Sept. 25: SCTE Satellite Tele-Seminar Program, "Cable vs. the telcos (part two)" and "Local origination equipment and its use (part one)," Transponder 2 of Galaxy III, 12-1 p.m. (ET).

Sept. 25-27: Atlantic Cable Show, Convention Center, Atlantic City, N.J. Contact Rhonda Moy, (609) 848-1000.

Sept. 25-27: Magnavox CATV mobile training center, Indianapolis. Contact Amy Costello Haube, (800) 448-5171 outside of New York or (800) 522-7464 in New York.

Sept. 26: SCTE Great Lakes Chapter technical seminar. Contact Daniel Leith, (313) 549-8288.

Sept. 26: SCTE North Country Chapter testing to be administered in BCT/E Categories I, IV, V and VII (tentative), Community Center, Edina, Minn. Contact Rich Henkemeyer, (612) 522-5200.

Sept. 26: SCTE Piedmont Chapter technical seminar on safety, system grounding and bonding. Contact Rick Hollowell, (919) 968-4631.

Sept. 26: Backbone Networks Corp. training on understanding fiber-optic networks, O'Hare Expo E., Chicago. Contact (508) 754-4858.

Sept. 27: SCTE Sierra Chapter technical seminar on FM and AML microwave (basics and refresher course). Contact Steve Allen, (916) 786-2469.

Sept. 27: Backbone Networks Corp. training on how to plan and buy (or sell) a fiber-optic backbone network, O'Hare Expo E., Chicago. Contact (508) 754-4858.

Sept. 27-29: SCTE Dixie Chapter technical seminar. Contact Rickey Luke, (205) 277-4455.

Sept. 30-Oct. 2: Minnesota Cable Communications Association annual meeting, Radisson Centerplace Hotel, Rochester, Minn. Contact Mike Martin, (612) 641-0268.

Planning ahead

Oct. 9-11: Mid-America Show, Kansas City, Mo.
Oct. 30-Nov. 1: Cable Television Association convention, London.
Nov. 28-30: Western Show, Anaheim, Calif.

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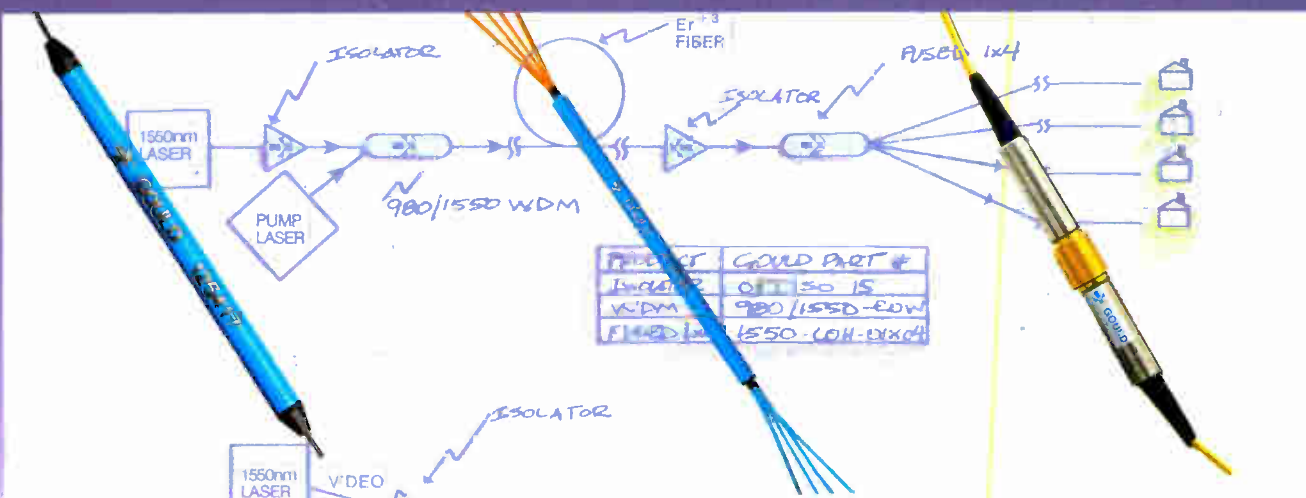
More Innovative Products From Gould Fiber Optics

In the fiber optics industry the implementation of new technology often relies on components yet to be developed. Gould introduces four timely products that make using emerging technology possible. The 1480/1550nm and 980/1550nm WDMs, The Singlemode truly fused 4 × 4 Coupler and The Optical Isolator.



