COMMUNICATIONS TECHNOLOGY

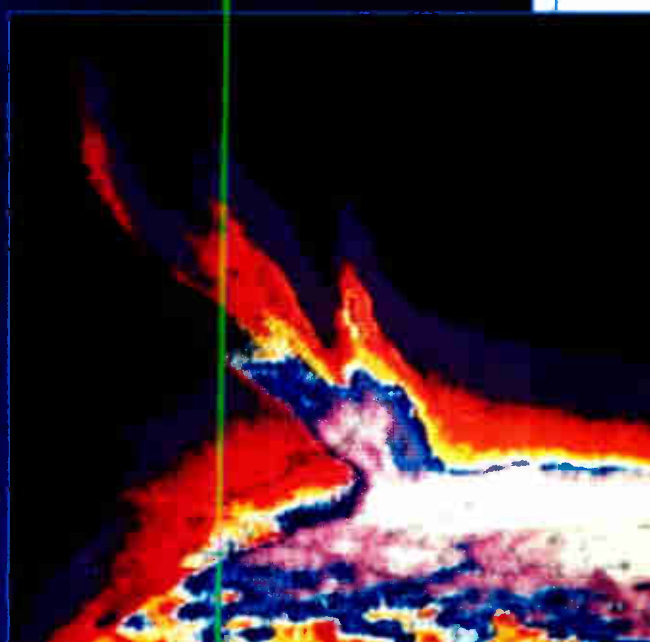
Official trade journal of the Society of Cable Television Engineers

AM Fiber

OSHA in the '90s

Microwave: Solid-state high power

The Sun and communications



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Cover
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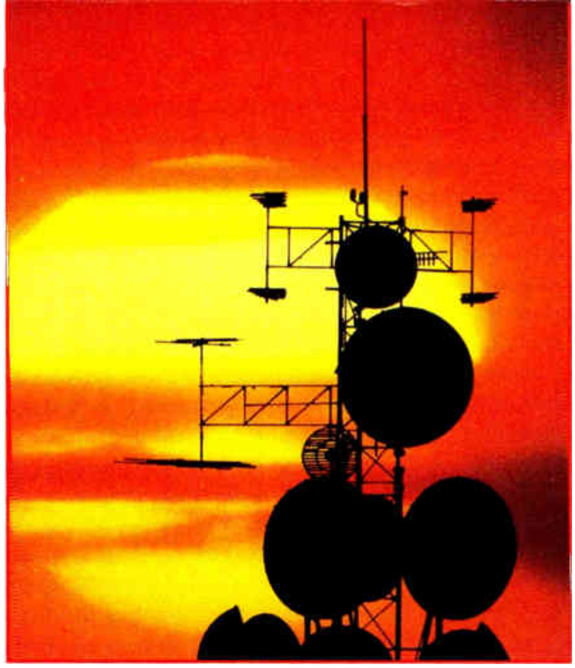

Courtesy Hughes Microwave

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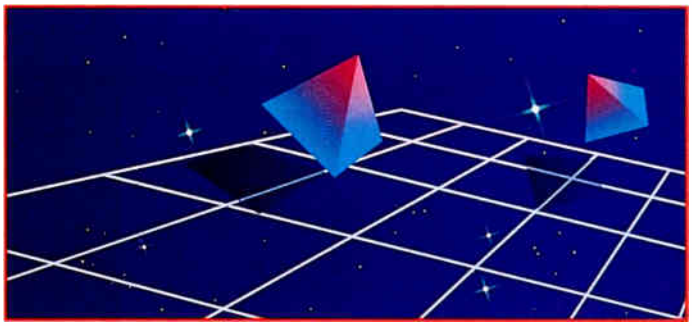
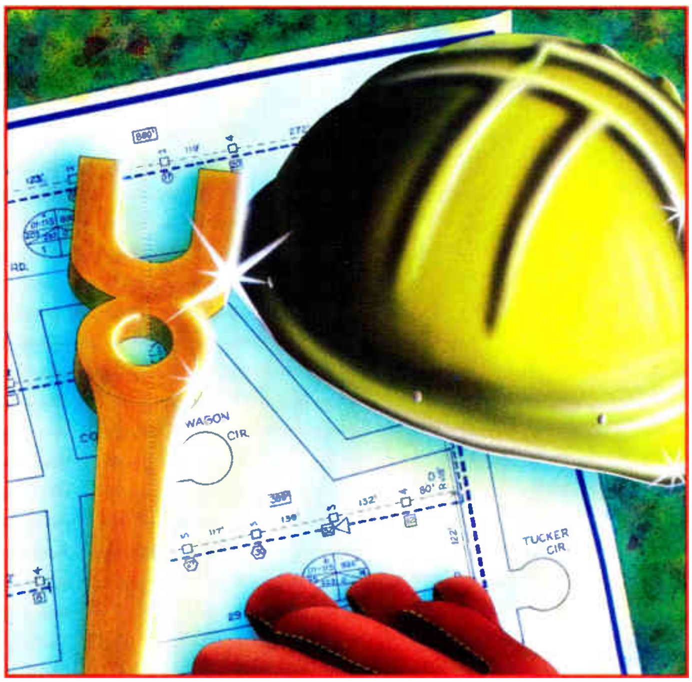


Courtesy Jones Intercable

Quality first 42



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INTRODUCING...

The Antel LANprobe: A laptop PC-based OTDR

A Totally New Approach to OTDR Design.

By incorporating interchangeable OTDR cards in a popular laptop personal computer (PC), Antel has designed a rugged, user-friendly, versatile and affordable OTDR to meet the short range and high resolution requirements of the LAN environment. The host laptop PC provides powerful menu-driven computing capability for running the OTDR system and signal processing software. The OTDR card housed in the laptop has its own microprocessor for controlling the acquisition of data and for monitoring the operation of all the hardware components. After spending a few minutes with the LANprobe in a hands-on demonstration, you'll recognize the benefits of this novel and powerful approach to OTDR design.

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EDITOR'S LETTER

Helping the industry apply and integrate technology

When I was a Boy Scout, some of my favorite outdoor activities were tracking and orienteering. The latter involved compass work with topographic maps and required a fair ability to recognize important landmarks. But one of the toughest parts of orienteering was knowing when to change direction—sometimes only slightly—to stay on course.

So it is with the title of this column. "Helping the industry apply and integrate technology" is the new mission statement of *Communications Technology* and as you might think, it is an indication of some exciting changes—some only slight—you'll see in the pages of *CT* in the coming months. As our industry evolves, it is important that we evolve with it.

To address this evolution, we'll be bringing you a new focus that will help you to do your job better. First and foremost, we recognize that each of you is a consumer: a consumer of knowledge. *CT*'s editorial direction is going to concentrate on three major areas of information to fulfill the needs of our readers.

Over the years the job of the cable technologist (whether installer or vice president of engineering) has changed considerably. I probably wouldn't be too far off to suggest that a good portion of your time is spent managing: managing those who work with you, managing your time or even managing the job you do. Therefore, one of the areas we'll be covering is *technical management*.

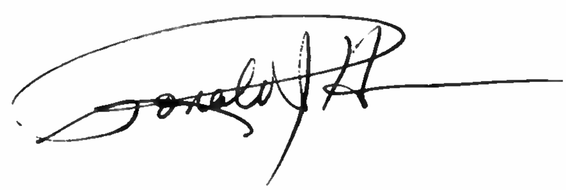
Our industry is driven by technology, so part of our thrust will continue to be *engineering*. This will be the higher level material: fiber optics, HDTV and other advanced technologies.

The third major area is what I consider the most important: *how-to*. This includes the fundamentals and hands-on (the nuts and bolts of our business); in other words, "Back to Basics."

While all three areas are of equal importance, I have a hunch the last one may turn out to be the most popular. This new editorial focus will be integrated with our regular features and you can expect a few new features too. All of this won't happen overnight of course, but you will notice a few changes even with this issue.

Since we are in the communications business, I want to make communication with you a two-way street. Starting with the next issue of *CT*, we'll have a "Letters to the editor" column. Tell us what we're doing right as well as what we're doing wrong. Your input will be valuable to ensure that we stay on track. Send your comments to: Editor, *Communications Technology*, 50 S. Steele St., Suite 700, Denver, Colo. 80209.

Finally, let me say it's a pleasure to be part of the team at CT Publications. I believe this is the first time in recent memory a CATV engineer has been on the staff of a cable publication but I think it's a good fit. I look forward to working for you, the reader!



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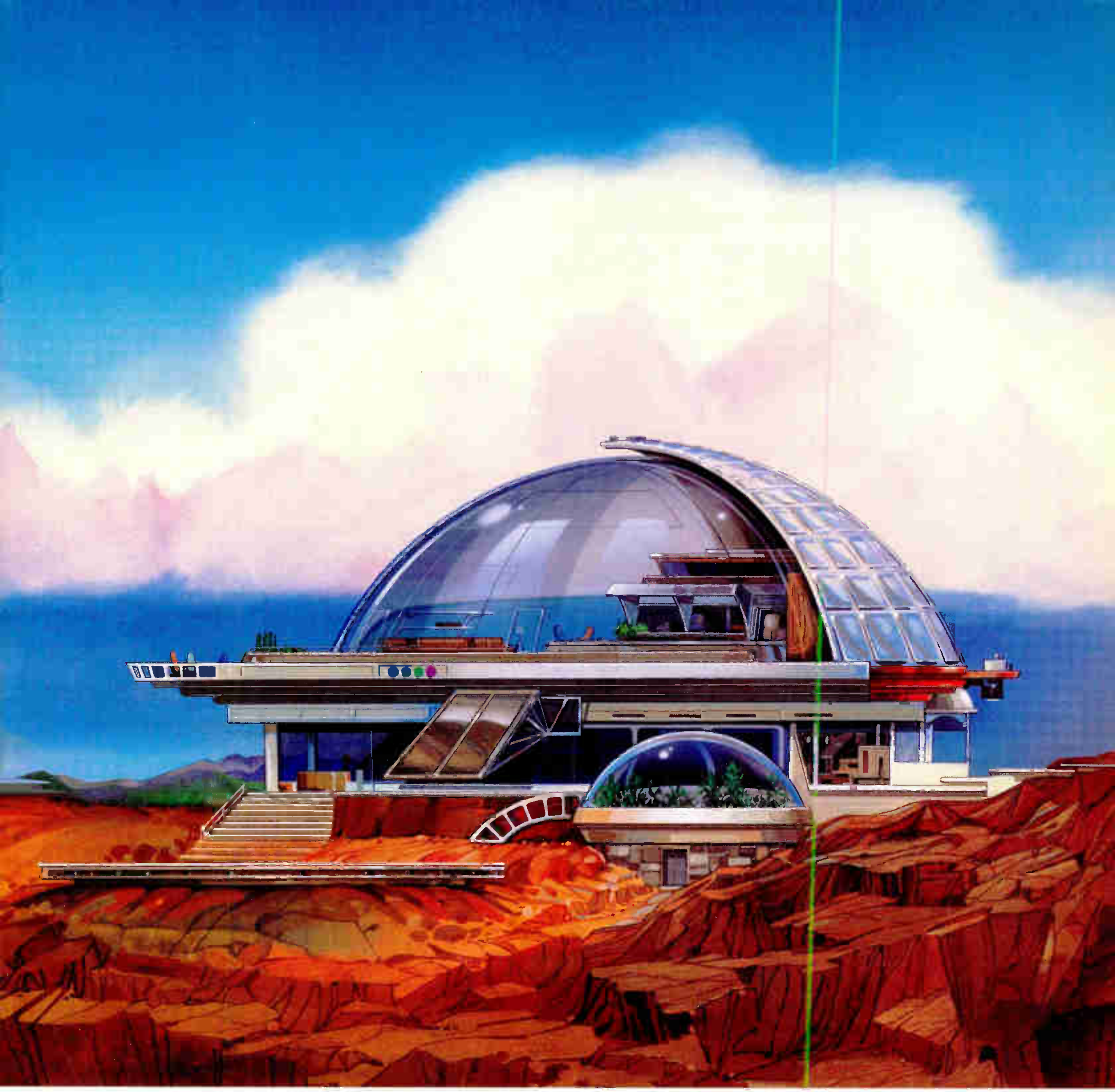

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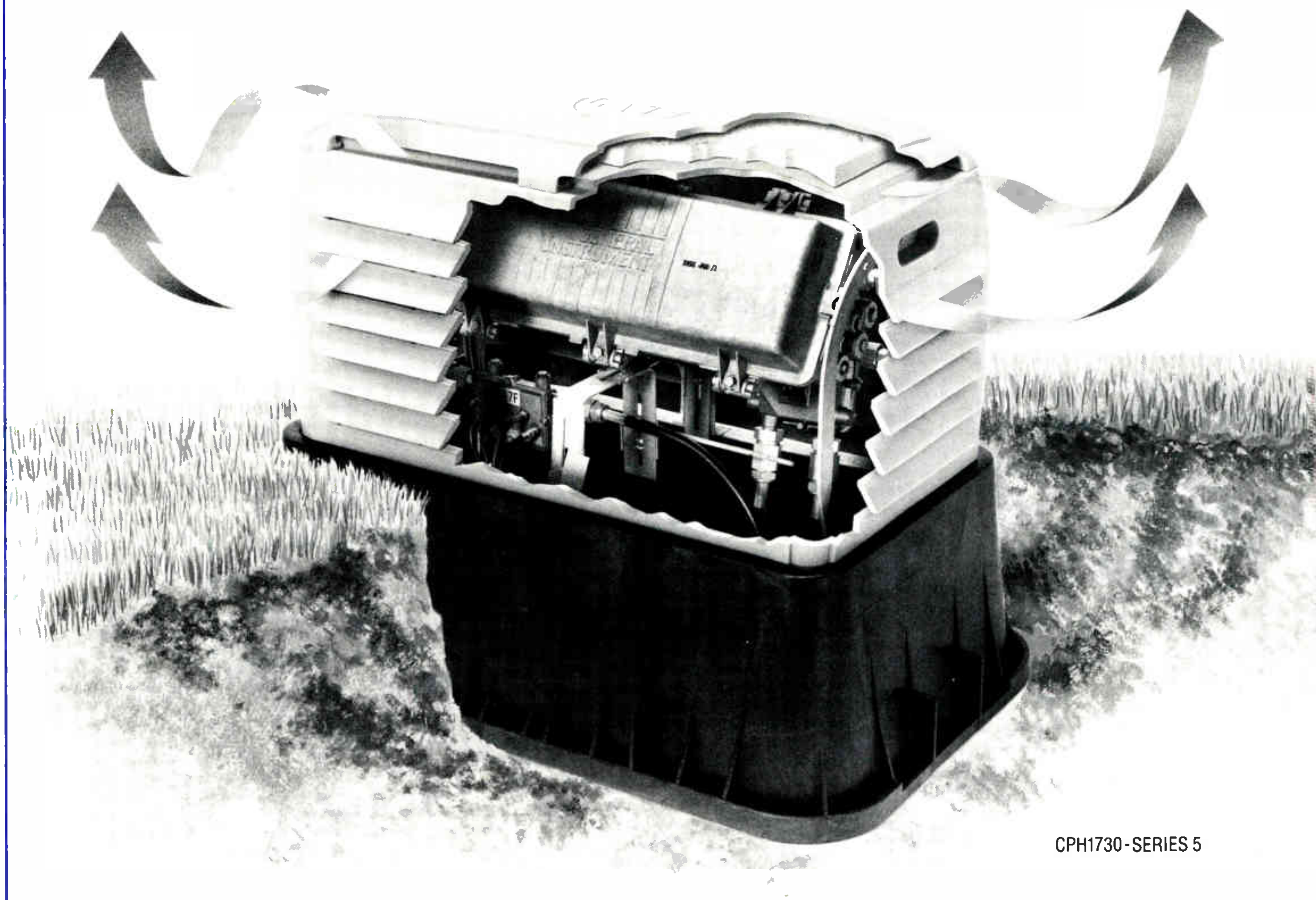

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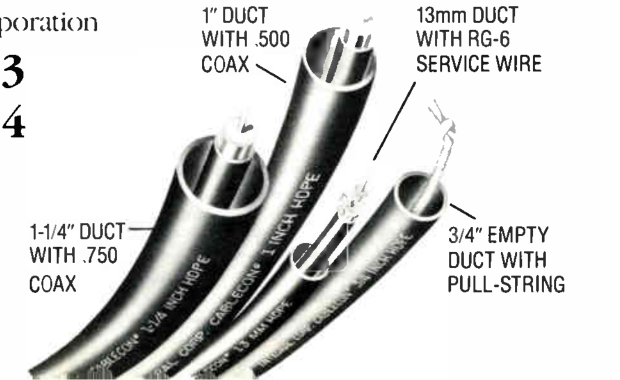

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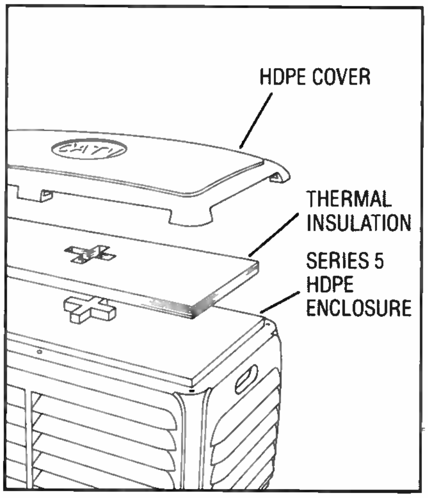

in your amplifiers, especially on the IC boards and power supplies. Independent field testing of "HDC" covers against competitive metal enclosures indicates this percentage could be even higher, depending upon the size of metal enclosure used in relationship to the amount of active and passive equipment spliced in it.

To prolong the life of your active equipment and increase system reliability, contact Channell today. Let us show you how our "HDC" covers can take the heat off your active devices, and assist you in preventing premature underground amplifier component degradation.

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MSOs adopt service standards

DENVER—The major cable TV operators here announced the adoption of industry-wide customer service standards to reaffirm that the '90s are "the decade of customer service" for the cable industry.

Executives from American Television and Communications Corp., Jones Spacelink Inc., Rifkin & Associates, Tele-Communications Inc., United Artists Entertainment and officials from Mile Hi, United and Jones Intercable systems made the announcement to coincide with an announcement made in Washington, D.C. That announcement was made by the National Cable Television Association, whose board of directors approved the standards, which are slated to be in effect July 1991.

The standards provide that under normal operating conditions, the average telephone answering time will not exceed over 30 seconds and that callers will not receive a busy signal 97 percent of the time. Supplemental weekday and weekend office and telephone hours based on community needs are called for. Standard installations will be made within seven business days and service outages will be responded to immediately in most cases, but no later than 24 hours. Non-outage problems must have a response within 36 hours during the normal work week. A local cable company must provide written information on service options, prices and policies at the time of installation and notify customers at least 30 days in advance of any rate or channel changes within the control of the operator.

It is expected that these new standards will require sophisticated telephone systems, new computers from cable billing suppliers, more service trucks and larger staffs. More installer/technicians will be needed for faster, better service and more customer service representatives will be needed to handle the increased demand for faster, more efficient response to service and installation calls.

Although these standards were agreed to voluntarily and the NCTA has no "policing power," a seal will be given by the NCTA for a cable system to display when that system complies with the standards.

Donations boost scholarship program

EXTON, Pa.—Rex Porter of Midwest CATV initially made possible the SCTE Scholarship Program with a $2,500 personal donation in 1986 and now with additional funds given by him and others, the program will continue through 1990. Most recently, Porter made a $5,000 donation to the program at the Western Show.

The National Cable Television Institute matched Porter's grants and more donations were made by the New York State Cable Commission, CT Publications Corp., Texscan, Steve Bell and Fred Rogers of Dudley Cable TV. Originally slated as a one-year program, it was supposed to conclude after the presentation to the 12th recipient in October 1987.

Porter's continued support, the NCTI's fund matching arrangement and other contributions will allow future tuition assistance for technical training courses to industry personnel who show great potential for advancement in CATV. (For more details, see *The Interval*.)

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SIECOR

Reader Service Number 11.

Adelphia makes $25 million upgrade

BUFFALO, N.Y.—Adelphia Cable International recently began a $25 million, five-year system upgrade, which will include fiber-optic technology.

The upgrade will include 2,000 miles of cable plant servicing over 170,000 households in suburban Buffalo. According to the company, the upgrade will expand the present channel capacity from 36 to 72 channels.

The fiber-optic portion of the upgrade is designed to improve picture quality, reduce outages and make future expansion of channel capacity possible. Over 100 miles of fiber will be used.

Civic seeks cable partner

CHRISTCHURCH, New Zealand—Civic Enterprises Ltd. could be the first broadband cable TV business in New Zealand. There are presently no cable systems in the country, which has a population of 3.3 million people.

Under the Telecommunications Act in 1989, private sector entities were provided by the government the opportunity to obtain network operator licenses. Civic was one of three network operators to obtain the special authorization.

Civic is seeking a joint venture partner to take a leadership role in the development of the company through the construction and operation of various cable communications systems throughout the country. John Rutherford, Civic's principal, also is considering the delivery of telephony.

"While it is Civic's principal thrust to expediously construct several cable systems in key markets throughout the country, we are exploring the value of offering telephony as well," he said.

CableLabs, Raychem to test F-connectors

BOULDER, Colo.—Cable Television Laboratories and Raychem agreed to conduct tests into cable F-interface connector corrosive failures. The goal is to provide data on how the interface fails from a molecular or materials viewpoint.

The tests will explore F-interface material changes and correlating electrical performance degradation as a result of copper accelerated salt spray exposure. Effects of low voltage and low current power passing in drops as well as other special F-interface cases will also be examined.

The degradation of the F-interface connector is a well-documented problem within the industry. The corrosive degradation problem lies with connectors on cable plant that is located outside the customers' homes.

Hall named MBE

LONDON—Tom Hall, secretary of the U.K. Society of Cable Television Engineers, was recently appointed Member of the Most Noble Order of the British Empire (MBE).

In 1945 Hall was instrumental in the formation of the U.K. Society of Relay Engineers (since renamed the SCTE). He became the secretary of the U.K. SCTE in 1947 and still holds that office today. He was the editor of the Society's publication *Cable Television Engineering*.

The presentation was made at Buckingham Palace by Queen Elizabeth II.

- Midwest CATV finalized an agreement to distribute General Instrument's broadband local area network product lines. Major General Instrument products to be stocked are amplifiers, passives and translators.

- Orchard Communications installed a fiber-optic backbone for CF Cable in Montreal. The 27-mile (43 km) backbone transmits 40 channels from the headend in Montreal to a hub in Kirkland, Quebec, at performance specifications said to be better than RS250B medium haul.
- Leader Instruments Corp. established a new European subsidiary, Leader Instruments Europe Ltd. It is based in London.
- Gould Electronics formally designated its fiber-optics division. According to the company, this is a reflection of the continued growth in the fiber business and Gould's commitment to this area.
- Comment Cablevision was awarded the third largest franchise ever given by the U.K. Cable Authority. The company, owned by US Cable and USWest, will provide cable TV and telecommunications within the Tyneside region.
- Times Mirror Cable and Prime Cable purchased over $6.5 million in Pioneer addressable converters. Times Mirror purchased the BA-6000 series converters for its Providence, R.I., and Vista, Calif., systems. Prime Cable bought Oak-compatible converters (the BA-5000 and BA-6000 series addressable converters) for its Las Vegas, Nev., system and the BA-5000 series converters for its Chapel Hills, N.C., system.
- Business Systems Inc. is providing Viasat AB of Stockholm, Sweden, with its subscriber management product, The Wizard. Viasat AB handles sub management for sister company AB Finvik, which directs its cable TV operations. The Wizard is an information system for (among other things) dispatch, outage analysis, addressability, pay-per-view control and inventory management.
- Kingston Cablenet of Ontario purchased 12 AM (amplitude modulated) fiber systems through Scientific-Atlanta's Canadian distributor, Comlink Systems Inc. The equipment will be used to upgrade the 450-mile system from headend to hub and increase bandwidth to 550 MHz.
- The National Cable Television Institute introduced two new courses: "CATV technology for industry suppliers" and "CATV technology for non-technical personnel." The courses include lessons on the history of CATV, how signals come into the system, how and why signals are processed and how they are distributed, basics of converters and decoders, and key issues facing CATV technology today.
- Telecom Australia purchased 95 video measurement sets from Tektronix Australia PTY Ltd. Tektronix began shipping the VM700A video measurement sets in January.
- Paragon Cable introduced its instant installation program. The company reassigned installers to specific regions and when a new customer calls to order cable, a service representative asks if someone is home to meet the installer. Crews call the dispatcher after every installation and then are directed to the next home.

Correction, Clarification

In the process of preparing each issue of *CT*, we go to great lengths to ensure the quality of the articles we publish. Part of this process includes a "peer review," whereby technical articles are checked for accuracy, originality and overall value to our readers. Occasionally, but very rarely, something gets by our scrutiny. That is just the case with the article titled, "Reliability aspect of AML microwave systems" that appeared in January. It was brought to our attention that the original version of the article, authored by Abe Sonnenschein of Hughes, was presented in 1976 at the First Annual Conference on CATV Reliability. We apologize to Sonnenschein and Hughes for our oversight.

Survival formula: Science in, sports out

By Isaac S. Blonder
President, Blonder Broadcasting Corp.

Our aging capitalistic society—in the civilian manufacturing arena—is still dependent upon private resources to finance the R&D needed to stay abreast of worldwide competition in consumer products. Thirty years ago I might have said that American engineering was superior, but the marketplace soon thereafter put my company into jeopardy when we had to abandon our profitable lines of industrial closed-circuit TV and hi-fi amplifiers. (You don't have to possess an MBA to make the decision to drop a product when the cost of an American-made vidicon is $175 and the complete industrial TV camera arrives from a foreign source with more features at a price of $187.50 and is negotiable downwards in quantity.) The surviving electronics manufacturers of today are playing catch-up or offering custom items that have not caught the eye of the importer. The same dilemma is probably facing the U.S. manufacturer in other markets besides electronics.

My analysis of our loss of competitiveness (probably too simplistic for the professional economists) is, lazy schools filled with lazy students, *no* funds for civilian R&D, government restrictions and prejudice against the manufacturer (juicy subject for a future paper), unobtainable or expensive venture capital, and undercompensation for the inventor. Immediate corrective action on all items is unthinkable, but good things could happen if two actions were to be implemented: 1) impose a 3 percent charge on the gross income of all entities benefiting from an FCC license, to be spent on R&D and 2) eliminate intercollegiate sports and

"How and why did our august institutions of higher education become the minor leagues of organized sports?"

devote the freed space and funds to science education.