1480/1550nm AND 980/1550nm WDMs —
Developed to couple both the pump wavelength and the signal wavelength into a single fiber

Applications:
- Erbium doped fiber amplifier systems

Features:
- Low return loss, <55dB
- Low insertion loss, <0.5dB
- Small package, 3.6mm × 66mm
- Environmentally stable, –40° to +85°C
- Excellent isolation

SINGLEMODE 1 × 4 AND 4 × 4 FUSED COUPLER —
Distributes optical power from one to four inputs uniformly amongst 4 outputs

Applications:
- Fiber to the subscriber topologies
- Telecommunications
- Data communications
- CATV Multi-point distribution

Features:
- All-fiber design
- Low excess loss, <0.5dB typical
- Excellent uniformity, <1.0dB
- Small package size
- Broad operating wavelength range
- Environmentally stable, –40°C to +85°C

IN-LINE OPTICAL ISOLATOR —
Designed to suppress optical feedback in laser-based fiber optic systems

Applications:
- High data rate transmission systems
- Fiber amplifier systems
- Wavelength division multiplexing systems
- High-speed analog (CATV) systems

Features:
- In-line singlemode fiber pigtails
- Low insertion loss
- Polarization independent
- Broad operating temperature and wavelength range

Gould, Inc., Fiber Optics Division
6730 Baymeadow Drive, Suite D
Glen Burnie, MD 21060, USA
Telephone (301) 787-8300
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GOULD

Communication: A two-way system

This is the first of a two-part "President's Message" advocating communication within the Society.

By Wendell Woody
President, Society of Cable Television Engineers

Good communication from the Society of Cable Television Engineers national board of directors to each SCTE member is most important. Equally vital is the "return path" from the membership back to the chapter officers, your regional director and the national board. As your new president for one month now, I have spoken at SCTE technical programs in cable shows from Breckenridge, Colo., to Newport, R.I., covering the following chapters: Rocky Mountain Chapter, Razorback Chapter, Iowa Heartland Chapter and the New England Chapter.

In addition to communicating the merits and benefits of the Society and the goals of this year's board of directors, I have let the "transmitters" feeding the "return path" run wide open with no "AGC control!" And believe me I received a lot of return information from this face to face personal contact. The following is a number of questions and issues most frequently raised. They are all "addressable" and your board will adhere to no form of "interdiction" to halt a good response to you.

National mailing list

- *Why don't I get mail from the SCTE headquarters office in Exton, Pa., anymore?* You should! Did you receive the bylaws change package last fall, the election package in December, your free *1990 Memership Directory and Yearbook*, and a Cable-Tec Expo registration package? If not, send in the accompanying change of address form.
- *How could I get dropped from the mailing list?* There are two major possibilities: your $40 annual membership dues expired or you never advised the Exton office of your change of mailing address.
- *Why don't I get advised when my membership expires and the annual fee is due?* You are sent three notices and here's the procedure. At 60 days before your expiration date, you are sent a letter along with an invoice marked "first notice." This mailing also includes a current calendar of national events. At 30 days before, you are sent another letter and calendar with an invoice marked "second notice." At the beginning of your last month, a final letter and invoice marked "final notice" is mailed to you. If there is no response from you by the end of that month your name is removed as an active member and you are placed on a holding list. You will remain on this list for 24 months and then will be completely dropped from SCTE records.
- *What if you are sending my notices and mail to my old address and I never get it?* Very, very frequently this is the absolute cause of all your problems. No notice is received, your membership expires, you don't get your free *Membership Directory and Yearbook*, and all your communications from national headquarters come to a halt.
- *Who is responsible for updating address changes?* You, the member, must notify the office in Exton! Many of you use your work address as your SCTE mailing address and your mail continues to go to your former employer. (Note to employers: It would be a great aid if you would alert us by returning all SCTE mailings sent to your previous employees.)
- *My local chapter has my current mailing address. Don't they advise SCTE national?* Yes, but they are required to submit an updated chapter membership roster only once a year. Meanwhile, you may have already been transferred to the inactive holding list.
- *Why doesn't "Communications Technology," the official trade journal of the Society of Cable Television Engineers, advise the SCTE national office of my address change when I notify them regarding my magazine subscription? CT*'s total circulation is many times larger than our national membership roster, with a much larger data base to manage than our membership roster.
- *Why does my "CT" subscription stop even though my SCTE annual dues have never lapsed or expired?* The *CT* subscription cannot be automatically renewed each year merely by paying your SCTE annual dues. You must complete and return your *CT* subscription renewal notice each year. This is a requirement of the circulation audit control agencies.

Membership action

Your board is working vigorously to improve the Society and better serve its membership. It is imperative we have your help too. Please use the mailing address change form to update your address with the SCTE national headquarters office in Exton.

As a note to the chapters and meeting groups, please duplicate this form and always have it available at all meetings. This simple act of communication can be a giant problem solver.

SCTE

Change of address

Please print or type information. It will be used exactly as it is submitted here. Mail to SCTE, 669 Exton Commons, Exton, Pa. 19341.

Member name: ______________________

Member #: ______________________

Old address

Company: ______________________

Old address: ______________________

City: ____________ State: ________ ZIP code: ________

New address

Company: ______________________

New address: ______________________

City: ____________ State: ________ ZIP code: ________

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Introducing the new DIR-647 Integrated Receiver/Descrambler

For over 30 years, DX has been at the forefront of technological advances in the satellite communications industry.

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Over the years, DX research and manufacturing has continued to meet the critical demands of large CATV operators by introducing high-performance products unsurpassed for reliability, quality, and value. The DIR-647 is the latest in a long list of breakthrough solutions in satellite communications, and has been engineered with one goal: to help you deliver the clearest, sharpest pictures possible.

The DX challenge

Call us. We'll prove to you how superior the DIR-647 really is, and what it can do for your cable system. Write or call DX Communications, Inc. today.

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DX ANTENNA

Ahead in Satellite Communications Technology

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