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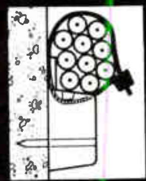

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City ______ State ______ ZIP ______
Signature ____________ Date ______

1. Primarily, my responsibilities include:
- ☐ Corporate Marketing
- ☐ System Marketing
- ☐ Corporate Operations
- ☐ System Operations
- ☐ Other ____________ *(please specify)*

2. In the performance of my job, I authorize, specify or recommend products and/or services for purchase.
Yes ☐ No ☐

3. Please check the category that best describes your firm's primary business (please check only one).

1. Cable TV Systems Operations
   - ☐ a. Independent Cable TV Systems
   - ☐ b. MSO (two or more Cable TV Systems)
- ☐ 2. Cable TV Contractor
- ☐ 3. Cable TV Program Network
- ☐ 4. SMATV or DBS Operator
- ☐ 5. MDS, STV or LPTV Operator
- ☐ 6. Microwave or Telephone Company
- ☐ 7. Commercial Television Broadcaster
- ☐ 8. Cable TV Component Manufacturer
- ☐ 9. Cable TV Investor
- ☐ 10. Financial Institution, Broker, Consultant
- ☐ 11. Law Firm or Government Agency
- ☐ 12. Program Producer or Distributor
- ☐ 13. Advertising Agency
- ☐ 14. Educational TV Station, School or Library
- ☐ 15. Other ____________ *(please specify)*

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as our deficit balloons daily, has forced the administration to forego funds for technology-driven fields such as HDTV. What is even more disastrous for our financial health is the unstoppable, unreasoning, unintelligent outcries for social programs like housing, homeless and drug addiction. No one in Congress or the executive branch seems able to stand up to the caterwauling from the do-gooders. Added to the crowd of free-spenders are the environmentalists whose recent restrictions on automobile emissions are expensive enough to return us to the horse and buggy era.

Reviving our industry

Since there is no likelihood that public funds will come to the aid of scientific education or private industry, fundamental changes have to be insinuated into the U.S. body politic—therefore the necessary funds must come from within the economy. As I have previously proposed (see *CT*, 11/89), a 3 percent tax on FCC matters will generate about $2 billion, enough when aided by import duties to revive the consumer electronics industry. This money will pass directly into R&D, untouched by political mischief-makers and safe from social sinkholes.

Everyone agrees that our educational megastructure is malfunctioning at every level. The news medium reports without end the inferior status of U.S. schools and students to our foreign competitors in science and manufacturing. I intend to pass over the secondary school morass and concentrate on the college level where I believe one executive decision will have an immediate and positive effect on the quality of science education and the science content of a college diploma.

In brief, what I recommend is the total elimination of intercollegiate sports, principally football, basketball and baseball. The space vacated by sports, and whatever funds may be saved from the college budget, would be dedicated to science laboratories and instructors. All seekers after a diploma would be required to pursue a varied diet of science courses to attest to their ability to cope with the intricacies of our modern society. Previously, one was not considered educated unless he studied Latin, French, Shakespeare and the kings of Europe. Scientific literacy should be mandatory for today's college graduate.

I searched the library in vain for the vital statistics on college sports. How and why did our august institutions of higher education become the minor leagues of organized sports? In my college days there was an incessant flow of propaganda from the bowels of the coaching staff—you will learn through sports how to be a gentleman, smile at a loss, be generous to your fallen foe and never quit. Sadly, even in those days before World War II, athletes took special courses only open to team players, scholarships were awarded first to the athletes, the leftovers to scientists. Busboy jobs were always held by the athletes (can't let the muscle men starve like the rest of the depression babies) and at every school function the athletes occupied the head table in the limelight. Take a clear-eyed view of today's colleges. Athletes are recruited and paid vast sums to engage in a full-time sport activity, study time is meager or absent, but an unearned diploma is awarded to the athlete by an administration who knows they have committed a fraudulent, perhaps even a criminal act.

So, I am hoping against hope, that the college presidents will repent their school's ways and abandon the worship of that evil temptress—Sports—and return the school to its rightful goal, instilling a scientifically based education in its graduates that will preserve our country's living standards and its survival.


Courtesy Times Fiber

Performance of AM multichannel fiber-optic links

By Rezin Pidgeon
Principal Engineer
Frank Little
Project Manager
And Lee Thompson
Director of Distribution Engineering and Fiber-Optic Products, Scientific-Atlanta Inc.

Since the beginning of lightwave communications, fiber-optic systems have been designed for digital transmission. For digital communications, the intensity of the optical source is modulated on and off (referred to as "on-off keying" or "OOK") in response to logic levels zero and one. Because the modulation is digital, modulation linearity is not an issue. For analog modulation, however, it is a basic system parameter and a key factor in some systems. Also, laser noise requirements are much more stringent with amplitude modulation. Subcarrier FM (frequency modulation) has been used to advantage in multichannel CATV systems since it is less affected by modulation non-linearities than AM systems and requires a carrier-to-noise ratio (CNR) of only 16 dB or so. However, since the cable distribution system to the home must carry signals in the AM format, AM technology is preferred in cases where system objectives can be met with AM.

This article first discusses direct laser modulation, laser noise and the effects of optical reflections on noise. Expressions for CNR due to laser noise are given and CNR expressions are derived for the optical receiver. Laser distortion is discussed and relationships between distortions and channel loading are given. Data for a CATV prototype system are presented.

Intensity modulation of optical source

Light is generated in a semiconductor laser by forward biasing the semiconductor junction with a DC current. The relationship of light intensity to input current is given by the L vs. I curve. An example of a distributed feedback (DFB) laser L-I curve is given in Figure 1. As indicated, lasing begins at a bias current referred to as the "threshold current" (I_{th}) and increases nearly linearly for bias currents greater than threshold. The light intensity (L) is commonly given in milliwatts or dBm. The efficiency of the electrical-to-optical conversion is given by the slope efficiency (SE) of the laser, which is defined as the slope of the L-I curve at the operating point I_b:

$$SE = \frac{\Delta L}{\Delta I} \quad \text{mW/mA} \qquad (1)$$

Slope efficiency also is referred to as differential quantum efficiency. For the laser of Figure 1, the slope efficiency is 8.5 percent. Note that efficiency is not dimensionless, since the laser produces watts of output in response to amperes of input current.

To amplitude modulate a laser by a multichannel AM CATV source, the broadband RF signal is added to the laser DC bias current. The amount of intensity modulation produced by the broadband RF signal is given by the modulation index, normally defined on a per-channel basis and equal to the peak change in optical intensity divided by the average optical intensity. In this article it is assumed that all carriers are of equal amplitude. Modulation index (m) is defined as

$$m = \frac{\Delta L_p}{L_o} \qquad (2)$$

where:
ΔL_p = the peak change in optical power caused by a single RF carrier
L_o = the average optical power

The term *optical modulation depth* (OMD) also is used to define the amount of modulation and is identical to the modulation index. Typically, for a 40-channel AM system, m ranges from 0.035 to 0.05.

Linearity of laser modulation is an important parameter in analog fiber systems. Laser linearity is measured by some manufacturers as the percent change in slope efficiency over the operating range normalized to the slope efficiency at the bias point; i.e.,

$$\text{Linearity} = \frac{\Delta SE}{SE_o} \qquad (3)$$

where:
ΔSE = the change in slope efficiency and
SE_o = the slope efficiency at the bias point

A plot of normalized slope efficiency as a function of current is given in Figure 2. In this example, laser linearity is 8.5 percent for an optical modulation depth of 1.

Laser linearity also is specified by the amount of harmonic distortion generated by the laser and by two-tone second- and third-order distortion. (Distortion is discussed in later sections in this article.)

Laser optical noise

In analog lightwave systems, noise from the optical source contributes to the optical link CNR and is an extremely important factor in practical system applications. Laser diodes produce fluctuations in light output (or intensity noise). This intrinsic intensity noise is caused by the statistical nature of the carrier re-combination process. Laser noise is defined by RIN (relative intensity noise) as

$$RIN = \frac{\langle L_n^2 \rangle}{L_o^2} \quad (4)$$

where:
$\langle L_n^2 \rangle$ = the mean square spectral intensity of light output noise

Noise power is referred to as a 1 Hz bandwidth and RIN is dimensionless. RIN is normally expressed in dB/Hz and is equal to 10log(RIN).

Theoretical analyses[1] show that intrinsic laser noise is maximum for laser threshold current and decreases as the bias current increases as follows:

$$RIN \propto \left(\frac{I_b}{I_{th}} - 1 \right)^{-3} \quad (5)$$

Generally, for commercially available lasers, laser types with a lower threshold attain better noise performance than those with a higher threshold for the same output power.[1] Intrinsic noise is essentially independent of modulation frequency at low frequencies and increases to a resonance peak corresponding to the relaxation oscillation frequency of the laser. The overall shape of the RIN response curve has the same general characteristic shape as the modulation frequency response.[2]

Knowing RIN and the modulation index, one can calculate the CNR in a 1 Hz bandwidth (C/No) and CNR for a 4 MHz bandwidth according to CATV practices. The equivalent input noise current $\langle I_n^2 \rangle$ that would produce optical noise equal to that produced by the laser is, from Equations 1 and 4, given by

$$\langle I_n^2 \rangle = RIN \left(\frac{L_o}{SE_o} \right)^2 \quad A^2/Hz \quad (6)$$

Likewise, for optical modulation depth of m, the peak input signal current is mL_o/SE_o. The mean square signal current I_s^2 is

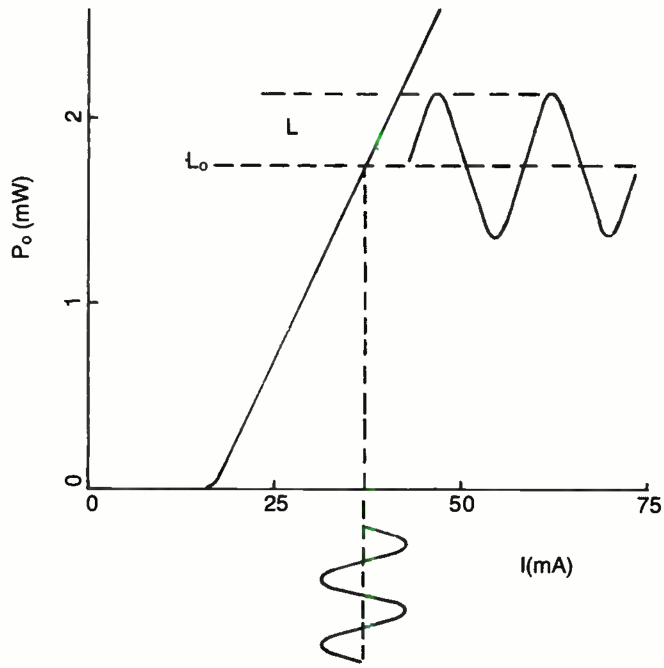
$$I_s^2 = \frac{1}{2} \left(\frac{mL_o}{SE_o} \right)^2 \quad A^2 \quad (7)$$

From Equations 6 and 7 the CNR for a 1 Hz bandwidth is

$$C/No = \frac{m^2}{2RIN} \quad (8)$$

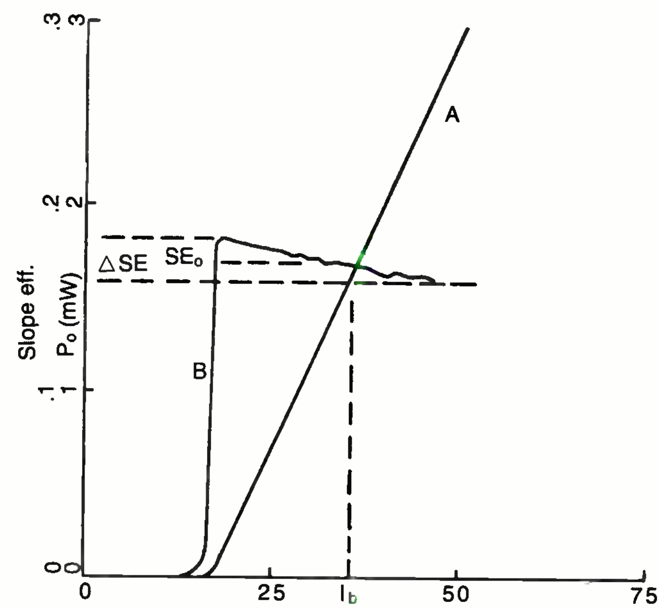
Of particular interest is the CNR in a 4 MHz bandwidth due to laser noise:

Figure 1: Laser light intensity vs. bias current



Laser bias is in mA and optical output is in mW. The response to a sinusoidal modulation current is shown.

Figure 2: Laser L-I curve (A) and slope efficiency (B)



$$CNR_{rin} = \frac{m^2}{8 \times 10^6 RIN} \quad (9)$$

Expressed in dB,

$$CNR_{rin}(dB) = -69 + 20\log(m) - RIN(dB) \quad (10)$$

Table 1

Order	Frequency terms	Distortion relative to fundamental	Relative value (dB)
2	$2F_1$	$mC_2/2$	0
2	$F_1 + F_2$	mC_2	6
3	$3F_1$	$m^2C_3/4$	0
3	$2F_1 + F_2$	$3m^2C_3/4$	9.5
3	$2F_1 + F_2 + F_3$	$3m^2C_3/2$	15.6
3	F_1 (X-MOD)	$3m^2C_3/2$	15.6

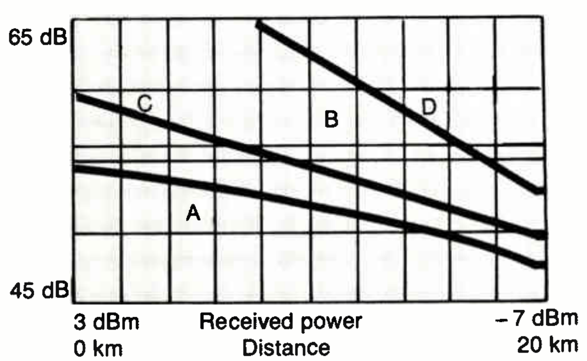
Note that CNR_{rin} due to laser noise is independent of laser power. The effect of link loss and the contribution of optical receiver noise on the link CNR is given later.

As an example, if RIN = −153 dB and m = 0.04 (typical for 40 AM channels), CNR_{rin} due to laser noise is 56 dB. Commercial DFB lasers with integral optical isolators are available with RIN better than −150 dB/Hz. These lasers are capable of meeting current objectives for AM applications.

Intrinsic laser noise can be altered considerably due to the interaction of the laser and optical fiber. Laser diode noise increases significantly when light is reflected into the laser by discontinuities in the optical path.[1] Near-end reflections , less than ~10 cm, interact with the laser cavity and cause mainly low frequency noise in the kilohertz range. Reflections from ~10 cm to ~100 m cause periodic noise peaks in the RF spectrum, and reflections from greater than ~100 m cause noise with an almost flat noise spectrum in the HF and VHF range[1]. In Reference 1, the quantitative evaluation of reflection effects on laser noise characteristics was reported. It was found for the three types of lasers investigated that the maximum laser-coupled reflected power should be −65 to −73 dB to limit the increase in induced noise to within a few dB of the intrinsic laser noise level.

To prevent excess reflection-induced laser noise in practical AM systems, lasers with internal optical isolators should be used. These devices are commercially available with 30 dB of optical isolation. Furthermore, because of the high isolation required, fusion splices are recommended to ensure optimum performance.

Figure 3



A—link CNR. B through D are CNR due to: B—laser intrinsic noise, RIN = −153 dB/Hz, C—photodiode quantum noise, responsivity = 0.85 A/W, D—amplifier noise, R_1 = 1,000 ohms, F = 3 dB. Laser output is 2 mW and modulation index is 0.04/channel. Fiber loss budget is assumed to be 0.5 dB/km.

Photodetection of optical signal

An optical receiver must be employed to convert the intensity modulated optical signal to an RF signal for distribution in the CATV feeder network. For AM CATV systems, PIN photodiode detectors are usually employed. FM and digitally modulated systems operate at lower signal-to-noise ratios (SNRs) than AM systems and thus the received optical power is usually lower. For those systems, an avalanche photodiode (APD) is often used. An APD functions similarly to a PIN photodiode except that the APD can provide current gain whereas the PIN is limited to unity gain. However, the APD generates more noise in the optical/electrical conversion and is therefore at a disadvantage where the received optical power is large. Therefore, this discussion will be limited to PIN photodiode detectors only.

A photodiode emits electrons in response to incident photons. Quantum efficiency η is defined as

$$\eta = \frac{\text{number of photoelectrons}}{\text{number of photons}} \quad (11)$$

and is equal to reflection loss times absorption loss times absorption efficiency. Typically, quantum efficiency for a PIN photodiode is approximately 80 percent at 1.3-1.5 μm but an efficiency of approximately 95 percent can be realized.

Responsivity (R) is the measure of detected current due to incident optical power. Responsivity is given by

$$R = \frac{\text{detected photocurrent}}{\text{incident optical power}} \quad \text{A/W} \quad (12)$$

$$= \eta \frac{q\lambda}{hc}$$

where:
q = electron charge (1.6×10^{-19})
h = Planck's constant (6.63×10^{-34})
c = light velocity and
λ = optical wavelength

In the ideal case, η = 100 percent and responsivity is

R = 0.684 A/W at λ = 0.85 μm
= 1.046 A/W at λ = 1.3 μm
= 1.248 A/W at λ = 1.5 μm

A photodiode detector also generates a noise current called *shot noise*, caused by the discrete nature of electrons. In a photodiode, discrete charge carriers are generated by the incident optical signal and each contributes a pulse of current to the total DC current. These pulses are emitted randomly in time and thus produce a noise current (shot noise).

For a PIN photodiode, shot noise $<I_{sn}^2>$ is equal to

$$<I_{sn}^2> = 2qI_o \quad \text{A}^2/\text{Hz} \quad (13)$$
$$= 2qRP$$

where:
I_o = the DC current that flows in response to the incident optical power P

(Continued on page 46)

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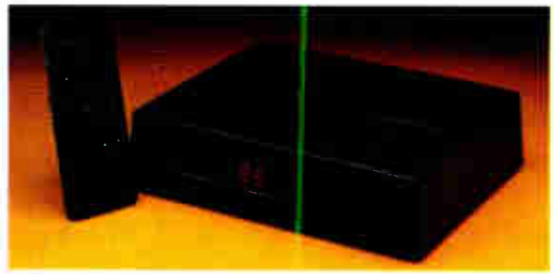

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Courtesy Times Fiber

Get serious: AM fiber optics

By David E. Robinson
Director, Jerrold Cableoptics, General Instrument Corp.

The games are over. It's time to get serious. AM (amplitude modulation) fiber optics are for real. The laboratory scientists have done their job delivering high-performance, manufacturable product to the cable TV industry. Now the challenge shifts to those designing, constructing and maintaining the CATV plant.

This article will first review the performance of AM fiber-optic trunking systems. Then, it will highlight some of the many practical considerations facing cable TV's plant engineers. Topics include optical splitters, splices, connectors and mechanicals.

AM video distribution systems often require higher performance components and construction/maintenance care than FM (frequency modulation) or digital counterparts. AM's efficiency and plant compatibility are tough to beat. For over 40 years our industry has paid attention to the details with coaxial cable to efficiently distribute a broad array of AM video services to consumers. With similar care, AM fiber will prove even more effective for key portions of our CATV plant.

Figure 1: "Bad" fusion splice

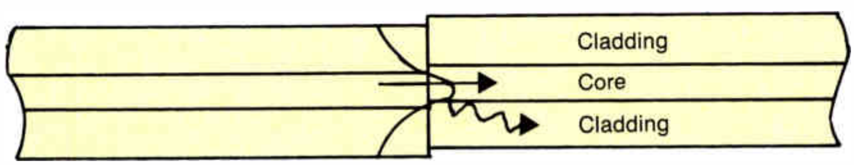
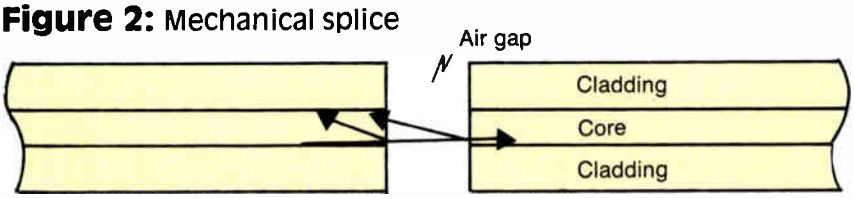


Figure 2: Mechanical splice



Performance

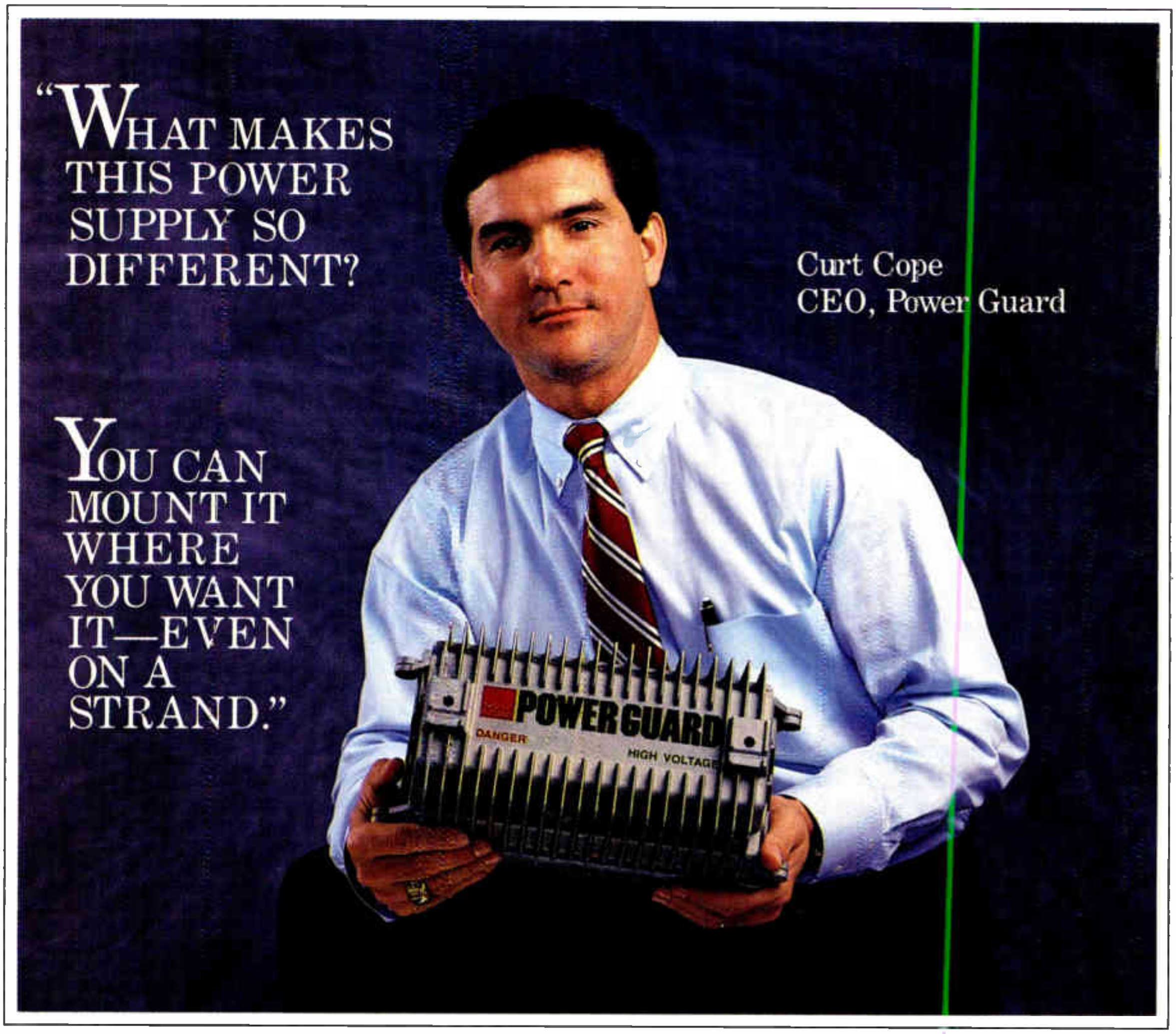
To improve end-of-line subscriber picture quality and reliability during bandwidth expansion rebuilds, our industry now seeks better performing AM fiber systems. Although varying by operator and system, the general performance target to construct true AM fiber "backbones" was something like the following:

Bandwidth	50-550 MHz
Channels	80 (NTSC)
Reach	10 miles
Carrier-to-noise (C/N)	55 dB
Composite second order (CSO)	−65 dBc
Composite triple beat (CTB)	−65 dBc

Until recently, all commercial systems fell short of that target (when measured with test signals from a multicarrier CW generator according to NCTA recommended practices). Virtually all of those systems relied on optical components designed originally for the lower standards of digital telephony transmission. But some laboratory scientists and product engineers began designing lasers, photodetectors and systems specifically for AM CATV.

As a result, product now is available ex-

(Continued on page 83)



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Distributed By Midwest CATV

Measuring return loss of mechanical splices

By K.M. Yasinski
Member of Technical Staff, AT&T Bell Labs

And Mike Kelly
Manager, Fiber-Optic Projects, Anixter Cable TV

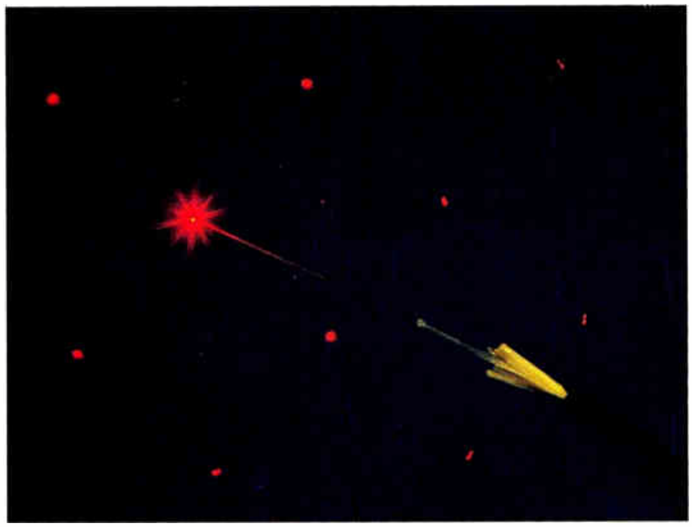
Ferrule-based mechanical splices can be designed to yield a wide range of return losses by varying the end preparation method and/or index matching gel. While large reflections are not usually desirable, some customers also object to vanishingly small values because the inability to see them on an OTDR (optical time domain reflectometer) complicates fault locating procedures. Thus a logical design goal could be for the splice reflections to be large enough to see with an OTDR but small enough to negligibly impact even high-speed digital transmission systems.

AT&T's Rotary Mechanical Splice is an example of this type of design, and results demonstrating its characteristics for field-installed systems will be shown and discussed. Other designs with lower (or higher) reflections also could be offered if needed. As an example, by using slightly different end preparation methods, ferrule-based splices can be modified to achieve ultra-low reflections, which may be appropriate for analog transmission systems. Some results illustrating this also will be given.

Regardless of the designed value of return loss, one must verify in the field that the desired values are attained. This is especially important when splices are installed in a high productivity mode where as many as 60 fiber splices a day are being made by a single splicing crew. This can be accomplished with commercial OTDRs using the following multistep operation.

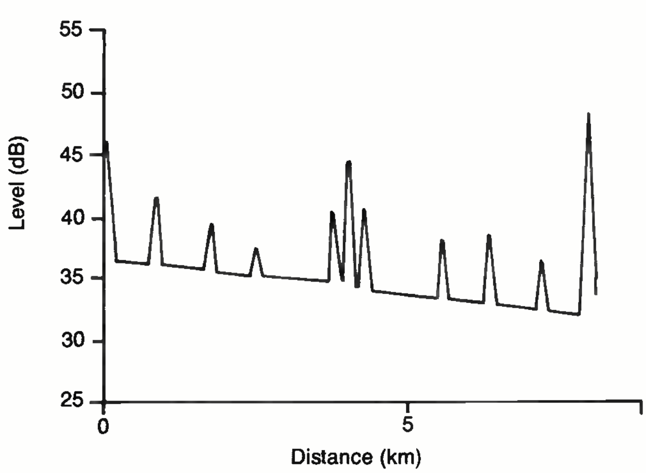
OTDR return loss measurement method

The OTDR transmits narrow pulses into a fiber and displays the reflected signal vs. time or, equivalently, distance. If the distance between splices is larger than one half the OTDR's spatial pulse width, the splice reflections can be viewed separately from each other, as shown in Figure 1. The return loss of the splices can in principle be determined by measuring the height of the reflections. However, two complications occur. The first is that OTDRs only display a relative decibel scale so one can only measure the decibel difference between two reflections. To get absolute readings one must generate a known reference reflection that the splice can be compared to. The most readily available reference is the Rayleigh backscatter from the fiber itself.



Courtesy Times Fiber

Figure 1: Typical OTDR trace



At any point in the fiber its reflectance is:

$$R_{bs} = \frac{v_g}{2} PW\alpha_s S \quad (1)$$

where:

v_g = the group velocity,
PW = the temporal pulse width of the equivalent rectangular pulse,
α_s = the fiber attenuation due to Rayleigh scattering and
S = the proportion of backscatter that is captured by the fiber (which is a function of the fiber's spot size).

Defining the return loss as $RL = 10\log_{10}(R)$, Equation 1 shows the return loss due to backscatter (RL_{bs}) for nominal AT&T single-mode fiber to be −46.3 dB at 1.31 μm and −48.8 dB at 1.55 μm when PW = 2μs. The uncertainty in these numbers is typically a few tenths of a decibel due to fiber parameter uncertainties. Note that RL_{bs} changes by −3 dB for every halving of the OTDR's pulse width. So if very narrow pulse widths are used, RL_{bs} can become too small to measure. In this case one could use as a reference the −14.7 dB Fresnel reflection from a 0° fiber end in air. This also can be used to check the RL_{bs} value.

The second complication is that even the difference between the fiber and splice reflections cannot be read directly from the OTDR. The reason is that the reflected power measured at the splice is the sum of the power backscattered from the fiber and the power reflected at the splice. (This is because the spatial width of the OTDR pulse is much wider than the splice, so most of the pulse remains in the fiber while a portion is being reflected by the splice.) Thus the actual difference in decibels between the splice and fiber return loss (RL_{sp-bs}) is found from the measured difference ($RLmeas_{sp-bs}$) by:

$$RL_{sp-bs} = 10\log_{10}\left(10^{[(2 \times RLmeas_{sp-bs})/10]} - 1\right) \quad (2)$$

where the factor of 2 in the exponent is needed because most OTDRs display one way loss; i.e., one-half of the measured round-trip loss. One then finds the return loss from the splice as:

$$RL_{sp} = RL_{sp-bs} + RL_{bs} \quad (3)$$

For later use we also derive the equation for the backscatter that occurs when the input signal has a much wider duration than typical OTDR pulses. We begin by generalizing Equation 1 to show the backscatter that occurs at the fiber's input due to a differential length, dz, of fiber that is a distance z from the input. If the input is a continuous wave signal, the reflectance will be Equation 1 with an equivalent pulse width of $2dz/v_2$ and multiplied by the round-trip fiber attenuation:

$$R_{bs(z)} = dz \times \alpha^s \times S \times \exp^{-2\alpha s} \quad (4)$$

When this is integrated over the entire length, L, one obtains the cumulative reflectance:

$$R_{bs}^{cum} = \frac{\alpha^s}{2\alpha} S(1 - \exp^{-2\alpha L} \quad (5)$$

For long fiber lengths the exponential term is negligible and the reflectance due to backscatter is:

$$R_{bs}^{cum} = \frac{\alpha^s}{2\alpha} S \quad (6)$$

which corresponds to return losses of about −31.6 dB at 1.3 μm and −31.7 dB at 1.5 μm. These are the cumulative return losses

Figure 2

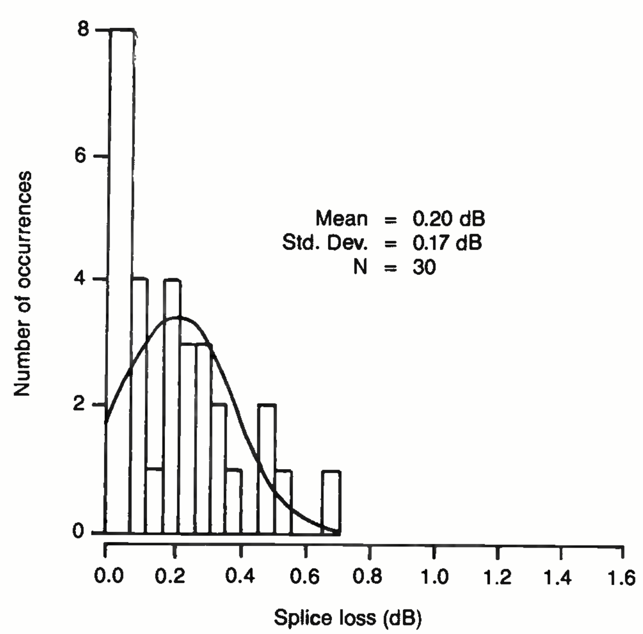
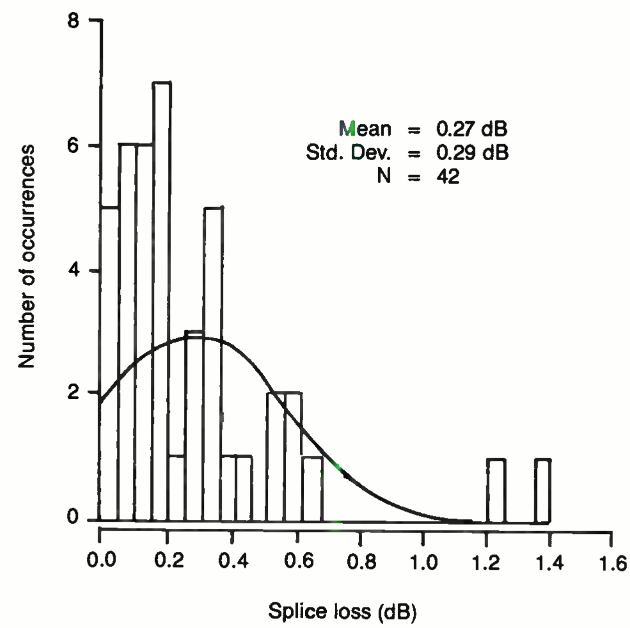


Figure 3



due to backscatter alone for a typical transmission system and represent a reasonable design goal for splices and connectors.

Field measurement procedure

For field tests on large numbers of splices, a computer controlled measurement is most convenient to use. This also allows disk storage of the data for later analysis or comparison. Each splice and fiber is measured for return loss using varied OTDR settings. The actual calculation of return loss usually requires combining multiple sweeps. First, the entire cable will be measured with a high attenuation setting and a wide pulse width. This ensures that the peak level is not clipped or distorted. Then the fiber backscatter will be measured at a lower attenuation (higher gain), with the splice reflections "masked," and at times a narrower pulse. This ensures that the lower level backscatter signal will have minimum noise, will be free of "dead zone" distortion due to transients from preceding reflections and will be accurately measured between even closely spaced splices. Since these OTDRs cannot mask more than three splices on the screen, this last step alone requires numerous sweeps. The following results utilize all of the techniques previously described.

Field installations of Rotary Mechanical Splices in Cox Cable of San Diego yielded average splice losses of 0.20 dB, as illustrated in Figure 2. These results were attained using Anixter's Angle Rotary Splice (ARS), which introduces a 10° angled end in the polishing process to minimize losses. Figure 3 illustrates measurements of fusion splicing utilized in the same system, at an average of 0.27 dB splice loss. Similar results have been obtained by other cable operators in a variety of applications.

Experimental results for modified ferrule-based splices

As applications of fiber optics become more widespread and varied, special requirements on splice return losses may arise.

(Continued on page 77)

High power microwave broadband transmitter design and application

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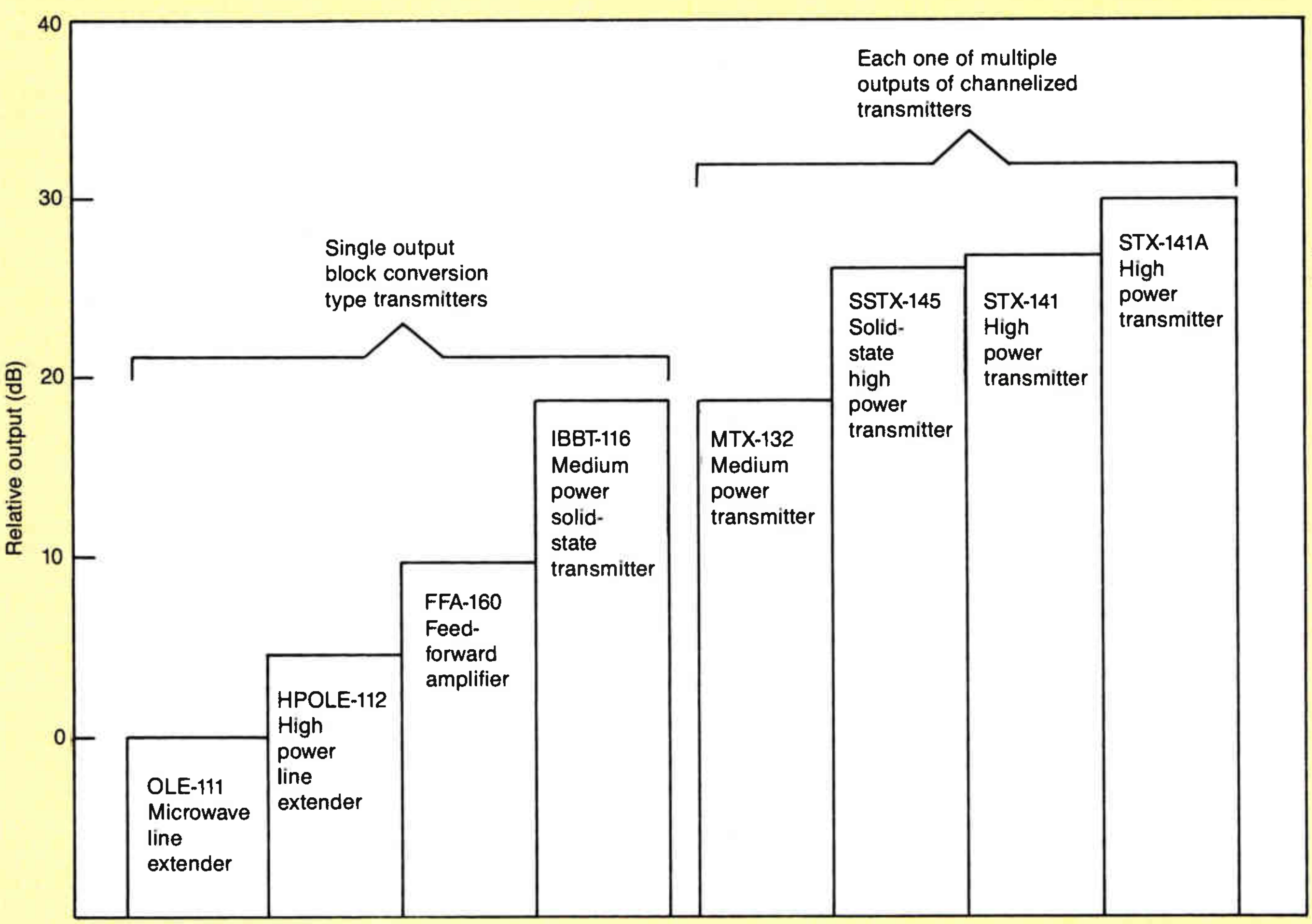
Hughes Aircraft Co., Microwave Communications Products

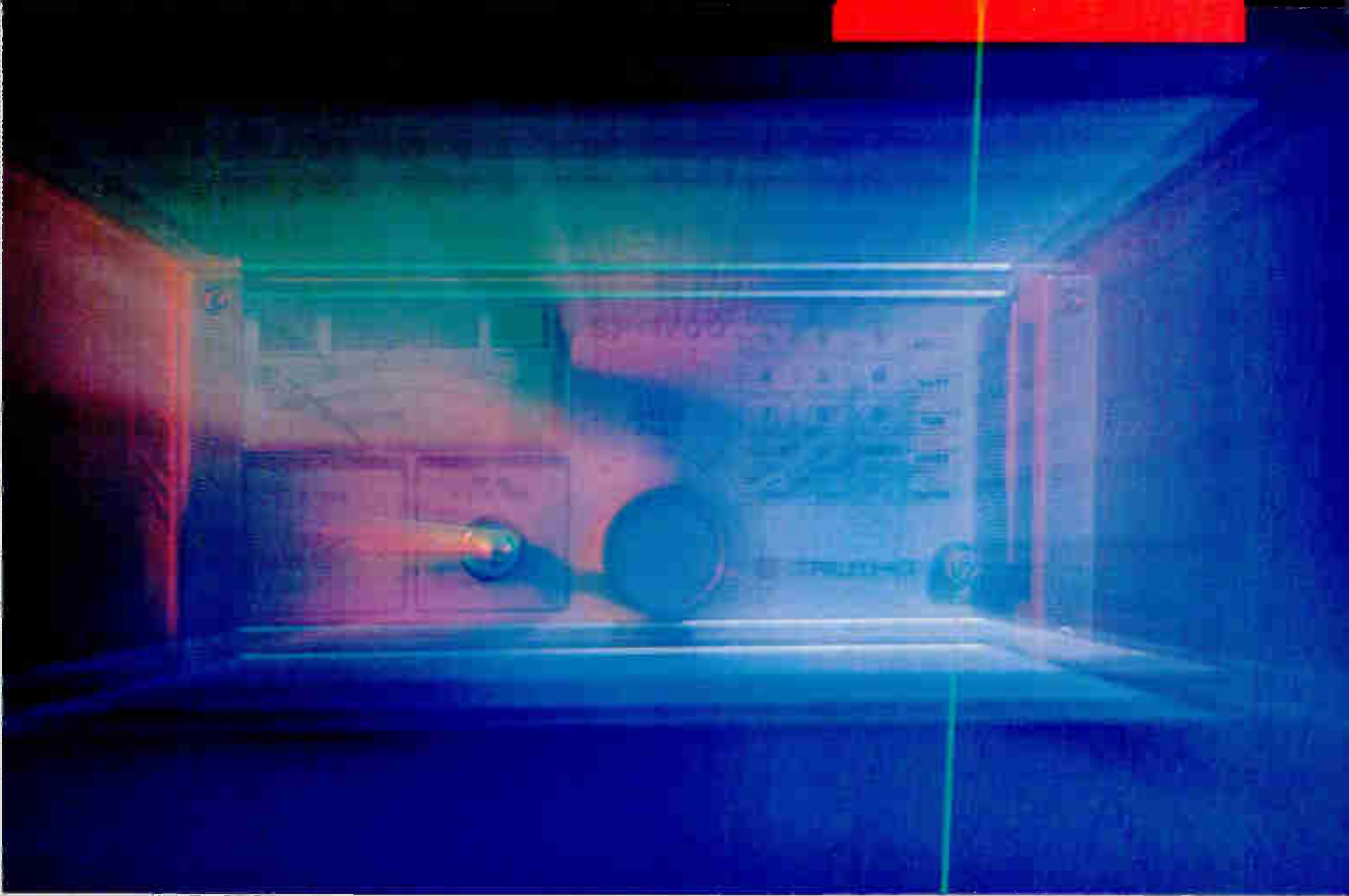
Courtesy Hughes Microwave

Continuing improvements in high power FET amplifiers and associated linearization techniques have led to the development of an all solid-state broadband microwave transmitter with an output capability previously achievable only with channelized 12.7 to 13.2 GHz very high capacity microwave equipment. The high power feedforward transmitter also incorporates power doubling to achieve an 8 dB increased power output capability relative to previously described block upconversion type units. Improved maintainability features also are provided.

The impact of this new microwave transmitter on CATV system design includes economic alternatives for longer path or multiple receive site applications. In addition, the transmitter perform-

Figure 1: Relative output capability





0 to 600 in .035 seconds

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The smooth, analog meter movement, combined with the large digital readouts make the SP 1700 as quick to read as it is easy to use.

The SP 1700 stands up to heavy use thanks to construction that is engineered to meet the MIL STD 810D drop test. It's also highly water resistant, has a front panel replaceable F connector and comes in a padded carrying case.

The SP 1700 Digital offers more of what technicians *really* need:

- Selectable channel plans which include: NCTA, HRC, IRC, PAL or use the 99 channel memory to store your own.
- 5 to 600 MHz frequency range
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- 60 Hz and 120 Hz active carrier hum testing
- Highly water resistant
- Meets MIL STD 810D drop test
- Industry exclusive 2 year warranty

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Trilithic ■ 9202 East 33rd Street ■ Indianapolis, Indiana 46236 ■ 317-895-3600
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ance capability makes possible consideration of new system design techniques when planning channel expansion of existing amplitude modulated links (AMLs) as well as new applications where only channelized transmitter solutions previously would have been feasible. Further transmitter design details and

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IBBT performance parameters

Number of channels	P_O (dBm)	C/N (dB)
12	15	66
21	13	64
35	10	61
60	7	58
80	5	56

Power output (P_O) and carrier-to-noise ratio (C/N) for 65 dB C/CTB and 65 dB C/CSB.

Figure 2: AML IBBT-116

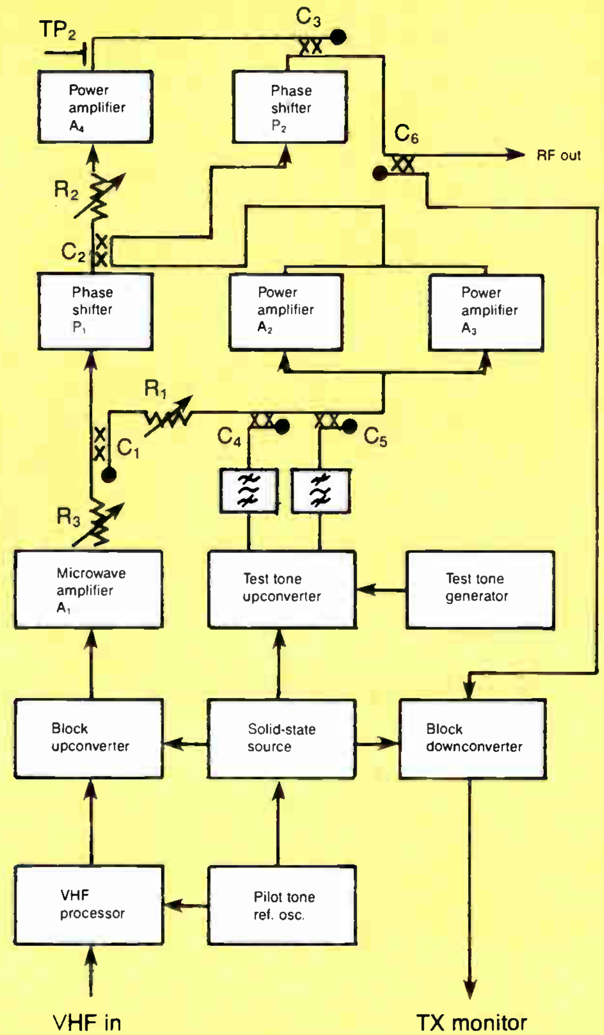


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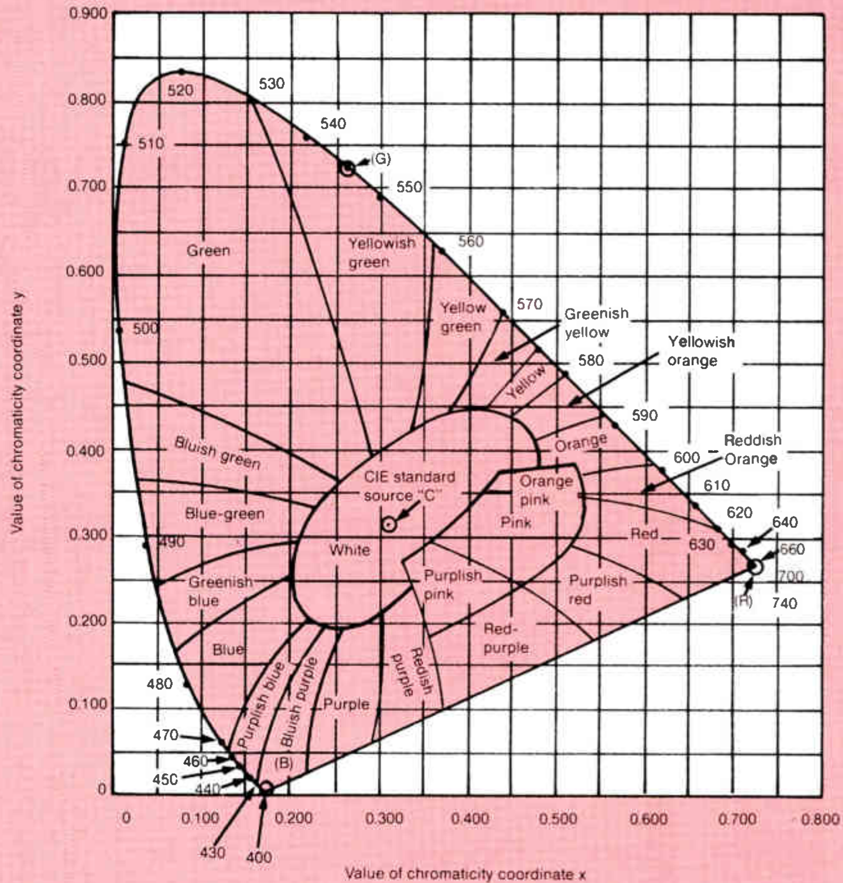
Figure 1: CIE chromaticity diagram



The CIE chromaticity diagram

As noted in a previous column ("CT," May 1989), noise in an HDTV (high definition TV) system—and probably IDTV (improved definition TV) also—will be defined by measurements related to the noise that appears to the human observer from the display. Measurement techniques, also based on human observers' perception, will be used for determination of HDTV/IDTV color presentation capabilities. Such analyses are particularly important because, since most of the HDTV and IDTV transmission schemes do not suffer from the limitations of NTSC color transmission, they produce colors that are often referred to as "richer, truer," etc.

Light, including the spectrum that is visible, can be treated quite reasonably and thoroughly by the physical laws of electromagnetic radiation. But add the concept of color and confusion enters the picture. This is because the human has entered the loop. If color perception is thought of in an information theory context, the disturbing element becomes apparent. The transmitter is the source of light, with possibly some frequencies more dominant than others, the transmission channel is usually air only (although obviously other factors can disturb the channel; i.e., glass) and the receiver is the human being. And that is the problem. The receiver—the final trans-

Table 1: Chromaticity coordinates of Planckian radiators

Absolute temperature (°K)	x	y	Reciprocals of slopes of isotemperature loci
1000	0.6523	0.3449	1.037
1500	0.5852	0.3934	0.824
1900	0.5372	0.4114	0.690
2000	0.5262	0.4135	0.663
2043.8***	0.5216	0.4139	0.651
2100	0.5155	0.4147	0.636
2200	0.5051	0.4152	0.610
2300	0.4952	0.4152	0.585
2360	0.4893	0.4150	0.569
2400	0.4856	0.4147	0.560
2500	0.4766	0.4137	0.537
2600	0.4678	0.4122	0.514
2700	0.4594	0.4105	0.490
2800	0.4515	0.4086	0.469
2854**	0.4476	0.4075	0.458
2900	0.4440	0.4063	0.447
3000	0.4366	0.4039	0.427
3100	0.4296	0.4015	0.407
3200	0.4230	0.3988	0.387
3300	0.4168	0.3961	0.369
3400	0.4108	0.3934	0.351
3500	0.4050	0.3905	0.333
3600	0.3995	0.3876	0.316
3700	0.3943	0.3848	0.299
3800	0.3893	0.3821	0.284
3900	0.3844	0.3793	0.268
4000	0.3799	0.3764	0.253
5000	0.3449	0.3515	0.122
6000	0.3220	0.3317	0.013
7000	0.3062	0.3165	−0.075
8000	0.2950	0.3047	−0.148
10000	0.2806	0.2883	−0.258
∞*	0.2399	0.2342	−0.672

*** Freezing platinum
** CIE, 1931, Source A
* H_λ proportional to $1/\lambda^4$

Figure 2: Typical color gamuts and light sources

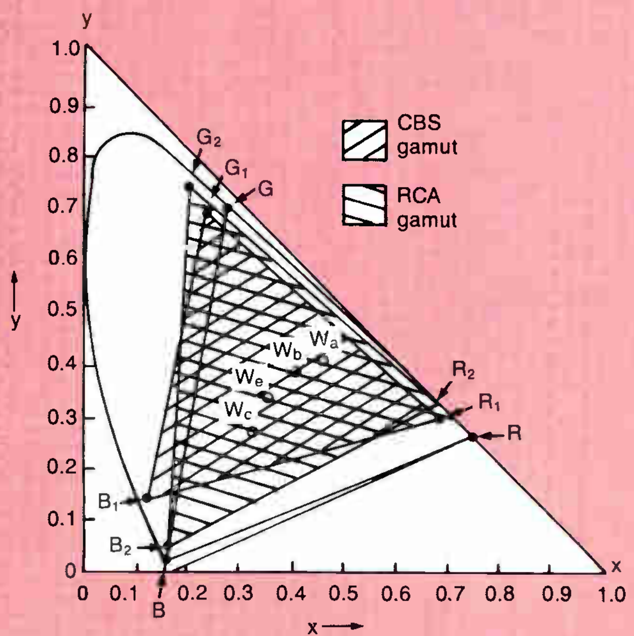
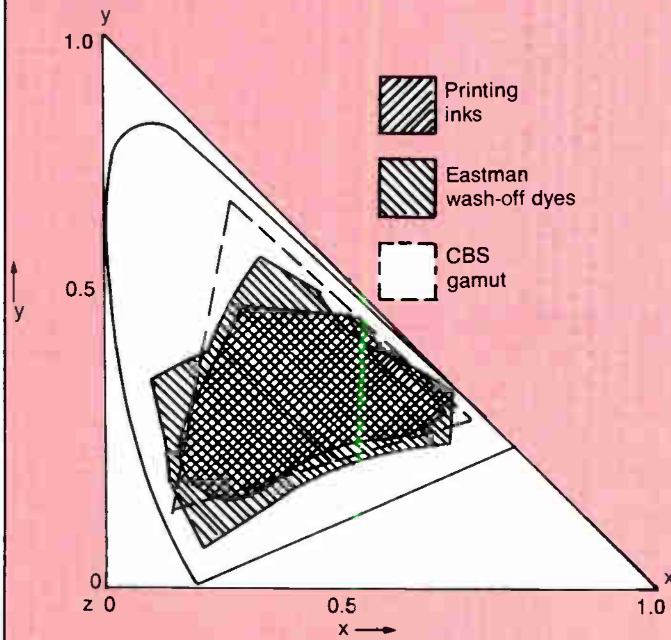


Figure 3: Gamuts of important color reproduction systems



ducer—does not obey any neat set of concise mathematical laws of physics that we presently know. Therefore, the main source of data about color vision is largely empirical. Multitudinous test data is the foundation for visual colorimetry.

It is at this point that the CIE chromaticity diagram (Figure 1) enters the picture as an international standard for colorimetry specified by the "Commission Internationale de l'Eclairage" (CIE). This diagram, properly used, is an indispensable tool in the field of colorimetry. This article outlines its history, its derivation and its applications.

This is the last of four parts; it begins with examples of specific colors and color gamuts. The first three parts appeared in the August, October and November 1989 issues.

By Lawrence W. Lockwood
President, TeleResources
East Coast Correspondent

With the properties of the x-y chromaticity diagram in mind, we are now in a position to locate certain colors on it and

Figure 4: Gamuts covered by standard color-patch systems

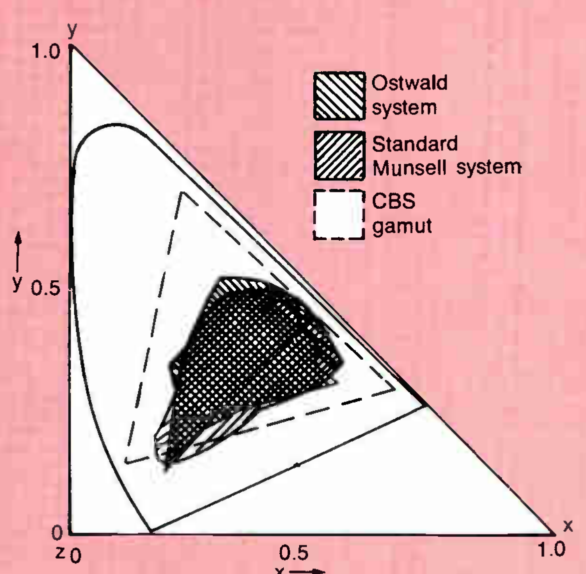


Figure 5: Color distortion vectors

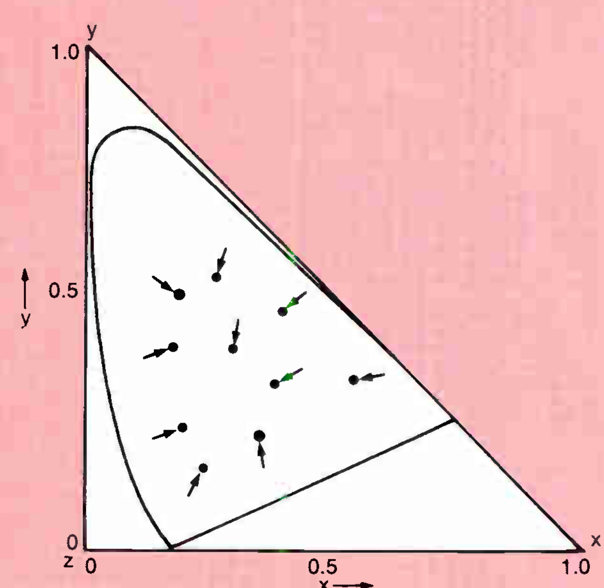


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Figure 6: Relative perceptibility of color distortion in various regions of the chromaticity diagram

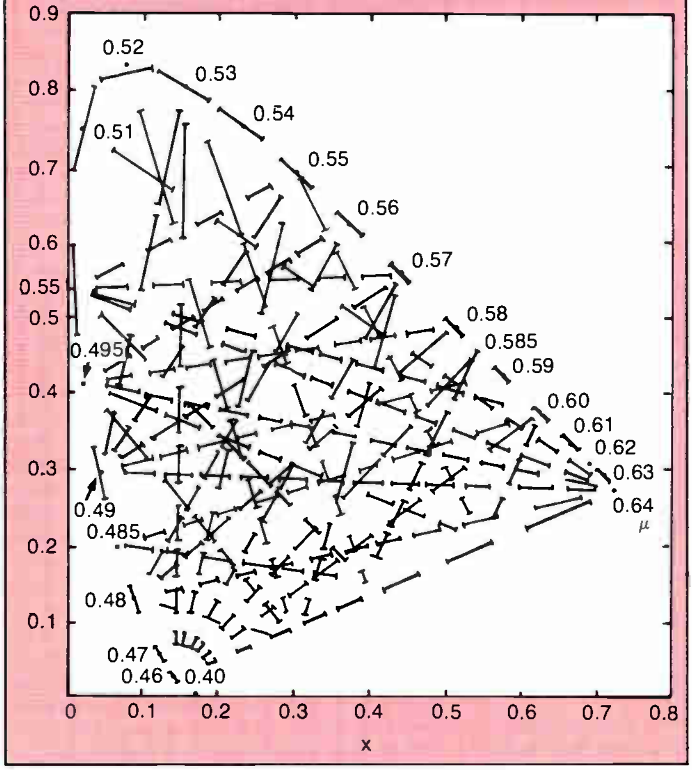
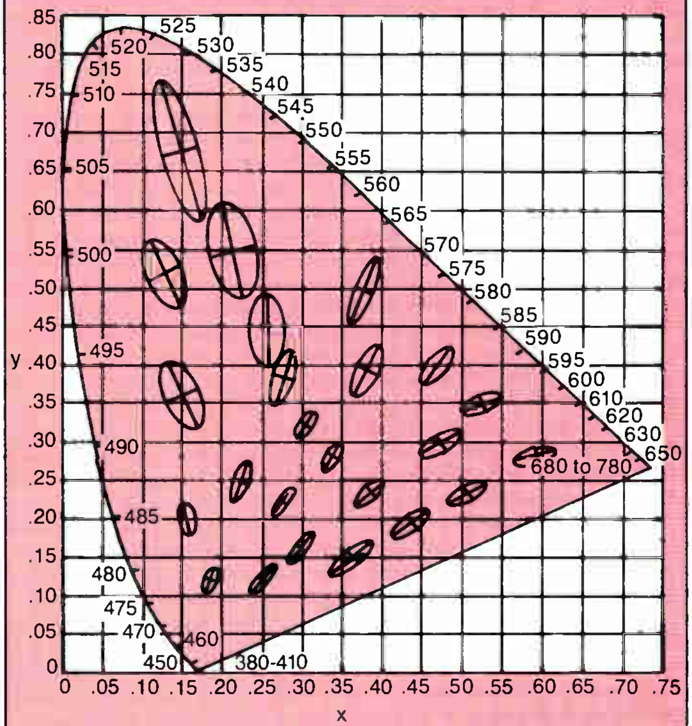


Figure 7: Standard deviations of color matching, represented as radii (magnified 10 times) from colors indicated by centers of ellipses

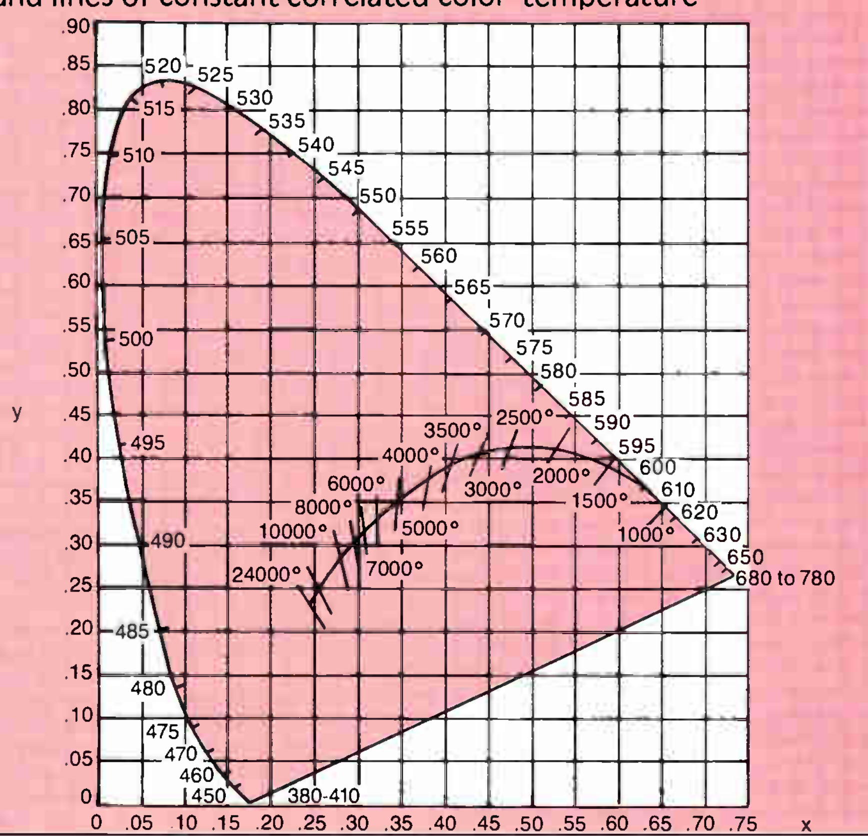


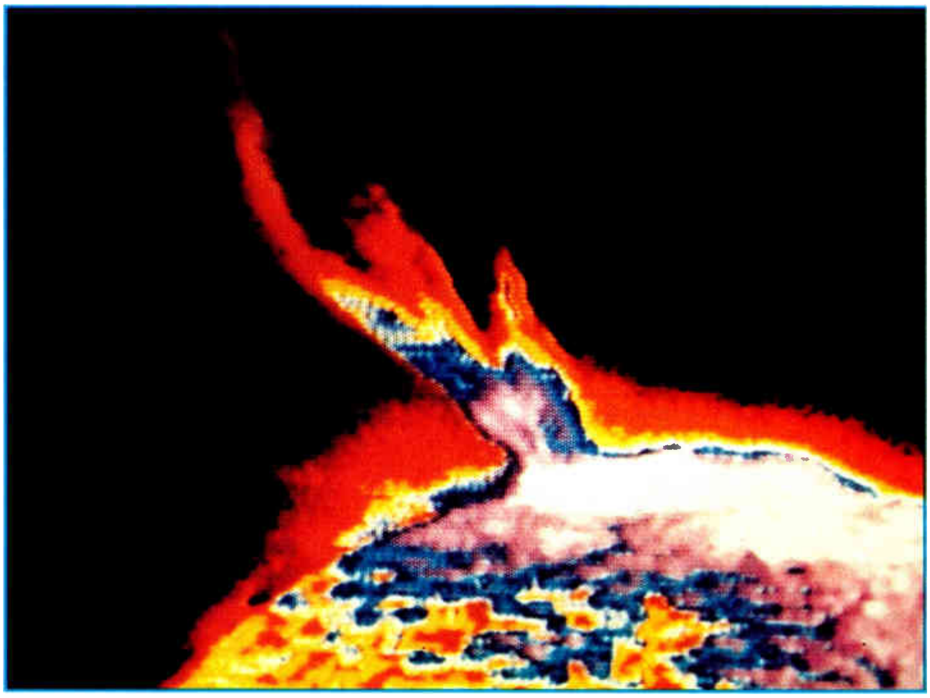
to show the boundary of the gamut of colors that can be covered by certain color reproduction processes. Figures 2 to 4 show typical examples. In Figure 2, the CIE spectral primaries are shown as RGB and the equal-energy white as point W_e. Three other standardized white lights are shown. W_a, known as illuminant A, represents the color of artificial illumination, actually that of a tungsten incandescent lamp operated at color temperature of 2,848 °K. Illuminants B and C (W_b and W_c) are two forms of daylight, noon sunlight and northsky daylight, respectively. Also shown in Figure 2 are the primary colors for TV receivers. The points R_1, G_1, B_1 are those standardized for the CBS (field-sequential) color system; R_2, G_2, B_2 are those for the RCA (dot-sequential) color system. It will be noted that the color TV primaries do not cover so wide an area as the spectral primaries R, G, B.

Figure 3 shows the gamut of colors covered by two other color reproduction systems: color printing and color photography (Eastman washoff relief dyes). It will be noted that the color TV primaries cover a considerably wider gamut than that of color printing, indicating that the color rendition in a TV system can be more comprehensive than that of the widely

(Continued on page 81)

Figure 8: Chromaticity diagram showing locus of chromaticities of Planckian radiators and lines of constant correlated color temperature





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The sun and communications

By Ron Hranac

The star at the center of our solar system—the sun—affects communications in more ways than you might realize. Here it is March already and many of you are gearing up for the first of two annual satellite sun outages (which may have occurred in some areas by the time you read this).

Just a year ago, a massive solar flare disrupted communications in another way and also was responsible for northern lights that were seen as far south as the Bahamas and Guatemala. This same solar phenomenon caused several utility lines in Canada to overload, eventually leaving 6 million Canadians without electricity. How is it that something 93 million miles away can produce such havoc? Let's look a little closer at some of these phenomena, starting first with satellite sun outages.

Sun outages

Because of the inclination of the Earth's equator to its orbit around the sun, the sun's relative angle to the equator varies throughout the year. On June 21, the sun is farthest north (23° above the equator), and on Dec. 21 it reaches its southernmost position, 23° below the equator. From this, it can be seen that the sun "travels" across the equator twice each year. These equatorial crossings occur around March 21 and Sept. 21, and are called the spring and fall equinoxes.

The geostationary satellites, from which much of the industry's programming is received, orbit the Earth 22,300 miles above the equator. Near the spring and fall equinoxes, the sun—which is crossing the equator—is in line with the geostationary satellites (see accompanying figure). Around March and October of each year, TVRO antennas on the ground may "see" both the desired satellite and the sun at the same time. The sun's radiated energy is much stronger than the satellite's transmitted energy; even though the sun is considerably farther away, it literally overpowers the satellite's signals.

The sun outage usually lasts a few minutes each day for a few days during these two months and will vary in intensity and duration depending upon the location of the antenna, which satellite it is pointed at and antenna characteristics such as diameter and beamwidth. Some systems will be affected little or not at all, while others may suffer fairly prolonged outages (perhaps up to an hour or more) for each of several days during these biannual events.

Sun outages sometimes are blamed on sunspots; in reality, sunspots have nothing to do with sun outages. There is no practical way to prevent sun outages from disrupting satellite communications, although they can be predicted. Many programmers provide computerized predictions of sun outages to their affiliates, but most operators take for granted the twice yearly program interruptions.

It is that time of year again; if some of your satellite pictures are being plagued by "sparklies" or maybe even total outages for brief periods each of a few days this month, take a look at the dish receiving the affected signal. If the sun is shining, the shadow of the feedhorn or subreflector will be directly in the center of the dish during the disruption, indicating that a sun outage is the culprit.

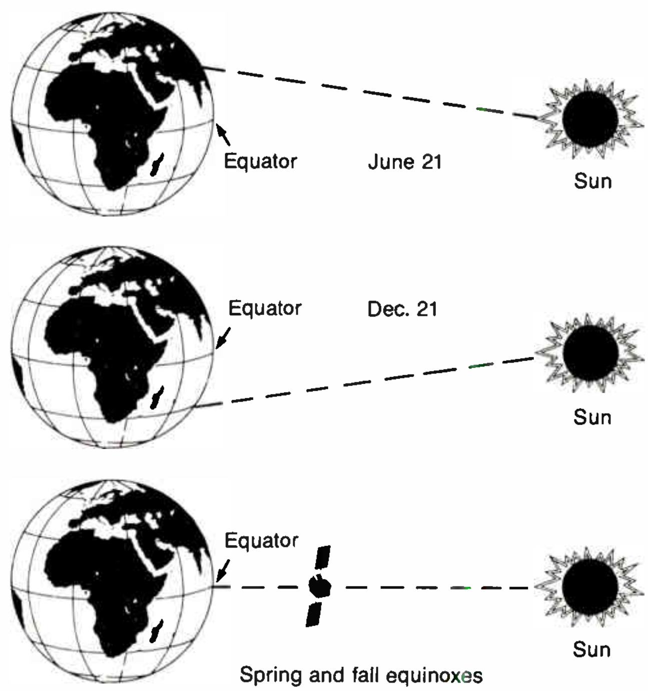
The sun and the ionosphere

Shortwave (HF or high frequency) radio communications around the world is possible because of the existence of an upper region of the Earth's atmosphere called the ionosphere. The ionosphere is formed by ultraviolet radiation from the sun, and various layers of the ionosphere are capable of bending radio waves—generally those below 30 MHz—and returning them to Earth.

The actual amount of ultraviolet radiation striking the ionosphere varies considerably, not only from hour-to-hour, but also from season-to-season. Year-to-year variations parallel the 11-year sunspot cycle. For the most part, the ionosphere affects communications only in the HF bands, but occasionally (and especially during peaks in the 11-year sunspot cycle) higher frequencies can be affected. We are in such a peak now and VHF co-channel interference can be caused by abnormal ionospheric propagation.

Ionospheric disturbances are phenomena that usually affect communications in the HF bands by weakening the signals, sometimes to the point where the signals and even atmospheric noise disappear altogether. Two major types of ionospheric disturbances are *ionospheric storms* and *sudden ionospheric disturbances*. Both are believed to be caused by solar flares. An ionospheric storm may develop gradually or suddenly and can last from one or two days to a week or more. A sudden ionospheric disturbance usually begins suddenly and seldom lasts more than an hour or so.

Variance of the sun's relative angle to the equator



When a solar flare occurs, radiation produced by the flare travels away from the sun at the speed of light. About eight minutes after the flare erupts, a sudden ionospheric disturbance may occur, temporarily disrupting radio communications on Earth. An enormous amount of matter also is ejected from the sun during a flare, and 18 to 36 hours after the flare an ionospheric storm may happen. This onslaught of particles from the sun often produces auroral displays as well, which also can affect communications.

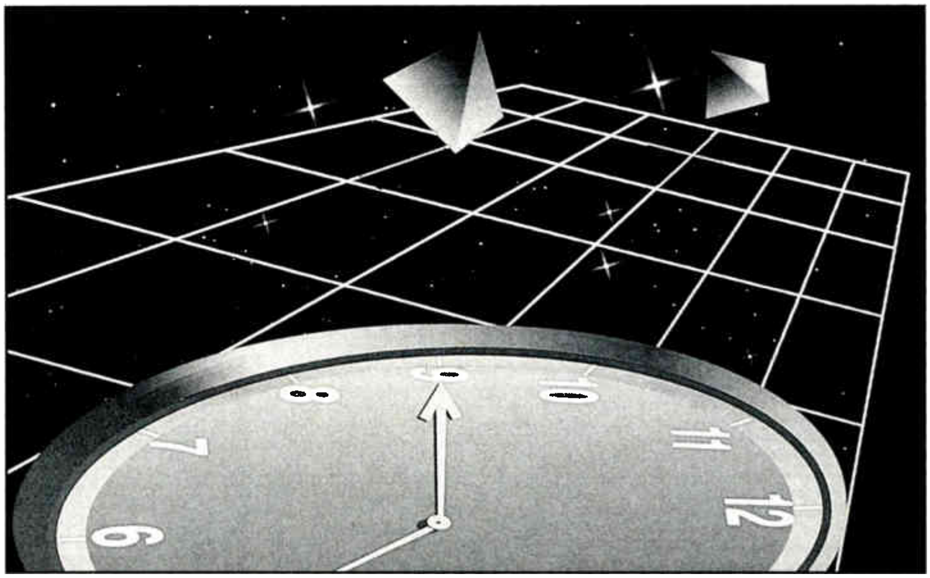
March 1989 solar flare

In early March 1989, a massive solar flare erupted on the sun. One of the three biggest flares since solar record keeping

(Continued on page 80)

Jones counts down to quality

By Pam Nobles
Staff Engineer/Technical Training, Jones Intercable Inc.



Courtesy Jones Intercable

Several years ago, Jones Intercable had no comprehensive programs to address deterioration of picture quality, rising service calls percentages, out-of-control signal leakage, ungrounded drops and loose or corroded F-fittings. This was very evident through the tracking of service call percentages.

In the last two years we have worked hard to develop several stand-alone programs, such as the Qualified Installer Program, quality assurance program, the five volume *Jones Engineering Manual (JEM)*, electronic mail for improved communication and our service call reduction and management program. Combined with our efforts in interactive laser disk training programs in the customer service area and the dedication of our field associates, Jones has established itself as a leader in quality-oriented performance improvement programs in the cable industry. These programs and hard work have resulted in a 24 percent reduction in service calls companywide! At $30 per service call, this represents a potential savings of $3.3 million to the company per year.

However, new challenges continue to confront the cable technical community as never before. The public is challenging us to new standards of customer service, picture quality and reliability. The resulting regulatory and political environment has never been so watchful over our technical and customer service performance, and there is more than just talk about the regulation of many aspects of our industry if we cannot correct its deficiencies. Impending competition from overbuilders, telcos and video rentals challenges us to provide better performance than ever before. The advancing technologies of fiber optics and high definition TV are placing new challenges for higher performance as well. It was obvious that we must do much more to bring total quality to all our day-to-day technical operations and to shift the creation and maintenance of quality programs from corporate engineering to each system—where it more appropriately belongs. This is the purpose of our "Countdown to Quality Program."

What is Countdown to Quality?

Countdown to Quality is a program of technical opportunity that will assist each chief engineer in identifying quality standards, establishing system-to-system target goals, developing quality strategies and creating a feedback mechanism for tracking system progress. Each system's year-end goal or objective is divided into monthly planned or budgeted targets for monthly tracking and feedback purposes during the year.

The program, therefore, is not exactly new but rather a net to gather together and track all existing and possible new system foci of attention on one simple worksheet. The worksheet will replace nearly every other system report. This simple one page sheet will be each system's primary device to monitor and report the system's technical vital signs.

The initial framework of the program was developed by Bob Luff, group vice president of technology. Through discussions with Fund Engineering Manager Steve Hubbard and others in corporate engineering, the concept was named, refined and defined until a tangible idea was ready for sharing. Together with other creative entities in the corporate office, we then developed the launch package, which included a high tech slide presentation, a package of handouts and prepared poster boards for final results. The time was right to present the concept to the chief engineers at our annual engineering conference.

During the four days of the conference, engineers had the opportunity to participate in the development of a truly unique and exciting program. Basically, the chief engineers created the Countdown to Quality Program. Never in our history was such a program development accomplished by so many (those directly affected by the program) in such a short period of time.

At the very heart of the program is a simple spreadsheet listing the major performance categories called "Vital Signs," which were chosen as the elements most important to the total quality of system technical operations. Listed on the "Tech nical Operations Vital Signs" worksheet are the desired company performance goals or standards. Each vital sign will have a section containing the determined company quality standard goal and defined measurement method recommendation. These target goals or objectives were established at the conference and will be reviewed with each system management team. There are ever-present practical limitations, including budget and staff resources. In other words, everyone's "wish list" will not be satisfied 100 percent. The chief engineers are already well-experienced and fully aware of these considerations, and will determine the best balance between total quality of all technical operations and practical budget and staff restraints.

Conference launch

The conference launch of the program opened with a blast—literally! The slide presentation, complete with a rocket blast-off in stereo was shown to generate a feeling of mystery and anticipation, and to prepare the engineers for their endeavor.

Engineers were randomly assigned to a group by way of color dots on their name tags. The two vital signs for each group's focus were assigned according to the color dot. The first day they got together with the other members of their group, elected a group spokesperson and decided on a fun name for the group. Pictures were taken of each group, developed during the conference and inserted in frames containing the group names as a reminder of their vital signs partners.

Primarily, the chief engineers' role at the conference was to:

1) Determine how the preliminary worksheet should be revised,
2) Determine exactly which items should be vital signs, and
3) Define which quality standards should be established for each vital sign for the company and the method by which that performance should be measured.

The final process for the chief engineer would be to establish (in conjunction with the system and fund management team) the specific system annual and monthly target goals for each item.

During the conference, the groups were given time to meet and develop their topics. To ensure a broad view that included those not in a specific vital sign group, each group member was asked to interview three people not in his group on the preliminary positions. On the second day of the conference the information collected up to that point was reviewed and refined by the group.

On day three, the groups completed their recommendations for the vital signs performance standards and measurement method. The spokesperson of each group also prepared for the final presentation by collecting all group material and summarizing it on a prepared poster board. On day four each spokesperson shared the results of the group's effort and our program was underway.

"It was obvious that we must...shift the creation and maintenance of quality programs...to each system—where it more appropriately belongs."

Back at the corporate office

The next step was to combine and package all the chief engineers' comments. Roy Ehman, director of engineering, undertook this task. Finding that the information developed at the conference was fairly complete, he worked on establishing a uniform presentation format consistent with the *JEM* and also updated the spreadsheet.

The initial launch slide presentation was converted to a video and an introduction to the program by both Glenn Jones and Luff was added. Also, a lapel pin—a stylized "Q" for quality—was designed to be worn during the year by all technical associates to display to the public and to provide a constant reminder to ourselves of our attention to quality. Each chief engineer received the *JEM*-style notebook with the compiled text, a copy of the final technical operation vital sign spreadsheet on a working disc, a batch of Q-pins to distribute and the introduction video.

As mentioned earlier, the heart of the program is the vital signs worksheet. At first sight the sheet may look a little formidable (like any other new program), but actually these are all items that we have—or should have—been tracking for some time. Nothing new has been added to the work load. They have just been brought together into one powerful management tool encompassing major technical operations.

The procedure is to enter each system's budgets and monthly results in the appropriate columns and the variances for the month, quarter and year-to-date will be indicated. The vital signs spreadsheet is very simple with uncomplicated formulas and no tricky programming that needs to be mastered.

An item called "subscriber minutes" is generated by the spreadsheet itself when the "on-time" or reliability index has been entered. The credit for this enhancement goes to Luff. The purpose is to provide a figure that is easily understood by the public and the media while the percentage (on-time) remains a great figure for engineers and folks like MCI to appreciate. It also lends itself to running trend analysis graphs when data has been accumulated.

All entries in the results columns that are considered undesirable produce a variance with a negative sign. For the sake of consistency, this also applies to revenue and non-revenue capital budgets. Obviously the reasons behind variances

Our final "Vital Signs" list

- Qualified Installer Program percent qualified
- Quality assurance drop score
- Capital revenue
- Marketable passings
- Capital non-revenue
- Staff turnover (percent)
- Facility control (percent)
- Vehicle safety (percent)
- Hours of safety training
- Hours of technical training
- Signal leaks per mile
- Cumulative leakage index
- Percent of facilities inspected
- Service call reduction
- Reliability index
- Subscriber minute off
- Longest hours down time
- Percent FCC/FAA requirements
- Accidents per associates per month
- Serious accidents per month
- Construction tracking
- Annual proof (percent complete)
- Semi-annual trunk sweep
- Annual distribution sweep
- Inspect standby and regular power supplies
- Measure end-of-line signal levels
- Semi-annual offsets

are more important than the signs and must be taken into account for any specific item.

Benefits

The overall benefits of the program to each system include:

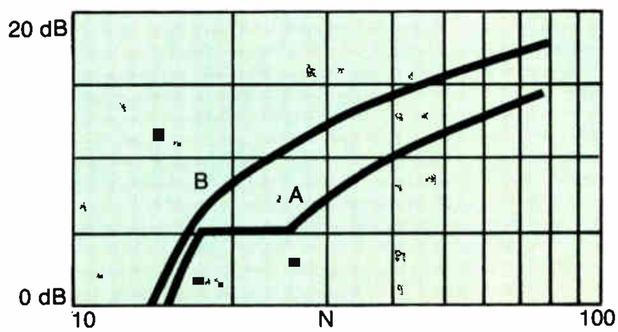
- Serves as a goal-setting tool
- Establishes quality performance objectives
- Simplifies standard performance measurement
- Represents an important quality strategy development tool
- Replaces most other monthly reports
- Is a significant time-saving reporting system.

Countdown to Quality has been met with enthusiasm by the chief engineers as well as fund vice presidents and system managers. The program is still too new to see results. However, with each system's help we expect the program to evolve into the best and most convenient technical operations management tool.

Fiber-optic performance

(Continued from page 22)

Figure 4: Number of discrete second-order beats (in dB) that comprise CSO as a function of the number of channels N in the standard frequency plan



This shot noise limits the SNR that can be achieved by the photodiode detector for a given optical input signal power. This limit is referred to as the *quantum limit*. If shot noise dominates in system operation, the system is said to be "quantum-limited."

Consider the signal current that flows in response to an incident optical signal. If the power incident on the photodiode is P watts, then from Equation 2, the peak signal power is mP. The resulting peak signal current is mRP, and the mean square signal current I_s^2 is

$$I_s^2 = \frac{1}{2}(mRP)^2 \quad A^2 \tag{14}$$

From Equations 13 and 14 the CNR in a 1 Hz bandwidth is

$$C/No = \frac{m^2RP}{4q} \tag{15}$$

Thus, the quantum-limited CNR for 4 MHz bandwidth is

$$CNR_{sn} = 3.906 \times 10^{11} m^2RP \tag{16}$$

Expressed in dB,

$$CNR_{sn} = 85.9 + 20\log(m) + 10\log(R) + P(dBm) \tag{17}$$

Table 2: System performance

Frequency (MHz)	CNR (dB)	CTB (dB)	CSO (dB)	X-MOD (dB)
55.25	54	69.7	69	57
83.25	53.7	74	71	57
121.25	54.1	67.7	>75	56
145.25	53.8	66.9	69.8	
175.25	54.3	67.6	70	58
205.25	54.3	66.9	70	58
241.25	53.8	66.6	69	58
265.25	54.3	66.9	66.5	57
295.25	54.3	67.5	65	59
325.25	54.1	67.5	62	60

For example, if m = .04 (typical for 40 channels) and R = .85 A/W, the quantum-limited CNR_{sn} is 57.2 dB for P = 0 dBm. CNR decreases 1 dB per dB decrease in received optical power.

Consider now the noise added by the amplifier that boosts the output current of the photodiode. Even in an ideal case in which the amp contributes no excess noise, thermal noise is added by the load resistor that terminates the photodiode. Thermal noise current $<I_n^2>$ in resistor R_l at temperature T is

$$<I_n^2> = \frac{4kT}{R_l} \quad A^2/Hz \tag{18}$$

where:
k = Boltzmann's constant (1.38×10^{-23}) and
T = °Kelvin

If the amplifier noise factor is F, the equivalent input current spectral density $<I_{an}^2>$ is

$$<I_{an}^2> = \frac{4kTF}{R_l} \quad A^2/Hz \tag{19}$$

Note that the noise factor of an amplifier is a function of the source impedance, which, in the case of interest herein, is a current source shunted by a small capacitance in the range of 1 pF. Thus, the amplifier noise figure in situ is likely quite different from that measured in a characteristic impedance of 50-75 ohms, as is generally the practice. Equivalent input noise current is better suited for the transimpedance amplifier concept than the more common noise figure specification.

As indicated in Equation 19, it is desirable to increase the photodetector load resistance in order to decrease the amount of amplifier noise. FET amplifiers are designed for that purpose. However, the impedance level that can be achieved practically is limited by the inherent circuit capacitance and the bandwidth required. Practical values for AM CATV applications range from approximately 500 to 2,000 ohms. The design value is, in general, a function of the received signal power and sensitivity required.

The SNR due to only amplifier noise can be determined in a manner similar to that for the quantum-limited case. The signal current is given by Equation 15. The CNR for a 1 Hz bandwidth due to amplifier noise is

$$C/No = \frac{(mRP)^2R_l}{8kTF} \tag{20}$$

The amplifier-limited CNR_{an} (for 4 MHz bandwidth) is

$$CNR_{an} = 7.81 \times 10^{12}(mRP)^2\frac{R_l}{F} \tag{21}$$

Expressed in dB, CNR_{an} is

$$CNR_{an}(dB) = 68.9 + 20\log(m) + 20\log(R) + 10\log(R_l) - F(dB) + 2P(dBm) \tag{22}$$

For example, if the received power P = 0 dBm, and if m = .04, R = .85 A/W, R_l = 1,000 ohms, and F = 3 dB, then CNR_{an} due to amplifier noise is 66.5 dB. Note that CNR_{an} due to amplifier noise decreases 2 dB per dB decrease in received optical power.

The CNR for the fiber-optic link can be obtained from the individual CNRs defined previously in a manner similar to that

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used in computing the cascade CNR in a CATV system. Specifically,

$$CNR = 1 \div \left(\frac{1}{CNR_{rin}} + \frac{1}{CNR_{sn}} + \frac{1}{CNR_{an}} \right) \quad (23)$$

If the CNRs are expressed in dB,

$$CNR(dB) = -10\log \left(10^{\frac{-CNR_{rin}}{10}} + 10^{\frac{-CNR_{sn}}{10}} + 10^{\frac{-CNR_{an}}{10}} \right) \quad (24)$$

For the preceding examples, CNR_{rin} = 56 dB, CNR_{sn} = 57.2 dB, CNR_{an} = 66.5 dB and, from Equation 24, the total CNR is 53.3 dB. If the received power is decreased to −5 dBm, the system CNR is 49.9 dB.

Figure 3 is an example of a plot of link CNR and CNR due to RIN, photodiode shot noise, and receiver amplifier noise. The laser output power is 2 mW and other parameters are the same as in the previous examples. Also, link distance is shown assuming the link loss budget is 0.5 dB/km.

Intermodulation distortion

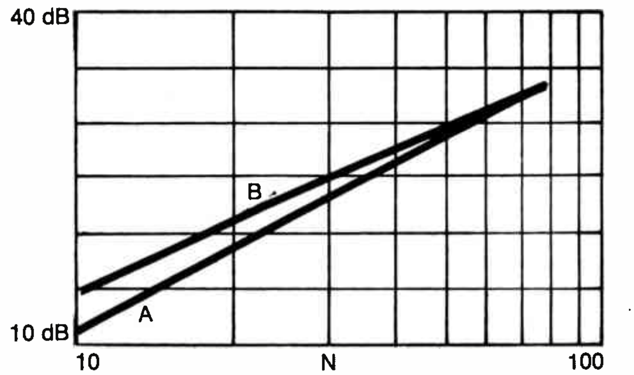
The main source of non-linear distortion in a well-designed fiber-optic system is the laser itself. Other sources of distortion include interaction of the fiber with the laser and reflections and discontinuities in the fiber system. Laser linearity can be degraded by the reflection of light into the laser cavity[3], but with the laser optically isolated, as it should be to prevent reflection-induced excess noise, this effect should not be a problem. In addition to non-linear distortions from reflected light, connectors and splices can generate additional distortion because the loss of connectors and splices is a function of optical frequency[4]. Non-linear distortions occur since direct modulation of a semiconductor laser not only modulates the light intensity but also the wavelength. The photodiode and receiver should not add significant distortion. In Reference 5, the non-linearity of photodiodes was measured and it was concluded that photodiode distortion is negligible.

Intermodulation distortion studies have provided a theoretical basis for determining distortion in a laser as a function of physical parameters of the device[6,7]. In Reference 7, expressions for second- and third-harmonic distortions and two-tone third-order distortion are given. It also was concluded that those expressions are valid for a variety of lasers, including DFB and Fabry-Perot devices at wavelengths of 1.3 and 1.5 μm. In theory, only the small-signal response characteristics of the laser are required to predict distortion levels. In Reference 8, experimental tests are reported that show that measured data at microwave frequencies agree well with theoretical calculations, including triple beat distortion of the form $F_1 + F_2 - F_3$.

In CATV and other systems, distortion is often calculated assuming the non-linear device is without memory (non-linearity is independent of frequency) and the transfer function of the device can be expressed by a power series. Although this is not a rigorous approach, the results can be reasonably valid and a meaningful relationship between system variables can be derived. This method has been used[9] to accurately describe laser non-linearity and predict intermodulation products. Also, since in CATV applications the maximum modulating frequency is low compared to the resonant frequency of the laser, the simple model should be useful[10].

The development that follows is patterned after the one in Reference 9. First, neglecting distortion, for a single carrier of

Figure 5: Maximum number of discrete third-order beats that comprise CTB as a function of the number of channels



modulation index m, the optical output $L_{(t)}$ of a laser is given by

$$L_{(t)} = L_o(1 + m\cos\omega_m t) \quad (25)$$

A laser with non-linearity is represented by the series

$$L_{(t)} = L_o[(1 + m\cos\omega_m t + C_2(m\cos\omega_m t)^2 + C_3(m\cos\omega_m t)^3] \quad (26)$$

where C_2 and C_3 are second- and third-order distortion coefficients. The ratio of the second harmonic to the fundamental is $mC_2/2$, and the ratio of the third harmonic to the fundamental is $m^2C_3/4$. From this, it is evident that second-harmonic distortion, relative to the fundamental, increases in proportion to the per-channel modulation index. Third-harmonic distortion, relative to the fundamental, is proportional to m^2.

By applying two or more carriers, each with modulation index m, the results can be extended to the other second- and third-order beats. Table 1 gives the relationship of the various beats and cross-modulation. It also shows the familiar principle that all second-order distortions, relative to the fundamental, increase in proportion to m, or at a 1 dB/dB rate. Likewise, the relative change in third-order distortion, including cross-modulation, is proportional to m^2 and changes at a 2 dB/dB rate. Note that the ratios in Table 1 are amplitude ratios; the factor 20log is used to convert to dB.

Composite triple beat (CTB) distortion and composite second-order (CSO) distortion are the results of power addition of all second- or third-order beats at the nominal frequency of interest. In systems not harmonically related and phase locked, frequency and phase uncertainties cause each beat to be distinct. The composite distortion is, therefore, given by the power addition of all beats at the nominal frequency. Distortion is calculated by counting the number of beats of a given type that fall at specific frequencies, and dividing the carrier/distortion ratio for a single beat of that type by the number of beats.

Cross-modulation is a third-order distortion and can be calculated based on parameters in Table 1 and the number of TV channels. It is measured according to CATV practices with all interfering carriers synchronously modulated. Therefore, as measured, cross-modulation distortion adds on a voltage basis. For N channels there are N−1 interfering channels to produce cross-modulation. The composite cross-modulation amplitude ratio (voltage ratio) is the ratio given in Table 1 for one interfering channel multiplied by (N−1). However, it has been our experience that laser cross-modulation is not always predictable, due perhaps to the nature of synchronously modulating the laser at 15 kHz with a high modulation index. In addition, the laser semiconductor is thermally modulated, causing the emission to be wavelength modulated. But, based on other perceptibility tests[11], cross-modulation is not expected to be a major factor with laser video modulation.

Figures 4 and 5 present the distribution of beat counts as a function of channel loading. This data can be used to calculate CTB and CSO from knowledge of harmonic, two-frequency or three-frequency distortion. For these figures, beat counts are calculated for the standard frequency plan (excluding Chs. A-2 and A-1). Figure 4 presents beat counts for determining CSO distortion. Curve A is the beat count (in dB) for the top channel ($F_1 + F_2$ beats plus second harmonics); Ch. 2 is the bottom channel. Curve B is the beat count (in dB) for Ch. 2 ($F_1 - F_2$ beats).

Figure 5 presents beat count data for determining CTB. Curve A is the equivalent triple beat count for the worst channel in N channels. All channels start with Ch. 2. In some systems, it is advantageous to split the total number of channels into two or more bands on one fiber, with each band modulating a laser, in order to reduce CSO and achieve better performance. For those applications, Curve B shows the beat count data for a contiguous band of N channels starting at any channel above A-2. These beats are triple beats of the form $F_1 + F_2 - F_3$ and two-frequency beats of the form $2F_1 - F_2$. The relative value of the latter is 6 dB less than that of the triple beat and is weighted accordingly (one-fourth the power) when determining the equivalent triple beat count.

For the simple model of the static L−I characteristic described by Equation 26, linearity as given by Equation 3 can be related to the distortion coefficients C_2 and C_3 and, by means of Table 1, the various distortions. For a single carrier with optical modulation depth = 1, second-harmonic distortion is $C_2/2$, and linearity due to parabolic curvature of the L−I characteristic is $4C_2$. Thus, C_2 = (linearity)/4, and the relative amplitude of the second-harmonic component = (linearity)/8. On this basis, for 40 channels with m = .04 and linearity = 4 percent, calculated CSO at Ch. 2 is 53.7 dB.

An example will illustrate how CTB and CSO can be predicted from knowledge of harmonic, two-frequency or three-frequency distortion. Assume that the specified second-harmonic distortion is −55 dBc for a modulation depth of 0.25. Calculate CSO for 20 channels assuming the per-channel modulation index is .06.

First, the harmonic distortion is calculated for the change in modulation index. Table 1 shows that the relative amplitude of second-order distortion is proportional to m. Therefore, the improvement in second-order distortion for a modulation index of 0.06 is 20log(0.25/0.06), or 12.4 dB. Thus, the carrier/second-harmonic distortion ratio at m = 0.06 is 55 dB + 12.4 dB = 67.4 dB. Next, the difference in a two-frequency beat and a second-harmonic is accounted for. From Table 1, $F_1 \pm F_2$ distortion is 6 dB greater than second-harmonic distortion, so the carrier/($F_1 \pm F_2$) distortion is 67.4 dB − 6 dB = 61.4 dB. (The preponderance of second-order beats are of the type $F_1 \pm F_2$; only one harmonic component at most can be included in CSO beats.) Finally, a correction is made to account for the number of beats on a particular channel. From Figure 3, a factor of 8.5 dB is added to account for seven beats at Ch. 2 for 20 channel loading. Thus, the calculated CSO is 61.4 dB − 8.5 dB = 52.9 dB.

System performance

Laser technology for CATV applications is currently progressing rapidly as more effort is expended in laser development for this market. With this changing technology, there is presently much variance in performance and yields from laser sources, particularly with regard to distortion specifications. For a while it may be desirable for manufacturers to select and grade lasers to meet specific system requirements. Lasers that do not meet CSO objectives but are satisfactory otherwise could be used where the bandwidth is less than an octave or so. As the technology improves, yields and variances are expected to improve.

The system data in Table 2 was taken with one of the better lasers of those available at the time from different manufacturers. This system performance cannot be guaranteed at this time in a standard product. Processes and specifications for this laser are being improved by the manufacturer, which should make this device suitable for production systems. This laser exhibits good linearity, which enables a high modulation index to be used and still achieve very low distortion. Data was taken on a production prototype developed for the CATV market. Some of the system parameters are:

Laser type—DFB
Laser wavelength—1,330 nm
Output power—2.6 mW
Link distance—15 km
Link loss—5.6 dB
Channel loading—40
Bandwidth—330 MHz (Chs. 2 to EE)

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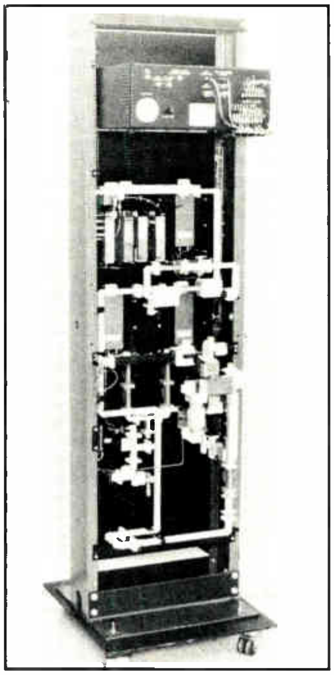


AML IBBT-116 transmitter

Microwave

(Continued from page 32)

system application considerations are provided.

Microwave block conversion type transmitter designs[1] were initially based solely on "brute force" techniques. The output power amplifier had to be backed off a long way from its full output capability because of composite triple beat (CTB). This type of limitation did not exist in earlier channelized transmitters. Such transmitters also were backed off to achieve desired video-audio intermodulation performance but the backoff was much less because audio was carried 17 dB below video and there was no contribution of beats, such as the CTB, that occurs elsewhere in the cable system. Channelized transmitters had to contend with output multiplex combining losses but these combining techniques also led to multiple outputs that, in many cases, were required since the microwave local distribution system (LDS) had multiple receive points.

The initial performance gap between the block conversion transmitter and the AML MTX-132 channelized transmitter was 18 dB, not counting the fact that the MTX-132 transmitter offered built-in multiple outputs. This gap was reduced to 13 dB by the addition (to the AML OLE-111) of a predistortion linearization[2] network resulting in a higher power microwave line extender.

A further breakthrough occurred with the development of the microwave feedforward amplifier[3]. Although feedforward was a well-known technique in CATV and had been demonstrated at 4 GHZ,[4] the AML FFA-160 advanced the state of the art by successfully applying the feedforward technology to a commercial product at 13 GHz. Indeed, by using the FFA-160 as a post amplifier for the OLE-111, the performance gap between channelized and block conversion technology was narrowed to 8 dB.

With the development of the AML IBBT-116, the performance gap is totally closed. True, the MTX-132 has the advantage of multiple outputs and no CTB, but since additional power output is obtainable from the IBBT-116 by trading for increased CTB relative to the 65 dB carrier-to-CTB (C/CTB) at which the comparison in Figure 1 is made, one can even get greater power output from the IBBT-16 than from a single output port of the MTX-132.

IBBT-116 description

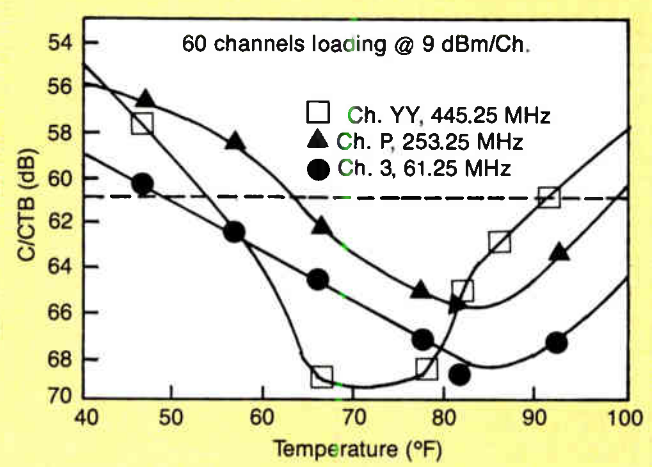
The indoor broadband transmitter, AML IBBT-116, has a 3-IM intercept point of 57 dBm. To our knowledge, this represents the state of the art for all solid-state microwave Ku-band transmitters or amplifiers. In addition to low third order distortion, the transmitter is designed for low composite second order (CSO) beats and output noise. The key performance parameters are summarized in the accompanying table.

The high performance capability is achieved through a combination of power doubling and feedforward. Figure 2 shows a block diagram of the transmitter. The wideband VHF input is combined with the microwave pilot tone signal in the VHF processor and then block converted up to 12.7-13.2 GHz microwave. Filters within the block converter select the upper sideband signal, amplified by low noise intermediate power amplifier A_1. Attenuator R_3 is set for a nominal 30 dB transmitter gain, which together with the A_1 noise figure and signal level largely determines the transmitter carrier-to-noise (C/N). Coupler C_1 is the start of the feedforward circuit. The main amplifier consists of power doubled A_2 and A_3. The amplified signal is compared at coupler C_2 with the direct input signal. R_1 and P_1 are then adjusted for best carrier cancellation as monitored at the transmitter control panel through TP_2. The remaining (distortion) signal is amplified by A_4 and reinjected into transmitter output through coupler C_3.

The test tone generator and upconverter provide low level signals that are added to the multichannel signal during test and alignment. Since the test tones are absent in the reference arm of the feedforward circuit, they simulate distortion signals created within A_2 and A_3. R_2 and P_2 are adjusted to minimize the output test tone signals that were injected into C_4 and C_5, and are available through C_6 to the VHF transmit monitor test port. This adjustment optimizes the transmitter C/CTB by feeding the distortion signal forward with proper amplitude and phase to cancel the distortion created in A_2 and A_3. Test tone frequencies f_1 and f_2 are selected to minimize interference with the on-line signal, but are turned off during normal operation.

The rear view of the IBBT-116, shown in the accompanying photograph, clearly shows the three power amplifiers A_2, A_3 and

Figure 3: Typical CTB vs. temperature



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the SCTE INTERVAL

March 1990

SCTE President Jack Trower (second from right) presents the Dixie Chapter with a chapter plaque at its Nov. 18 meeting.

Two New Chapters Elevated; Three New Meeting Groups Form

Two SCTE meeting groups were recently officially elevated to full chapter status. The new SCTE chapters are the Central California Chapter from Hanford, Calif. and the Dixie Chapter from Guntersville, Ala.

The Central California Chapter was recognized as an official SCTE chapter at the 1989 Western Show held Dec. 13-15 in Anaheim, Calif. National Treasurer and Region 1 Director Pete Petrovich was joined by Chapter Development Committee Chairman Mike Aloisi in the presentation of chapter status to the group's officers.

The Dixie Chapter was officially elevated to chapter status by SCTE President Jack Trower at its Nov. 14 meeting, held at the Holiday Inn East in Montgomery, Ala.

The Society currently has 39 chapters and 16 meeting groups for a total of 55 local groups. While the majority (over 70 percent) of SCTE groups have attained chapter status, the Society continues to develop new meeting groups, which are chapters in development.

Recent months have witnessed the

formation of three new meeting groups under the auspices of the Society. The new groups are: the Vermont/New Hampshire Meeting Group, based in North Springfield, Vt.; the Lake Michigan Meeting Group, based in Grand Rapids, Mich.; and the Western Pennsylvania Meeting Group, based in Lake City, Pa.

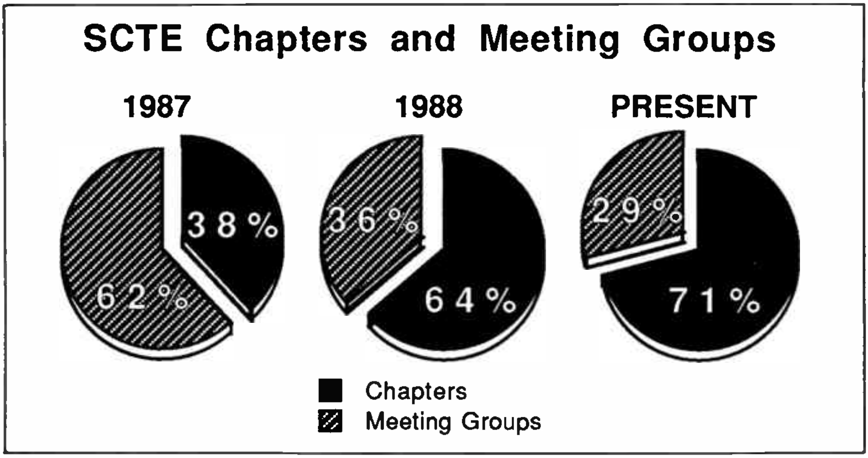
The Vermont/New Hampshire Meeting Group was initiated by Matthew Alldredge of Cable Master Technical Corp. He sent a questionnaire to technical personnel in his area to assess the feasibility of forming this group. Based on the results, the group is currently formulating plans for future meetings.

The Lake Michigan Meeting Group was co-founded by Grant Pearce of UA Cablesystems and Marty Sabraw of Starion/Amway Corp. In a letter sent to all SCTE members in western Michigan, it was announced that the group will hold its first meeting April 10 in Grand Rapids, Mich.

The Western Pennsylvania Meeting Group was organized by Bernie and Sandy Czarnecki of Cablemasters Corp. to serve not only their area but eastern Ohio and northern West Virginia as well. The group held a preliminary meeting Jan. 31 at the Cranberry Motor Lodge in Warrendale, Pa., to plan future group events and appoint officers, directors and subcommittees.

Bill Riker

Officers of the Central California Chapter receive chapter status from Pete Petrovich and Mike Aloisi at the 1989 Western Show. From left are Petrovich, Steve Roberts, John Novotny, Aloisi, Dick Jackson, Arnie Brokaw, Sarah Hanks and Andrew Valles.



Bill Riker

Scholarship Committee Chairman Toni Barnett of CT Publications receives a $5,000 contribution to the Scholarship Fund from Rex Porter of Midwest CATV at the 1989 Western Show.

Porter, NY Cable Commission Donate to Scholarship Program

The Society recently received two generous donations towards its Scholarship Program, which awards tuition assistance for technical training courses to industry personnel who show great potential for advancement in the industry.

At the 1989 Western Show in Anaheim, Calif., Rex Porter of Midwest CATV made a $5,000 donation to program. He has made donations to the program totalling $9,500, including an initial contribution of $2,500 in 1986 and a $2,000 donation in 1987. In his presentation, Porter, a former SCTE director and 1987 SCTE Member of the Year, called upon the industry to join him in strongly supporting the Society and its programs to encourage the development and education of all industry personnel.

The New York State Commission on Cable Television recently donated $1,000 to the program. This marks the second instance the commission has made a donation in support of the program.

In a letter dated Jan. 3, Robert Levy, assistant chief of the commission's Division of Telecommunications, writes "The state cable commission and especially our telecommunications division, have long been strong supporters of the Society and its goals." He explains that the donation was derived from profits from the commission's June 1989 annual seminar.

Inaugurated in November 1986, the Technical Scholarship Program was initially made possible through Porter's $2,500 personal donation. The NCTI agreed to match Porter's grant, enabling SCTE to award $5,000 in technical tuition assistance. This was originally conceived as a one-year program and was supposed to conclude following the awarding of the 12th recipient in October 1987. But through donations by Porter, the New York State Cable Commission, CT Publications Corp., Texscan and Steve Bell and Fred Rogers of Dudley Cable TV, plus NCTI's continued fund matching arrangement, the program will continue to award scholarships through 1990.

1986 Recipients

Ruben Gonzalez, Group W Cable
David Wilhelm, Cable America Corp.

1987 Recipients

Chris Crosby, Cablevision Industries
Peter Daly Jr., Rollins Cablevision
David Frauens, Adelphia Communications
Jeffery Goodman, Columbia Cable
C. Mike Hutchens, Freedom Cablevision
Danny Kivett, Freedom Cable
Bill Marshall, Storer Cable
Michael Pieson, Group W Cable
Johnny Ray, Marietta Cable
David Soldan, Lincoln Cablevision
Billy Williams, McCaw Cablevision

1988 Recipients

Jane Lode, Daniels Associates
Michael Palmisano, Metrovision
Rosa Rosas, Galaxy Cablevision
Paul Stephens, Catawba Valley Cable Television

1989 Recipients

James Beavers, Complete Cable
Dan Fischer, Rogers Cablesystems
Steve Fishman, Med-Sat
Ken Gabehart, Thompson Cablevision
Grady Lee Keenan
Thomas O'Brien, Jerrold
Andrew Skop, Anixter
Gary Strickland, Tele-Media Corp.
Charles Thibodeaux, St. Tammany Cablevision

Interface Practices Committee Elects New Officers

The Society of Cable Television Engineers Interface Practices Committee elected new officers at its Dec. 13 meeting held in Anaheim in conjunction with the 1989 Western Show. Re-elected as committee chairman was Tom Elliot, vice president of engineering for Cable Labs. Elected as secretary for the committee was Ken Williams, manager of CATV development engineering for Raychem. John Swinmurn, manager telecommunications development engineering for Raychem, was elected chairman of the Subcommittee on Drop Interfaces. The newly elected chairman of the Subcommittee on Aluminum Cable Interfaces is John Radzick, product manager for Augat/LRC. Rex Ickes, director of engineering for Pyramid Industries, was elected chairman of the Subcommittee on Interface Testing.

As the committee moves into its second full year of operation, it is currently addressing issues associated with the plating of F-connectors, the quality of contacts in female connectors (F-ports), drop cable dimensions, aluminum cable male and female dimensions, ink dye testing of F-connectors and crimp tool calibration. The committee also met in conjunction with the Texas Cable Show in late February.

The SCTE Interface Practices Committee gathers representatives from all facets of the cable TV industry, including operators, manufacturers and contractors. Participation in the committee is open to all interested parties. For information regarding the committee and its upcoming events, contact Ken Williams at (415) 361-2213.

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

March 7 Sierra Meeting Group, Oxford Suites Hotel, Roseville, Calif. Topic: "Trunk Sweeping, Standby Power and System Preventive Maintenance Programs" with presentations by CaLan, Wavetek, Alpha Technologies, Viacom and Tektronix. Contact: Steve Allen, (916) 786-2469.

March 8 Big Country Meeting Group, Abilene, Texas. Information to be supplied. Contact: Albert Scarborough, (915) 698-3585.

March 10 Chaparral Chapter, Howard Johnson Plaza, Albuquerque, N.M. Information to be supplied. Contact: Brian Throop, (505) 761-6289.

March 13 Central Illinois Chapter, Sheraton Normal Hotel, Normal, Ill. Topic: "CLI Last Chance." Contact: Ralph Duff, (217) 424-8478.

March 14 Mount Rainier Chapter, information to be supplied. Contact: Sally Kinsman, (206) 821-7233.

March 14 North Country Chapter, Edina Community Center, Edina, Minn. BCT/E testing to be administered in Categories I, IV, V and VII. Contact: Douglas Ceballos, (612) 522-5200, ext. 705.

March 14 Wyoming Chapter, TCI Cable Office, Riverton, Wyo. Topics: "System Powering" with D.R. Johnston of TCI and "TDR" with J.R. Johnston of TCI. Contact: J.R. Johnston, (307) 632-8114.

March 14-16 Razorback Chapter, Meeting to be held in conjunction with "L'Ark Show" in New Orleans. Information to be supplied. Contact: Jim Dickerson, (501) 777-4684. →

March 15 Southeast Texas Meeting Group, Warner Offices, Houston, Texas. Topic to be supplied. Contact: Tom Rowan, (713) 580-7360.

March 20 Rocky Mountain Chapter, location to be supplied. BCT/E examinations to be administered (Tentative). Contact: Steve Johnson, (303) 799-1200.

March 21 Dixie Chapter, Montgomery, Ala., information to be supplied. Contact: Greg Harden, (205) 582-6333.

March 21 Greater Chicago Chapter, location to be supplied. Topic: "Safety." Contact: John Grothendick, (312) 438-4200.

March 21-22 Dakota Territories Meeting Group, March 21: Ramkota Inn, Pierre, S.D. March 22: Kirkwood Inn, Bismark, N.D. BCT/E examinations to be administered in Categories I, IV and VII. Contact: A.J. VandeKamp, (605) 339-3339.

March 21-23 SCTE National Seminar: "Fiber Optics 1990," Doubletree Hotel and Monterey Conference Center, Monterey, Calif. A total of 22 outstanding technical sessions to be presented by some of the CATV industry's most prominent technical leaders have been scheduled. Contact: SCTE national headquarters, (215) 363-6888.

March 24 Great Lakes Chapter, information to be supplied. Contact: Daniel Leith, (313) 549-8288.

March 24 Great Plains Meeting Group, Best Western, Council Bluffs, Iowa. Topic: "Rebuilds." Contact: Jennifer Hays, (402) 333-6484.

***March 27** Satellite Tele-Seminar Program, "Signal Leakage, CLI and the FCC (Part Two)" with John Wong of the Federal Communications Commission (FCC) and Brian James of the National Cable Television Association (NCTA). Plus "Supervisory and Management Skills (Part One)" with Dr. Bill Brown of Rollins University. Videotaped at Cable-Tec Expo `89 in Orlando, Fla.

March 29 Mount Rainier Chapter, information to be supplied. Contact: Sally Kinsman, (206) 821-7233.

April 7 Rocky Mountain Chapter, location to be announced. Topics: "CLI/System Troubleshooting/Computer-Aided Testing." Contact: Steve Johnson, (303) 799-1200.

April 10 Central Illinois Chapter, Pekin, Ill. BCT/E examinations to be administered (tentative). Contact: Ralph Duff, (217) 424-8478.

April 18 Great Plains Meeting Group, United Artists Cable, Bellevue, Neb. BCT/E examinations to be administered in Categories I, III, IV and VI. Contact: Jennifer Hays, (402) 333-6484.

April 18 Sierra Meeting Group, Oxford Suites Hotel, Roseville, Calif. Topics: "Signal Security and Scrambling Techniques" presented by Scientific-Atlanta and "Satellite and System Theft of Service" with Jim Allen of NCTA. Contact: Steve Allen, (916) 786-2469.

April 20 Miss-Lou Chapter, Baton Rouge, La., information to be supplied. Contact: Dave Matthews, (504) 923-0256.

***April 24** Satellite Tele-Seminar Program, **Special Edition**, "How To Fill Out the FCC CLI Form" with John Wong of the FCC. Plus "Supervisory and Management Skills (Part Two)" with Dr. Bill Brown of Rollins University and "SCTE Installer Certification Program" with SCTE Director of Chapter Development and Training Ralph Haimowitz. Videotaped at Cable-Tec Expo `89 in Orlando, Fla.

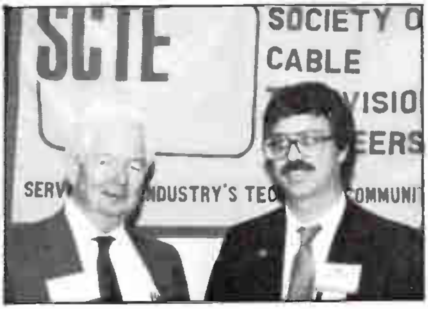
June 21-24 Cable-Tec Expo `90--Nashville Convention Center, Nashville. The best investment in technical education you can make!

*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.**

At the 1989 Western Show

Bill Riker

The FCC's Ben Nakamiyo speaks during a Dec. 13 Western Show panel discussion entitled "FCC Washington Update" that also featured moderator Steve Ross of Fletcher Heald and Hildreth, and Brian James and Wendell Bailey of the NCTA.



William Karnes, co-founder, founding chairman and past president of the Society, meets with Bill Riker at the 1989 Western Show in Anaheim, Calif.

BCT/E Incentive Program Offered; Certification leads to Higher Salaries

Columbia International Inc., a cable company based in San Angelo, Texas, has inaugurated an incentive program to reward its employees for participation in SCTE's Broadband Communications Technician/Engineer (BCT/E) and Installer Certification Programs.

According to Columbia International Executive Vice President Kenneth Gunter, a set cash bonus of $200 will be awarded to a company employee who completes the Installer Certification Program, while employees completing categories in the BCT/E Program at the Technician or Engineer levels will receive bonuses for each exam passed as follows:

Technician Level

First exam passed: $50
Second exam passed: $100
Third exam passed: $150
Fourth exam passed: $200
Fifth exam passed: $250
Sixth exam passed: $300
Seventh exam passed: $350
Total: $1,400

Engineering Level

First exam passed: $100
Second exam passed: $200
Third exam passed: $300
Fourth exam passed: $400
Fifth exam passed: $500
Sixth exam passed: $600
Seventh exam passed: $700
Total: $2,800

Although the bonuses vary based on the number of examinations the candidate has passed, examinations can be completed in any order and still qualify for the award. The program does stress, however, that employees seek certification in the program and at the level that is appropriate to their position.

According to Gunter, "the award program is designed to encourage and recognize progressive knowledge growth of our technical staff. It is not intended to be a mere windfall. Therefore, each applicant is expected to start the program at the highest level that his present experience and job category will reasonably support."

Gunter also recommends that Columbia's systems establish libraries of BCT/E resources to provide study materials for candidates.

The program went into effect Jan. 1. SCTE applauds the efforts of Columbia International to encourage training and education in the industry.

In related news, statistics recently released by the Society of Broadcast Engineers (SBE) show that SBE-certified engineers tend to receive higher salaries than those who are not certified.

The SBE survey concluded that radio or broadcast TV engineers earn an average of 11 percent more than non-certified engineers. The breakdowns for the two industries reveal even more, as there is a $6,550 (16 percent) difference between the average salary of certified and non-certified television engineers, and a $1,300 (4 percent) difference for radio engineers.

These figures give validity to the idea that certification leads to a higher salary (particularly in the TV industry) as well as improved technical skills and knowledge.

ATTENTION: Candidates in the BCT/E Certification Program won't want to miss next month's issue of *The Interval*, which will feature the newly revised BCT/E Guide. This invaluable resource includes outlines and bibliographies for each of the program's seven categories.

- - REMINDER - -

The Piedmont Chapter
of the
Society of Cable Television Engineers
* Presents *

FIBER OPTICS FOR CABLE TELEVISION APPLICATIONS

Wednesday, September 27, 1989
Holiday Inn, Hickory, North Carolina
- Fiber/Cable Design, Testing, Construction, Manufacturing -

Registration on site: $15.00 SCTE Members
$20.00 Non-members
* price includes coffee and lunch *

Registration/Coffee begins on site at 8:00 AM
The meeting will begin at 8:45 AM

* * For further info: Rick Hollowell, (919) 968-4661 * *

Chapter and Meeting Group Exchange

This section of the *Interval* has been created to aid in the exchange of ideas and procedures between SCTE chapters and meeting groups. We hope the information reprinted here will assist other chapters and meeting groups in organizing their own operations and give officers ideas in planning upcoming seminars.

Improving Meeting Announcements

By Ralph Haimowitz
Director of Chapter
Development and Training
SCTE

One problem area that many people have expressed concern about is the lack of attendance at local meetings. Chapters and meeting groups often ask about how to time the mailing of meeting notifications to their members. If they send them too soon, people forget. If they mail them too late, the members are unable to change their work schedules to allow their attendance at the meeting, or there is not enough time to process a company check to pay for their attendance.

The Piedmont Chapter seems to have come up with a reasonable solution to this problem. They mail out the initial notification at least 30 days before the scheduled meeting date, and then follow it up with a postcard notification about 10 days before the meeting. This timely reminder, which is received about a week ahead of time, reminds people to register to attend the event.

One other thing that helps a great amount is to schedule meetings on a regular day, i.e. the second Tuesday of each odd-numbered month (i.e. January, March, July, September and November) in the year. This way, everyone quickly becomes aware of when the meetings are held and only needs notification of topics.

Another thing that can reduce attendance at meetings occurs after initial interest begins to wane and it seems to be more difficult to find topics of general interest, particularly when you set a goal to have new and different topics at each meeting. We tend to overlook the real needs and interests of the members. An occasional return to the basics will often produce an increase in attendance. Presenting a more advanced version of a topic that previously received great interest and attendance with a new speaker can also prove attractive to prospective attendees.

If you or your chapter or meeting group have any ideas to share with other groups to help them solve attendance problems, please send those suggestions to the following address for inclusion in the Interval's "Chapter and Meeting Group Exchange" section:

SCTE Meeting Exchange
c/o Ralph Haimowitz
669 Exton Commons
Exton, PA 19341

Chapter and Meeting Group Reports

This section offers SCTE chapters and meeting groups the opportunity to publicize their activities, announce meeting dates and share ideas. Submissions to "Chapter and Meeting Group Reports" must be received at SCTE national headquarters prior to the first day of the month preceding the month of issue.

Appalachian Mid-Atlantic Chapter
Contact: Richard Ginter, Secretary/ Treasurer, (814) 672-5393

The Appalachian Mid-Atlantic Chapter met Jan. 16 and 17 in conjunction with the Pennsylvania Cable Television Association at the Marriott in Harrisburg, Pa. Jan. 16 featured seminars on "Fiber-Optic Technology" with Louis Williamson of ATC and "Headend Switching" with Fred Rogers of Quality RF. Wendell Bailey of NCTA gave a presentation on "CLI" on the following day. BCT/E examinations were administered both days.

Cactus Chapter
Contact: Harold Mackey Jr., Vice President, (602) 866-0072, x 282

Caribbean Area Chapter
Contact: John Green, (809) 844-7746
Report By: John Green

The Caribbean Area Chapter met Dec. 6 at the offices of CATV of Greater San Juan for a seminar on "Video and Video Testing." Dave Walters and Adolfo Rodgriguez of Tektronix, the speakers for the event, gave an excellent, highly technical presentation that included demonstrations of new equipment and test procedures. Seventeen people were present.

Cascade Range Chapter
Contact: Norrie Bush, Director
(206) 254-3228

Central California Chapter
Contact: Steve Roberts, President
(209) 582-5353

Central Illinois Chapter
Contact: Ralph Duff, Past President
(217) 424-8478

The Central Illinois Chapter presented a seminar on "Cable TV Fiber-Optic Construction" Jan. 9 at the Sheraton Normal in Bloomington, Ill. Entry, termination, splicing, cable handling, lightwave communication theory, pre-planning, design and physical construction were among the topics covered. The speakers included Rick Cole of Anixter, Gene Bray of AT&T, Jerry Hagar of Sergaents Telecommunications and William Mullen of US Cable. A splicing workshop also was offered for those interested in hands-on experience.

Central Indiana Chapter
Contact: Gregg Nydegger, Second Vice President, (812) 372-8424

Chaparral Chapter
Contact: Brian Throop, Secretary/ Treasurer, (505) 761-6200
Report By: Brian Throop

The Chaparral Chapter met Jan. 13 at the Howard Johnson Plaza Hotel in Albuquerque, N.M. Category II of the BCT/E Certification Program, "Video and Audio Signals and Systems," was the topic of the event, which featured speaker Ron Hranac, Region 2 Director. Twenty-eight people were in attendance.

The chapter's new officers are Bob Dardin, president; Mike Gormally, first vice president; Bob Baker, second vice president; and Brian Throop, secretary/treasurer.

Chattahoochee Chapter
Contact: Richard Amell, Secretary/ Treasurer, (404) 394-8837
Report By: Jack Connolly, President; and Dick Amell

The Chattahoochee Chapter held a meeting Dec. 12 at the Perimeter North Inn in Atlanta. The meeting focused on system sweeping and utilizing a spectrum analyzer. Speakers at this meeting were Dortch Walker of Tektronix and Steve Windle of Wavetek. Forty-one people attended the event.

Chesapeake Chapter
Contact: Doug Worley, Secretary (301) 499-2930

The Chesapeake Chapter administered BCT/E examinations at its Dec. 14 meeting, which was held at the Columbia Holiday Inn in Jessup, Md.

Delaware Valley Chapter
Contact: Diana Riley, Past President (717) 263-8258

The Delaware Valley Chapter met Dec. 6 at the Williamson Restaurant

Bill Riker

Appalachian Mid-Atlantic Chapter President Gary Selwitz addresses attendees at the chapter's most recent series of seminars, held Jan. 16 and 17 at the Marriott in Harrisburg, Pa.

in Horsham, Pa. The topic was "Fiber Optics in Cable TV," and the presentations included "How Cable TV is Moving into Fiber Technology" with John Holobinko of American Lightwave Systems; "How Does Fiber Work" and "Laser Technology" with Dick Old and Diane Hinte of Catel and J. David Johnson of Siecor; "Why Use AM Fiber?" and "Where and When To Use Fiber" with Robert Loveless of Scientific-Atlanta and John Aiello of Anixter; and "Fiber Optics-Today and Tommorow" with Dave Robinson of Jerrold.

Dixie Chapter
Contact: Rickey Luke, Secretary/ Treasurer, (205) 277-4455

The Dixie Chapter gathered Jan. 17 at the Holiday Inn Homewood in Birmingham, Ala., for a meeting on "CLI." Technical presentations included "CLI Programs" with Richard Murphy and Wade Goggins of Insight, "CLI Locating and Repair" with Joe DeJesus and Mark Majors of Storer Cable Communications and Jim Sims and Peter Kopf of Tele-Communications; and "CLI Forms and Paperwork" with Tommy Hill of Comcast.

Florida Chapter
Contact: Rick Scheller, Chairman

(305) 753-0100

The Central Florida Group of the Florida Chapter met Jan. 16 at the Holiday Inn in Lakeland, Fla., for a seminar entitled "CLI-Where Are You Now?" Jay Chicocca of Continental Cablevision spoke on FCC requirements, headend requirements and flyovers. The remainder of the session was devoted to a panel discussion moderated by Ed Misicka of ATC Orlando.

Gateway Chapter
Contact: Darrel Diel, Secretary/ Treasurer, (314) 576-4446

Golden Gate Chapter
Contact: Tom Elliott, Publicity Chairman, (408) 727-5295

"Towers" was the topic of the Golden Gate Chapter's Jan. 25 meeting, which was held at the Italian Gardens Restaurant in San Jose, Calif. Guy Black of Western Commtower and Bob Callaway of Microflect Corp. addressed the design and use of towers, focusing on wind and antenna loading, grounding, interference and safety.

Great Lakes Chapter
Contact: Daniel Leith, Second Vice President, (313) 549-8288
Report By: Douglas MacLeod, President

The Great Lakes Chapter held a meeting Jan. 24 at the Holiday Inn in Livonia, Mich. The topic was BCT/E Category II, "Video and Audio Signals and Systems." Perfect Sync and Scientific-Atlanta provided the speakers for this meeting.

Greater Chicago Chapter
Contact: John Grothendick, President
(312) 438-4200

The Greater Chicago Chapter focused on "Signal Processing Centers," Category I of the BCT/E Certification Program, at its Jan. 17 meeting, held at the Quality Inn in Chicago. Off-air site considerations, signal processing methods, signal quality, maintenance, monitoring, troubleshooting, proof-of-performance and BTSC stereo were among the facets of the topic that were discussed.

Heart of America Chapter
Contact: Wendell Woody
(816) 454-5421

Hudson Valley Chapter
Contact: Robert Price, President
(518) 382-8000

Inland Empire Chapter
Contact: Carl Sherwood
(509) 484-4931
Report By: Randy Melius

The Inland Empire Chapter met Dec. 6 at the Shep Rock Hanger in Coeur d'Alene, Idaho. Kip Hayes of Sun Country Cable conducted a training session on "Basic Electronics." Twenty people attended the event.

Iowa Heartland Chapter
Contact: Denis Martel, President
(319) 395-9699

The Iowa Heartland Chapter met Jan. 24 at the Amana Holiday Inn in Amana, Iowa. Marty deAlminana of Lectro Products discussed "Power Supplies and System Powering," and American Lightwave Systems gave a presentation on "Applications of Fiber Optics."

Michiana Chapter
Contact: David Miller, President
(219) 259-8015

Miss/Lou Chapter
Contact: Dave Matthews, Vice President of Facilities and Treasury, (504) 923-0256

Mount Rainier Chapter
Contact: Sally Kinsman, Secretary

and Media Director, (206) 821-7233
Report By: Bruce Habeck, Treasurer and Sally Kinsman

Eighty-one people were in attendance when the Mount Rainier Chapter met Jan. 17 at the Martha Lake Community Center in Seattle. In this session, we covered "Signal Leakage." Don Runzo of Comsonics spoke on "FCC Rules - Old vs. New," "Record Keeping," "Calculating Microvolts per Meter," "Equipment Calibration and Measurement Techniques." Brent Bayon from Viacom shared "The Salem Experience" with us, also discussing CLI test results and flyover vs. ground-base measurement. A panel of general managers and plant managers from the northwest discussed leakage control, compliance and time management. Steve Neumann's crew from TCI set up a demonstration area for a hands-on workshop on leakage detection equipment.

New England Chapter
Contact: Jeffrey Piotter, Secretary
(508) 685-0258
Report By: Jeffrey Piotter

The New England Chapter met Dec. 6 at the Sheraton in Boxborough, Mass. The topic of the business meeting was the future of the chapter: what will be required to keep regular meetings and technical sessions in place, and how the MSOs' technical and management departments can support the chapter. Region 12 Director Bob Price and Director of Chapter Development and Training Ralph Haimowitz led this discussion, suggesting the formation of satellite groups, as well as establishing committees to reorganize the chapter and arrange its meetings.

The technical session for the day featured Gord Zimmerman of Lindsay Specialty Products on "Off-Air Antennas." Zimmerman covered antenna design, the patterns and selection of proper antennas, problem solving and antenna configuration and tower loading and calculations. Seventeen people were in attendance at the meeting.

New Jersey Chapter
Contact: Art Mutschler,
Past President, (201) 672-1397
Report By: Jim Miller, Secretary

The North Jersey Chapter gathered Nov. 30 at the Holiday Inn in Wayne, N.J., for a meeting that attracted 55 attendees. "New and Emerging Technologies" was the topic of the seminar, which featured working demonstrations conducted by each speaker. The speakers were Frank Winship and Marty O'Connor of Anixter, who gave an excellent presentation on the development of AM fiber; Joe Waltrich of Jerrold Applied Media Lab, who brought us up to date on the development of HDTV; and Gerald Kalb of Kalcom Videoplex Sales and Marketing, who demonstrated his company's system of placing multiple channels on one screen.

North Central Texas Chapter
Contact: M.J. Jackson, President
(800) 528-5567
Report By: Terry Blackwell, Secretary

The North Central Texas Chapter met Dec. 19 at the Las Colinas Information Center in Irving, Texas, for a seminar entitled "Back To Basics" that served as a technical review of coaxial cable, amplifiers, distortion, carrier-to-noise, logarithms, dB vs. dBmV and much more. SCTE At-Large Director Richard Covell of Jerrold was the speaker. Thirty-seven people attended the meeting.

North Country Chapter
Contact: Rich Henkemeyer,
President, (612) 522-5200
Report By: Rich Henkemeyer

Seventy-two people attended the North Country Chapter's Dec. 11 meeting, which was held at the


Rikki T. Lee

The Rocky Mountain Chapter's 1990 officers are Eric Himes, secretary; Steve Flessner, president; Steve Johnson, treasurer; and Pam Nobles, vice president.

Sheraton Midway in St. Paul, Minn. Devoted to BCT/E Category VI, "Terminal Devices," the seminar featured Eddie Gunn of Scientific-Atlanta, who provided excellent descriptions of the scrambling and descrambling of video information.

Ohio Valley Chapter
Contact: Jon Ludi, Treasurer
(513) 435-2092

Oklahoma Chapter
Contact: Herman Holland, Secretary
(405) 353-2250
"CLI" was the topic when the Oklahoma Chapter met Jan. 10 at the Applewoods Restaurant in Okla-homa City. The speaker was Terry Bush of Trilithic.

Old Dominion Chapter
Contact: Margaret Harvey, Secretary
(703) 248-3400
Report By: Margaret Harvey
The Old Dominion Chapter held back-to-back meetings Jan. 14 and 15 at the Holiday Inn in Richmond, Va. "The F-Connector: Meeting CLI '64 or Bust' " was the topic of Sunday's presentation, while Monday featured a presentation on "Syndex" by Monroe Electronics.

Piedmont Chapter
Contact: Rick Hollowell, President
(919) 968-4631

Razorback Chapter
Contact: Jim Dickerson, Secretary
(501) 777-4684

Rocky Mountain Chapter
Contact: Steve Johnson
Board Member, (303) 799-1200
Report By: Pam Nobles
The Rocky Mountain Chapter met Dec. 9 at the Jones Intercable corporate offices in Englewood, Colo., to hear presentations by the company's Pam Nobles and Margaret Gaillard on "Ohm's Law" and "Cable Powering." The morning session was devoted to theory, discussion and instruction, while the afternoon gave the 31 attendees the opportunity to work through an actual power design.

Southern California Chapter
Contact: Tom Colegrove, Secretary/ Treasurer, (805) 251-8054

Tennessee Chapter
Contact: Don Shackelford, President
(901) 365-1770
Report By: Don Shackleford
The Tennessee Chapter took an in-depth look at fiber optics when Anixter representatives spoke at its Dec. 7 meeting on "Fiber-Optic Planning" and "Fiber Technical Considerations," respectively. The meeting was held at the Holiday Inn in Jackson, Tenn.

Tip-O-Tex Chapter
Contact: Mike Strakos,
(512) 664-8715

Upstate New York Chapter
Contact: Ed Pickett, First Vice President, (716) 325-1111

Wyoming Chapter
Contact: J.R. Johnston, Secretary/ Treasurer, (307) 632-8114
Report By: J.R. Johnston

Jim Degenhardt gave a presentation on the Jerrold Starport and addressable technology at the Dec. 10 meeting of the Wyoming Chapter, held at the TCI Offices in Riverton, Wyo.

Ark-La-Tex Meeting Group
Contact: Robert Hagan, Secretary
(214) 758-9991
Report By: Robert Hagan

The Ark-La-Tex Meeting Group met Dec. 6 at the Holiday Inn in Longview, Texas, for a seminar on "Fiber Optics" that featured Rand Reynard of Anixter and Gene Bray of AT&T.

Big Country Meeting Group
Contact: Albert Scarborough
Board Chairman, (915) 698-3585
Report By: Albert Scarborough

The Big Country Meeting Group met Jan. 11 at the Sunday House Inn in Sweetwater, Texas, to hear a presentation on "CLI" by Terry Bush of Trilithic.

Big Sky Meeting Group
Contact: Marla DeShaw, Secretary/Treasurer, (406) 632-4300

Bonneville Meeting Group
Contact: Roger Peterson,
(801) 486-3036

Dairyland Meeting Group
Contact: Bruce Wasleske, President
(715) 842-3910

Dakota Territories Meeting Group
Contact: Rick Reed, President
(605) 229-1775
Report By: A.J. VandeKamp, Secretary

The Dakota Territories Meeting Group held consecutive meetings Dec. 6 at the Ramkota Inn in Pierre, S.D., and Dec. 7 at the Doublewood Inn in Bismark, N.D. A total of 68 people attended the events, which featured John Koczan of Magnavox speaking on a variety of topics, including "The History of Cable," "Balancing," "Sweeping" and "Maintenance."

Great Plains Meeting Group
Contact: Jennifer Hays, President
(402) 333-6484
Report By: Marshall Borchert, Secretary/Treasurer

The Great Plains Meeting Group's Jan. 4 meeting, held at the Knolls Country Club in Lincoln, Neb., attracted 31 attendees. It featured a presentation by Ron Hassen of Scientific-Atlanta on "Fiber Optics."

New York City Meeting Group
Contact: Andrew Skop, President
(201) 328-0980
Report By: Andy Skop

The New York City Meeting Group held a meeting Jan. 17 at the Day's Inn in Holtsville, N.Y. for a seminar on BCT/E Category II, "Video and Audio Signals and Systems," that featured presentations on "Broadcast and Video Origination" by Mike Farina, "Video Test Equipment" by Neil Portnoy, "Troubleshooting and Installation" by Laura Ochler and "Video Formats" by Nick Dellelow. Twenty-six people were in attendance.

Palmetto Meeting Group
Contact: Rick Barnett, President
(803) 747-1403, ext. 262

Sierra Meeting Group
Contact: Steve Allen, President
(916) 786-8597
Report By: Steve Allen

The Sierra Meeting Group met Dec. 5 at the Oxford Suites Hotel in Roseville, Calif., for a seminar on "Signal Processing and Analysis" presented by Tektronix. Twenty-nine people were in attendance.

The group next met Jan. 16 at the same location. "20-Year Cable Plant" was the topic of the seminar, which featured presentations on "Coaxial Cable" by Comm/Scope, "Connectors and Interface" by Gilbert, "Environmental Considerations" by Channell Commercial and "Quality Control and Inspection" by Sacramento Cable. Thirty-four attendees were present.

Snake River Meeting Group
Contact: Jerry Ransbottom, Secretary/Treasurer, (208) 232-1879
Report By: Jerry Ransbottom

Twenty-eight people attended the Snake River Meeting Group's Dec. 2 seminar on "AM Fiber Optics," held at the Weston Plaza in Twin Falls, Idaho. In his presentation on "The Use of Optical Cable," Mike Kaus of AT&T discussed the basics of single-mode optical transmission. Tom Heiser and Bruce Habeck of Anixter spoke on the uses of AM fiber trunking using supertrunks and backbone configurations, and demonstrated rotary mechanical fiber splicing. SCTE Region 3 Director Ted Chesley of CDA Cablevision Inc. administered examinations in the BCT/E and Installer Certification Programs.

Southeast Texas Meeting Group
Contact: Tom Rowan, President
(713) 580-7360
Report By: Rosa Rosas, Secretary

The Southeast Texas Meeting Group held a seminar on "Fiber-Optic Communications" Dec. 14 at the Warner Cable office in Houston. Rand Reynard of Anixter gave a slide presentation on fiber as it relates to CATV video, and Tom Henderson of AT&T demonstrated fiber splicing. Twenty-one people attended the event.

The group next met Jan. 18 at the same location. SCTE Director of Chapter Development and Training Ralph Haimowitz presented a review of BCT/E Category IV, "Distribution Systems."

Valley Isle (formerly Hawaiian Island) **Meeting Group**
Contact: Howard Feig, Chairman
(808) 242-7257

Vermont/New Hampshire Meeting Group
Contact: Matthew Alldredge
(800) 552-6652

Western Pennsylvania Meeting Group
Contact: Bernie Czarnecki
(814) 838-1466

Wheat State Meeting Group
Contact: Mark Wilson, President
(316) 262-4270
Report By: Mark Wilson

The Wheat State Meeting Group met Dec. 7 at the Red Coach Inn in Wichita, Kan., for a group discussion and video presentation on BCT/E Categories IV ("Distribution Systems") and VII ("Engineering Management and Professionalism").

SCTE

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

Editors:—Howard Whitman
Bill Riker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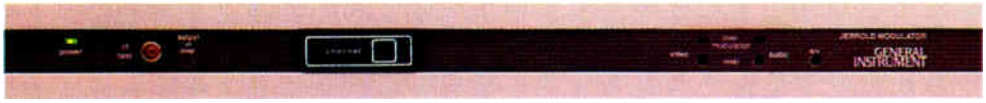

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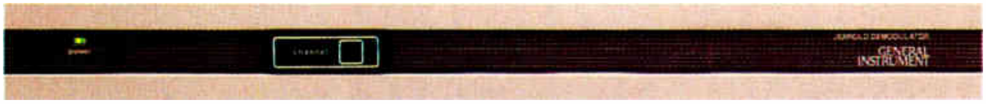

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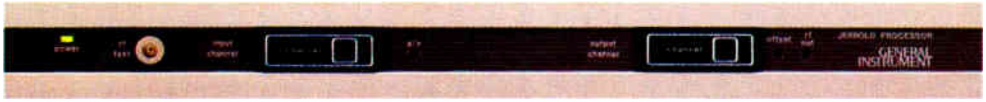
- ***MPX Output for BTSC Stereo Encoded Signals***

S450P Frequency Agile Heterodyne Processor



- ***Accepts VHF, UHF and Cable Channels to 450 MHz***
- ***Front Panel Controls***
- ***60 dBmV Output***

JERROLD COMMUNICATIONS

GENERAL INSTRUMENT

Reader Service Number 75.

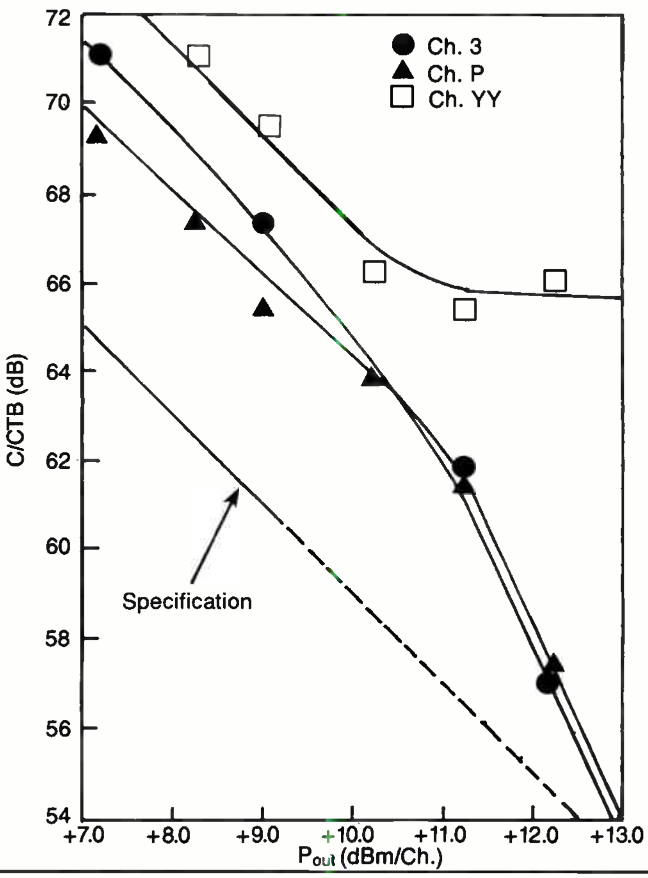
A_4, and the associated feedforward circuitry. The circuit incorporates a patented[5] temperature compensation scheme that reduces the temperature sensitivity of the feedforward distortion cancellation. Nevertheless, the C/CTB will deteriorate if the transmitter environmental temperature is not maintained at an equilibrium value. Figure 3 shows the typical variation of C/CTB with temperature for low-, mid- and high-frequency channels. With 60-channel loading at 9 dBm per channel the C/CTB specification is 61 dB. With the particular tuning of the example, optimized for the high frequency channel at normal room temperature, the CTB stays within its specified value between 63 and 92°F. For either hotter or colder environments, the tuning would have to be reoptimized.

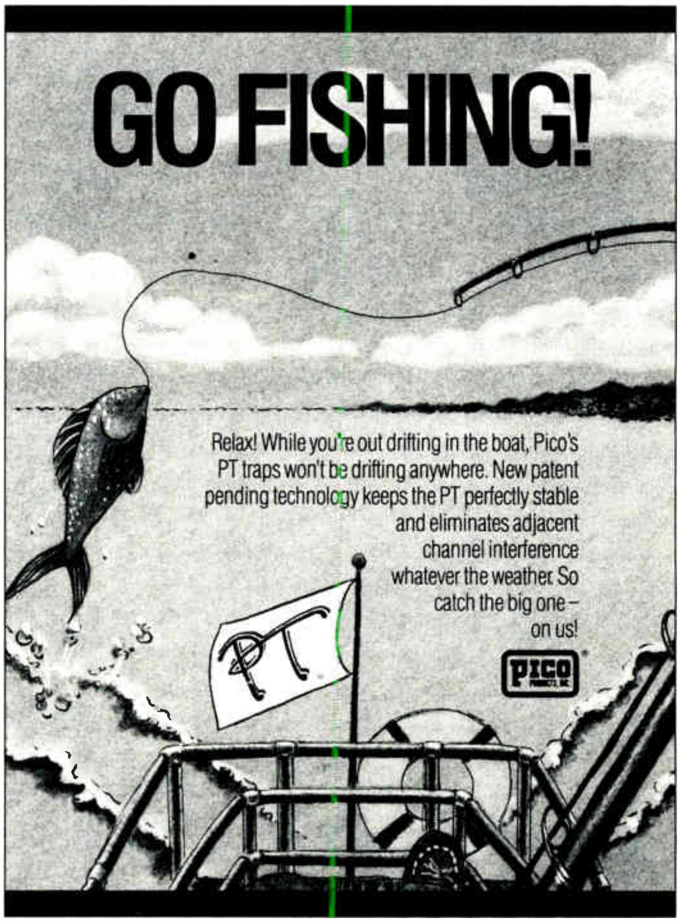
Figure 3 illustrates another facet of the feedforward circuit. Beyond about 40 channels, optimum tuning is not possible over the full frequency band. For this reason, full 550 MHz power output is derated by 2 dB, rather than 1 dB, from 60-channel performance. The compromise tuning is readily found by balancing the low- and high-frequency test tone cancellation as measured through the transmit monitor.

Figure 3 also suggests the IBBT-116 remains "well-behaved," or trades 2 dB of C/CTB for 1 dB of C/N, up to at least 9 dBm per channel for 60-channel loading. Indeed, although the accompanying table states the power output for 65 dB C/CTB, factory tests are run at 2 dB higher output corresponding to 61 dB C/CTB. Figure 4 shows that the transmitter remains reasonably well-behaved for power levels as much as 3 dB above those given in the table. Beyond this point, CTB can degrade more quickly than the 2-for-1 slope indicated by the extrapolated specification line.

Curiously, for the tuning conditions applying to Figure 4, only

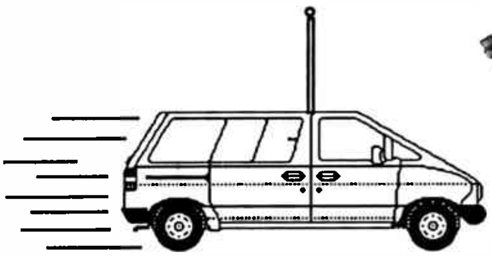
Figure 4: CTB vs. power output for 60-channel loading





Reader Service Number 39.

The FCC has done its part. Now it's up to you!



So says JOHN WONG, Assistant Chief of the Federal Communications Commission's Cable Television Branch, who will be featured in a SPECIAL EDITION of SCTEs SATELLITE TELE-SEMINAR PROGRAM, to be shown APRIL 24TH.

In January 1990, 27,000 CLI forms were mailed to cable operators. This exclusive video presentation provides step-by-step instructions on how to properly and accurately fill out "Form 320." It will also answer many of the questions most commonly asked about the CLI rules.

JOHN IS RIGHT. THE FCC HAS DONE ITS PART. NOW LET HIM HELP YOU DO YOURS.

WHEN: Tuesday, April 24, 11 a.m. to 1 p.m. ET
WHERE: Transponder 2 of Galaxy III
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Reader Service Number 1.

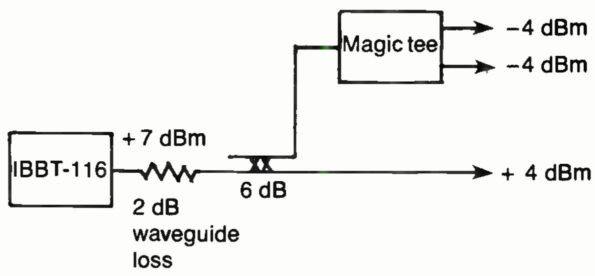
low- and mid-band channels degrade more rapidly at the higher power levels. The high-band channels exhibit an anamolous improvement, relative to normal slope, at higher power levels. This strongly suggests that the unit might have been retuned for more optimized performance across the full frequency band at the higher output levels. Further investigation is being conducted but the point to be made is that Figure 4 data was all obtained under one set of tuning conditions.

System applications

As with the MTX-132, the IBBT-116 can reach out 10 to 20 miles in a typical 60-channel application. The exact range depends on various factors including local climate and acceptable levels of signal quality. However, with the MTX-132, 16 output ports are available while the IBBT-116 has only one output. The difference is, however, not necessarily as large as it would seem. In some cases there are fewer than 16 receive sites, so the full output capability of the MTX-132 cannot be easily and efficiently utilized. (Space combining, in which two transmit antennas each carrying half the full channel complement, are both aimed at the same receive site can make more efficient use of the MTX-132 capability.)

In addition, only some of the receive sites may be near maximum range. Consider for instance an application with three receive sites where two of the sites are half range. The IBBT-116 output power splitting network could then be configured as shown in Figure 5. The insertion loss for the longer path is only 1 dB more so the maximum range is almost unaffected. This flexibility of design in the power splitting network to match receive site distances can, therefore, enhance the IBBT-116 system utilization potential.

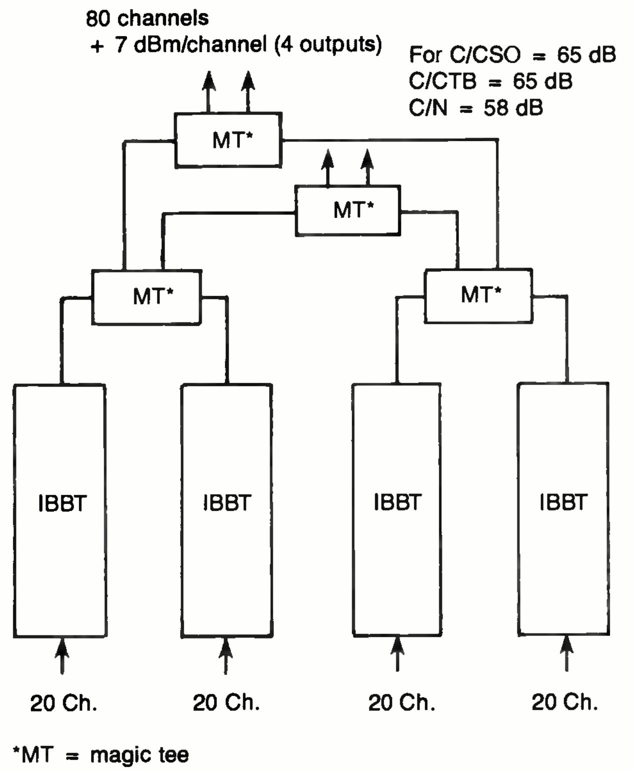
Figure 5: Power splitting network for unequal path lengths



Another example of IBBT utilization flexibility is illustrated by Figure 6. The illustration would optimally service a system consisting of four receive sites, all at or near maximum distance with full 80-channel carriage. Note also that the transmitter can easily be configured into a fail-soft redundancy mode in the event that one of the four IBBTs were to fail. For example, a VHF patch panel arrangement could route the affected 20 channels into one of the other broadband units with some increase in distortion until normal operation is restored. When compared to an 80-channel MTX-132 configuration, the multiple IBBT approach shown in Figure 6 would substantially save money and require only 40 percent of the floor space.

A third example of IBBT utilization is shown in Figure 7. It is assumed that an existing 32-channel MTX-132 needs to be expanded to 64 channels. It also is assumed that there are rela-

Figure 6: Multiple IBBT redundancy configuration



tively few receive sites so four outputs at +7 dBm per channel would suffice. The IBBT is operated with 32-channel output level approximately 2.5 dB above that implied by the table, so that C/CTB would be 60 dB, C/CSO would be 62.5 dB and transmitter C/N would be 64 dB. The result is a 64-channel transmitter with four output ports; a more cost-effective solution than adding four complete racks of MTX-132 equipment.

The +57 dBm 3-IM output intercept point of the IBBT-116 represents a new breakthrough in the state of the art of 13 GHz microwave block conversion transmitters. The resulting multichannel high output capability greatly expands the potential range of application of such transmitters. A greater variety of economical alternatives to channelized transmitter systems can now also be considered.

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[1] T.M. Straus, "Tradeoffs in Multichannel Microwave System Design," Las Vegas NCTA Convention Record, June 1985.

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[3] T.M. Straus and R.T. Hsu, "Application of Feedforward to CARS-Band Microwave Transmitters," Montreal CCTA Convention Record, May 1987.

[4] H. Seidel, "A Microwave Feedforward Experiment," BSTJ 50, No. 9, Nov. 1971.

[5] R.T. Hsu, "Feedforward Microwave Amplifier Arrangement with Ferrite Temperature Compensation," U.S. Patent No. 4,782,307.

Reprinted from the 1989 Canadian Cable TV Association Technical Record.

Figure 7: MTX-132 channel expansion using IBBT

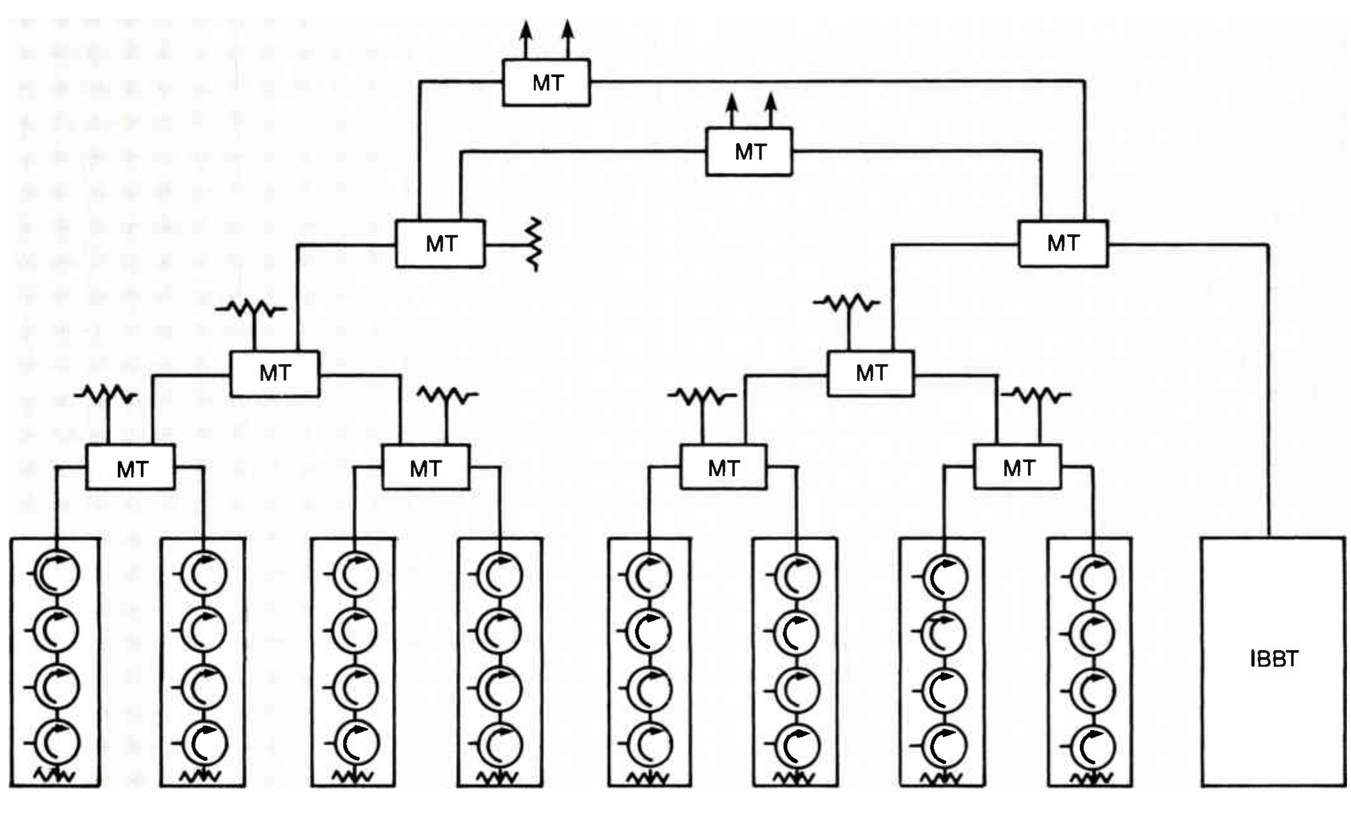
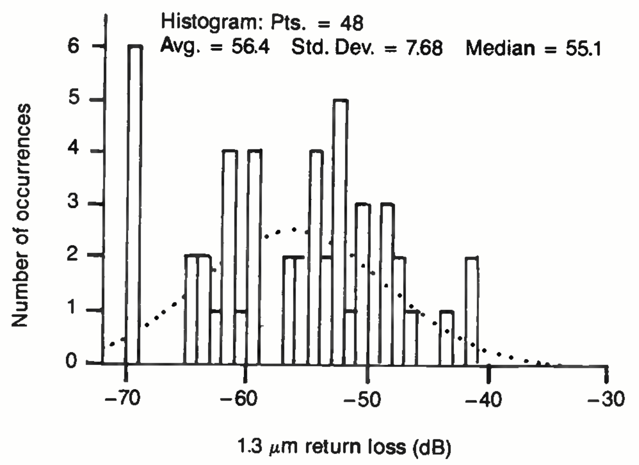


Figure 4: ERMS with low reflection polish



Fiber-optic splicing

(Continued from page 27)

Designers and maintainers of such new systems can still use ferrule splices; for, by simply choosing different end-face finishes, these splices can achieve virtually any return loss specified.

To illustrate, we present here laboratory results for two methods for changing the return loss characteristics of an ERMS (Enhanced Rotary Mechanical Splice). First, with only the substitution of a different polishing-paper material for the 0.3 μm paper now used on ERMS ferrules, the return losses shown in Figure 4 were obtained. For the 48 splices measured, the mean return loss is −56.4 dB (vs. the −40 dB for the standard polish), with the worst being −41 dB (vs. −29 dB previously). Of course, other polishing materials could be found that will produce characteristically different results.

A second approach is to alter the standard 0° angle of the ferrule end-face. To study this, a polishing tool with a 10° wedge-angle was used with standard finishing materials to prepare ferrules. The reflections for the resulting splices were, like fusion splices, undetectable on the OTDR. Which is to say, return losses less than −70 dB can be obtained for the ERMS with 10° end-angles. And, because the prealigned features of the ERMS makes its initial untuned configuration very close to its lowest-loss state, these angled splices are tunable and have proven to be environmentally stable for both splice loss and return loss.

Field OTDR measurements of installed ferrule-based splices have shown that typical return losses are below the cumulative fiber backscatter and hence would not cause problems for transmission systems. Furthermore, they are usually greater than the OTDR detected fiber backscatter and easily observed for accurate fault locating.

Also, two variations for end-face preparation show that ferrule splices can be tailored to produce any level of return loss that is needed.

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Donnelly

Orchard Communications appointed **Dennis Donnelly** as Western sales manager. Most recently he was manager of systems engineering for Catel. Contact 2 Tower Dr., P.O. Box 5031, Wallingford, Conn., (203) 284-1680.

The National Cable Television Institute revamped its management structure with the announcement that **Ronald Hieb** has assumed the title of chairman. Prior to this he was the executive director. **Byron Leech** will continue as president, but will relinquish day-to-day operating responsibilities to **Thomas Brooksher**, who formerly was the marketing director. Brooksher was named executive vice president and general manager. Finally, **Gerald Neese**, previously director of student services, was appointed director of operations. Contact P.O. Box 27277, Denver, Colo. 80227, (303) 761-8554.

TSB Inc. named **Wesley Schick** vice president. Prior to this he was vice president of fiber-optic products for Anixter. Contact 915 Douglas, P.O. Box 244, Yankton, S.D. 57078, (708) 541-3993.


Churchill

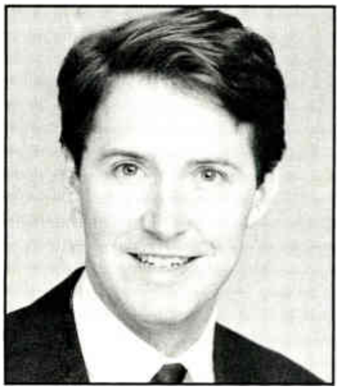
General Instrument's Jerrold Communications' U.K. office named **Patrick Sim** as director of operations. Previously he was manager of production planning and logistics for the company's subscriber systems division.

Also, **K.Y. Chou** was promoted to vice president and general manager of the Jerrold Taiwan manufacturing division. Most recently he was director of operations for that division.

In addition, **Jennifer Lambert Churchill** joined the company's Slough, England, office as director of business development. Formerly she was director of affiliate relations for Jerrold's Digital Cable Radio. Contact 2200 Byberry Rd., Hatboro, Pa. 19040, (215) 674-4800.

Scientific-Atlanta announced the appointment of **James Faust** as corporate vice president international. Previously he was the president of cable products for Zenith. Contact 1 Technology Parkway, Box 105600, Atlanta, Ga. 30348, (404) 441-4000.

David Green was named vice president of sales by **Passive Devices**. Previously he held various sales positions in the company. Contact 5149 N.E. 12th Ave., Fort Lauderdale, Fla. 33334, (305) 493-5000.



Flannery

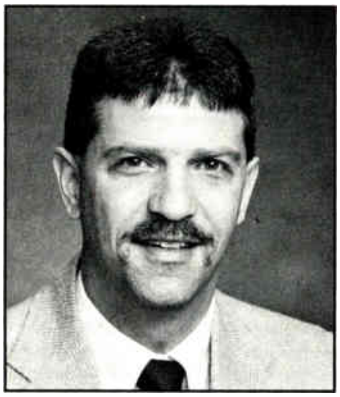
Jack Flannery was named director, affiliate sales and marketing by **International Cablecasting Technologies**. Formerly he was a marketing consultant with Kurt Salmon Associates. Contact 342 Madison Ave., Suite 505, New York, N.Y. 10173, (212) 983-3300.

Batson

J. Gary Batson was appointed director of new product development for **Power Guard**. Formerly he was with Athena Digital. Contact P.O. Box 2796, Opelika, Ala. 36801, (205) 742-0055.

Philip Morgan was named managing director of **US Cable**'s U.K. Division. Prior to this he was managing director of Cablevision Bedfordshire. Contact 28 West Grand Ave., Montvale, N.J. 07645, (201) 930-9000.

Pioneer named **Mark Hutchison** software engineer in the cable TV engineering department. Formerly, he was a software engineer for Fuller Weighing systems. Contact 600 E. Crescent Ave., Upper Saddle River, N.J. 07458-1827, (201) 327-6400.



Demos

John Demos was named account executive by **Cable Security/Power Guard**. Before this he was account executive for Hudson Supply Co. Contact P.O. Box 2796, Opelika, Ala. 36801, (205) 742-0050.

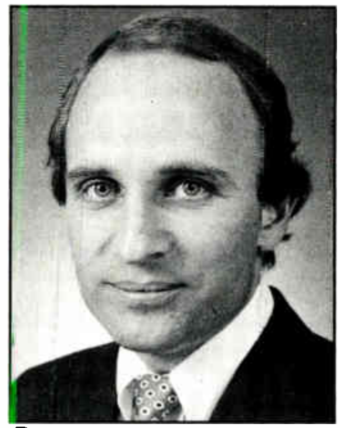
Comcast Corp. appointed **Brian Roberts** as president. He was the executive vice president and a director for the company. Contact 1414 S. Penn Square, Philadelphia, Pa. 19102-2480, (215) 665-1700.

Community Antenna Television Association appointed **Rob Stoddard** vice president-communications. Most recently he was the Washington bureau chief for Cardiff Publishing. Contact P.O. Box 1005, Fairfax, Va. 22030, (703) 691-8875.

MultiVision Cable TV appointed **William Yuille** as corporate construction manager. Previously he was group project manager for Telaction. Contact 321 Railroad Ave., Greenwich, Conn. 06830, (203) 622-4860.

Bowler

John Bowler was promoted by **Zenith** to president of cable products. Previously he was vice president of operations. The company also named **Michael Long** as director of engineering for cable products. Most recently he was manager of electrical engineering. Contact 1000 Milwaukee Ave., Glenview, Ill. 60025, (708) 391-8181.



Roper

William Roper was named president and chief operating officer by **BradPTS**. Previously he held management positions with Clevite Industries. Contact 5233 Highway 37 South, P.O. Box 272, Bloomington, Ind. 47401, (812) 824-9331.

Sun and communications

(Continued from page 41)

began 130 years ago, this explosion unleashed a shockwave that smashed into the Earth's magnetosphere and drove it back from its normal 34,000-mile distance to within the orbit of geostationary satellites. Subsequent shockwaves collapsed the magnetosphere to within 14,000 miles of the Earth's surface.

Intense bursts of RF (radio frequency) energy accompanied the flare and, because it occurred at about the same time as the normal satellite sun outages, caused above normal interference to satellite communications.

The collapse of the Earth's magnetic field also generated very large electrical currents in the magnetosphere, which induced currents in long metallic objects such as electrical power lines. These surges overloaded power lines in Canada, eventually causing widespread power outages.

Several satellites had to be powered down for the duration of this solar storm, because of electrical discharges in the satellites caused by voltages created by clouds of solar particles striking those satellites in space.

Probably the most dramatic effect of the March 1989 solar flare was the aurora that was seen as far south as Florida and Texas, as well as in the Bahamas and Guatemala. Not only did those northern lights produce some spectacular views, but they also contributed to VHF auroral propagation, a condition where radio waves are reflected off of the aurora.

While we often take the sun for granted as something that makes things grow, helps our tan or makes us feel warm when it shines, it also plays a big part in RF communications. At times it can enhance communications, and at others may completely disrupt communications. But at least understanding some of those effects may help us deal with the disruptions that sometimes happen.

References

1) *The Shortwave Propagation Handbook*, Second Edition, George Jacobs and Theodore J. Cohen (CQ Publishing Inc., Hicksville, N.Y.)

2) *Astronomy*, August 1989, "The Day The Sun Cut Loose," Gerrit Verschuur (Kalmbach Publishing, Milwaukee).

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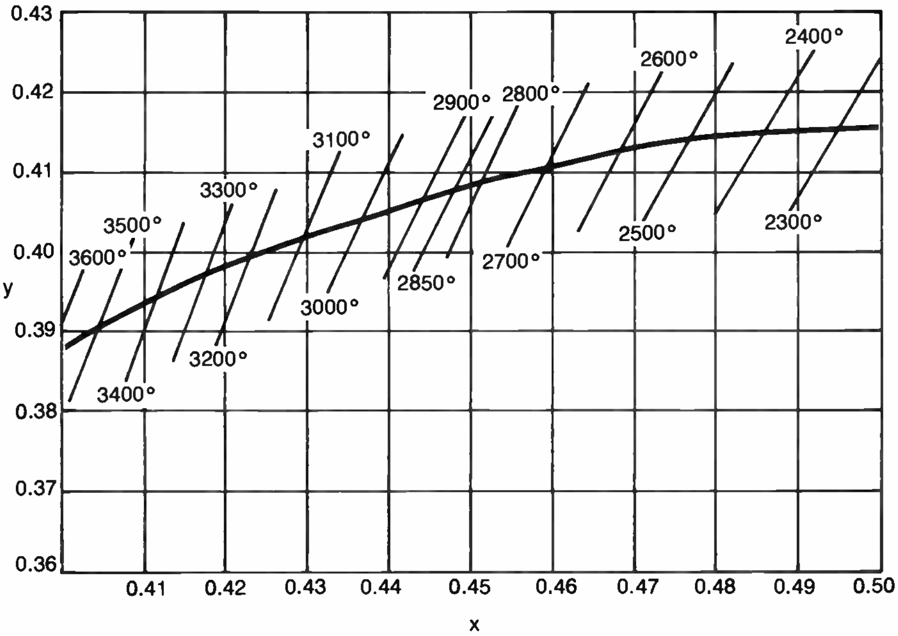
Chromaticity

(Continued from page 38)

Figure 9: Enlarged section of Figure 8 for color temperatures for 2300°K to 3600°K



accepted color printing method of reproduction. Figure 4 shows the gamut on which the color cards of the Munsell and Ostwald systems are based. These are printed cards, numbered in accordance with a system of specification that gives the hue and saturation, respectively. The collection of cards, known as a "color atlas," is useful in specifying a colored surface by direct visual comparison with standardized samples. This method of specification is particularly convenient for color matching outside the laboratory where measurements with a colorimeter are not feasible.

Specification of color distortion on the x-y diagram

The ability of a TV or other color reproduction system to recreate the hues and saturations of an object can be represented by pairs of points on the x-y diagram. One point represents the color coordinates of a particular portion of the televised object, the other the coordinates of the same portion of the reproduced image. A line connecting the two points, with an arrowhead attached to the image point, indicates the color distortion introduced by the system. Strictly speaking, this indicates only the chromaticity distortion, since no indication is given of the brightness distortion, which may also be present. The brightness distortion is indicated by the overall transfer characteristic.

A systematic comparison of the coordinates of different colored objects and the corresponding image color coordinates provides a number of color distortion vectors at various positions on the chromaticity diagram. An example is shown in Figure 5. Unfortunately, the magnitude and direction of these vectors, while providing a numerical index of color distortion, do not give an accurate indication of the subjective effect of the color distortion. This is true because the eye is much more tolerant of a color mismatch in certain regions of the diagram than in others.

A comprehensive study of this effect has been made by W.D. Wright, with the result shown in Figure 6. This is the x-y diagram, covered by a series of lines within the area enclosed by the spectral locus, the length of each line being three times greater than the just perceptible visual color difference, when the field of view is 2°. In the regions where the line segments are short, such as at the blue end of the spectral locus, the eye can detect slight differences in the hue or saturation of a color. Changes in color along horizontal lines passing through the white point are easier to detect, for example, than changes along a similar line above the white point.

In particular, as will be noted in Figure 6, very large distortion vectors may be tolerated in the region under the upper band of the spectral locus, the region not contained within the color TV primaries.

A slightly different representation is shown in Figure 7. Another set of data gathered presents standard deviations of color matching as functions of direction and position in the chromaticity diagrams.

Color temperature and location on CIE chromaticity diagram

The chromaticities of complete radiators at various temperatures are indicated in Table 1. These chromaticities are represented in Figure 8. Any chromaticity represented by a point on the locus of these points may be specified by the *color temperature* determined by interpolation between the points representing complete radiators at various temperatures. *Color temperature is not a valid specification of a chromaticity appreciably different from that of the most nearly similar Planckian radiator.* The temperature of the complete radiator most similar to such a color is sometimes of interest and is called correlated color temperature. Correlated color temperature is defined as the temperature of a black blody that produces a chromaticity most similar to that of the selective radiator in question.

Table 2: Chromaticity coordinates and color temperatures

Source	x	y	Correlated color temperature
CIE (1931) standard Source A	0.4476	0.4075	2850
CIE (1931) standard Source B	0.3485	0.3518	4880
CIE (1931) standard Source C	0.3101	0.3163	6740
Equal energy per millimicron	0.3333	0.3333	5500
Mean noon sunlight at Washington	0.3442	0.3534	5035
Sunlight above atmosphere	0.3204	0.3301	6085
Direct sunlight (Taylor and Kerr)	0.3362	0.3502	5335
Sun plus sky on horizontal plane	0.3213	0.3348	6000
Overcast sky	0.3134	0.3275	6500
North sky on 45° plane	0.2773	0.2934	10000
Zenith sky	0.2631	0.2779	13700
Carbon arc	0.3152	0.3325	6400
Macbeth (6800°K) lamp	0.3081	0.3231	6800
Macbeth (7500°K) lamp	0.2996	0.3123	7500
Sunlight above atmosphere (Moon's data for $m = 0$)	0.3179	0.3297	6215
Direct sunlight at sea level (Moon's data for $m = 2$)	0.3431	0.3567	5080

The correlation with color temperature is based on closest similarity and not on exact equivalence with one of the series of Planckian chromaticities. D.B. Judd in 1936 defined the loci of points having equal correlated color temperatures as short segments of straight lines perpendicular to the Planckian locus when drawn in his Uniform Chromaticity Scale diagram. Such lines are called *isotemperature loci*. Judd has determined the reciprocals of the slopes of the corresponding isotemperature lines in the CIE diagram, as functions of color temperature of their intersections with the blackbody locus. These values are given in the last column of Table 1, and the corresponding lines are shown in Figures 8 and 9. The wavelength corresponding to the intersection of any of these lines with the spectrum locus is called the *conjunctive wavelength* for the corresponding color temperature. Chromaticity coordinates and color temperatures of some sources of interest are shown in Table 2.

Bibliography

The text has liberally and extensively used material from the following references, particularly Fink.

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3) *Fundamentals of Display System Design*, S. Sherr, Wiley-Interscience, 1970.
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AM fiber optics

(Continued from page 24)

ceeding the specificiations listed previously. At least one commercial system can handle 80 AM NTSC video channels using two fibers with CTB and CSO distortions at −65 dBc or better. At 10 miles, the C/N is 56 dB or better. At 20 miles, C/N is 50 dB. This point-to-point test equipment performance is measured from a 30 dBmV input level at the headend transmitter through the 32-39 dBmV output of the optoelectronic trunk amplifier. Performance using modulated "live" video signals is considerably better, just like our long-standing experience with all-electronic systems.

To calibrate the performance of new AM fiber trunking systems, we can look at traditional coax systems and end-of-line picture quality. A 10-mile AM fiber link can replace an equivalent 10-mile 550 MHz coax link requiring a cascade of 16 feedforward amplifiers spaced at 27 dB. The fiber link outperforms this typical high-performance coax link by 6 dB in C/N, 5 dB CSO and 5 dB CTB. The fiber link can combine with a subsequent cascade of four feedforward trunk amplifiers, one bridger and two line extenders to deliver very good end-of-line picture quality at 49 dB C/N, −55 dBc CSO and −55 dBc CTB.

Yes, there are field adjustments that the plant engineer can make to optimize the performance of even the best AM fiber systems for his particular system. For example, the engineer might set the 10-mile AM fiber system at 53 dB C/N, −68 dBc CSO and −70 dBc CTB if superior distortion performance was the goal. With the different types of amplifier technologies available, spacing and level adjustments give the system designer many options to consider in delivering a high quality picture to any particular franchise's subs.

Optical splitting

Optical splitters give the system designer another economically attractive option. With today's higher power AM lasers, fiber links need not only be point-to-point. Two-way, four-way and even eight-way optical splitters can split a single laser transmitter's signal into multiple paths, feeding multiple optoelectronic receivers.

In principle, these optical splitters work much like familiar RF (radio frequency) splitters. Many models are designed for outside plant use. The insertion loss with a two-way device is about 3 dB under theoretical ideals. After accounting for all excess losses over temperature and for manufacturing margins, the total two-way splitter loss may approach 4 dB, depending on the model. Uneven splits are available that are similar to familiar RF directional couplers.

In our examples, we use evenly distributed splits and a loss of 3.5 dB for each two-way split. Table 1 illustrates some of the options available for employing such devices in AM fiber system design. A CATV designer often will find use for 10-mile fiber links with 54 dB C/N and therefore use a two-way splitter. The urban plant designer likely will find good use of eight-way splitters because his plant's sub density will demand use of more, shorter fiber links feeding fewer subsequent amplifiers. Four-way splitters also will fit many applications.

Table 2 illustrates the dramatic economic savings of optical splitting. If point-to-point AM fiber link terminal equipment cost is $40,000, then the typical cost per node comes down to about $25,000 when two-way splitters are employed. With an eight-way splitter, the cost drops to about $13,750 per node. Of course splitter costs (typically a few hundred dollars) and fiber cable and construction costs must be added to the final analyses. Yet today's AM CATV lasers give plant designers many splitting options to reduce overall build costs.

Splicing

For splitters we assume the use of devices (fused biconical tapers) with excellent return loss (>50 dB). High performance AM fiber systems—particularly the lasers employed—can degrade significantly in performance if individual reflections are not kept below 45-50 dB. The best AM lasers come with isolators integrated with the laser module package. Still, proper care must be used in fiber plant construction to maintain the integrity of the AM system. Therefore, the choice of splicing techniques should be weighted more toward return loss than insertion loss. Luckily, the best return loss choice for AM system splicing, *fusion*, also appears to be the best for insertion loss.

Outside of the *core* glass that the optical signals travel through is a *cladding* glass. This cladding glass has an index of refraction value very close to that of the core. In fusion splicing there are no air gaps from one fiber section to the next. Therefore, even if fibers are poorly aligned (causing excessive insertion loss) there are virtually no reflections from the splice. Figure 1 illustrates the lost signal resulting from a "bad" fusion splice being fully absorbed into the cladding glass of the second fiber section.

Figure 2 illustrates the risks prevalent with mechanical splices. Even a "good" mechanical splice in terms of insertion loss can result in excessive reflections according to AM CATV standards. Air gaps can cause unaccceptable reflections. The use of angled fiber ends and/or index matching gels with mechanical

Table 1: Optical splitting options

	Two-way	Four-way	Eight-way
Link distance	10-11 miles	7-8 miles	4-5 miles
Split loss	3.5 dB	7.0 dB	10.5 dB
Fiber/splice loss	7.0 dB	5.0 dB	3.0 dB
System loss	10.5 dB	12.0 dB	13.5 dB
Carrier-to-noise	54 dB	52 dB	51 dB

Table 2: Economic implications of optical splitting

	Two-way	Four-way	Eight-way
Node station unit cost	$10,000	$10,000	$10,000
× node quantity	× 2	× 4	× 8
Node station costs	$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

splices can reduce this reflection risk. In fact, recent data indicates that the latest generation of mechanical splices are capable of performance equal to fusion splices at the time of installation. Long-term performance in the field is being evaluated and initial results are promising. Such devices must withstand the tests of time—often in hostile outside environments. Temperature and vibration stresses could lead to deteriorated splice return loss from the time of original installation.

Except for temporary plant restoration purposes, there seems to be no dire need for mechanical splices. Unlike some fusion splicers designed in the early '80s, recently designed models are user friendly and make consistently low insertion loss splices.

The manufacturer of the splicer most often used by Jerrold tells us we should get splices with insertion loss of 0.1 dB or better. In practice, we have found the figure to be more like 0.05 dB or better. Our technicians really have to work at making "bad" splices for demonstration purposes. Then, the machine's built-in diagnostics inform the user of the problem.

Technicians can make relatively fast fusion splices with comparatively little training. New models will perform multiple splices simultaneously, speeding the process further. The materials cost per splice is negligible. The capital cost of the machines is significant at generally over $30,000 each. But every system need not own one since the significant fiber installation contractors have possession or ready access to the latest models.

Connectors

An all fusion spliced fiber link would be ideal for AM CATV performance. However, to ease system installation and maintenance, CATV may require quick connects and disconnects of the AM terminal equipment. The challenge is to minimize the reflection risk while achieving acceptable insertion loss.

Most connectors designed for less demanding digital telephony applications do not perform adequately. Most often, return loss is 40 dB or worse when we need 45-50 dB or better. At least one device (using a keyed, angle-polished design) achieves consistently good return loss (>50 dB), but poor and inconsistent insertion loss (0.7 dB or more).

New devices designed for our AM application appear to achieve 50 dB return loss with a maximum insertion loss at 0.4 dB and perform without the complication of index matching gel. Such devices are being assessed to confirm they will be consistent in volume.

Regardless of the connector model used, fiber ends must be properly cleaned for each new connect or reconnect. Dirt or fingerprints cause reflections and can kill AM fiber performance, particularly at the transmitter connection.

Mechanical consideration

For existing plant, you want to minimize the disruption while improving it with fiber. For new plant, you want to minimize the amount of new equipment, complexity and physical space required. Therefore, the little details must be considered when designing a system with AM fiber.

Headend space is at a premium. Higher power lasers allow use of optical splitters

"Whether for a new-build or a rebuild, AM fiber now can be deployed in most CATV systems."

and therefore cut down on the required transmitter rack space. Some transmitters house multiple plug-in laser modules and even return path optical receiver modules. Transmitters requiring lower RF drive inputs are less likely to require additional headend drive amplifiers. Systems using fewer fibers to carry the entire programming spectrum probably require less space. Fewer fibers also reduce the RF headend wiring complexity into the optical transmitters.

Practical considerations extend to the optoelectronic receiver too. For trunking (as opposed to supertrunking links of headends) a strand mountable, environmentally rugged station is preferred to product requiring environmentally controlled real estate. That station also must comply with RF ingress/egress standards. Some manufacturers offer optoelectronic receiver and electro-optic return path modules that plug into standard trunk and/or feeder amplifier stations. Also, a number of features are available from different manufacturers to accommodate the various dialects of backbone architecture (efficiency, path redundancy, etc.).

Current AM fiber systems, designed specifically for CATV trunking, now perform to the high standards required for commercial viability. True fiber backbones that deliver more and better broadband services to subs now are possible.

In addition to performance and economics, plant designers must incorporate a number of practical considerations into their decision making. The optical splitter is one valuable tool often overlooked until recently. Fusion splices are preferred over mechanical ones to best protect an AM fiber system from reflection risks. Connector manufacturers finally are closing in on the right combination of return and insertion losses. Designers also will choose solutions that are most compatible with existing plant and require the least real estate space.

Whether for a new-build or a rebuild, AM fiber now can be deployed in most CATV systems. Scientists have delivered the required lasers. Attention to the practical details of construction and maintenance will lead to our industry's full success in harnessing fiber technology.

March 1990

BACK TO BASICS

The training and educational supplement to Communications Technology magazine.

Spotlight on construction

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Formerly Installer/Technician

Basic aerial construction

By Bruce Liles
Owner, Casco Communications

Basic construction techniques are very important to all field personnel to keep the performance and appearance of your outside plant at its optimum. Let's go over the basic procedures for the construction of a new coaxial plant.

After a franchise area has been awarded, maps must be created showing streets, pole locations, strand routing, underground routing and footages. The system must then be designed for the proper amount of channels and equipment locations. The design is then drafted onto the strand routing maps. These routings must be verified through local utility companies and a "makeready" rideout of the area has to be done. (Makeready is a term used to describe the procedure of planning and preparing the utility pole space to be rented by your company).

Utility companies always require certain distances on each pole between their system and your planned cable TV system. The utility companies will raise or lower their equipment on poles that do not have the stipulated clearances. Each utility can set its own clearance specifications; some typical specifications are: 12 inches above telephone equipment, 40 inches below electric secondaries, 60 inches below electric primaries, 18 feet over roadways and 12 feet over residential driveways. (See Figure 1.) These are the basic specifications to reduce hazardous conditions, and may vary from the examples given here.

During the makeready rideout, the placement of guy wires and anchors also are noted on the maps. You should check with your construction department for a listing of specifications in your system. It is important for all field personnel to know these. While performing your duties you should be aware of violations of these clearances; they can cause very dangerous conditions.

Now you're ready

After you've completed the makeready, placed the guy wires and anchors, and secured all work permits, the construction crews can start placing the steel support strand and pole hardware. The strand is typically 1/4-inch galvanized steel and supplied on 5,000-foot reels. A 5/8-inch hole is drilled in the pole at the required distance from the other utilities. A 5/8-inch machine bolt is placed in the hole with a large square washer on each side of the pole.

Next the spacer nut is tightened to secure the bolt to the pole. Then as the strand is pulled from pole to pole it is placed into a "B" cable suspension clamp. The bolts are finger-tightened to allow the strand to slide through. Place the clamp and strand on the bolt through the middle hole in the clamp. Finger-tighten a second nut on the bolt to hold the clamp and strand in place. (See Figure 2.) At termination points the strand is tightened and secured at each end. When the strand installation is complete, placement of coaxial cable can begin.

Whoever places the coax in the system can make the outside plant look and perform at its best or look and perform like a system with years of weather and human abuse. The placement crew first selects a spacing of poles to install the cable on. The selection of the spacing comes from device location on the design maps. Beginning and ending points should be at device locations to avoid extra splices in the system.

Once the starting location has been selected, the placement of the cable reel trailer is very important. The trailer must be as level as possible with the center of the cable reel pointing straight at the cable guide or block attached to the strand. The trailer should be far enough back from the pole so that excessive downward pres-

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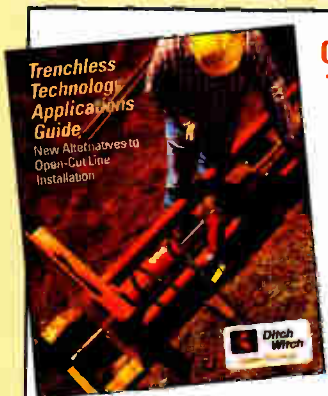

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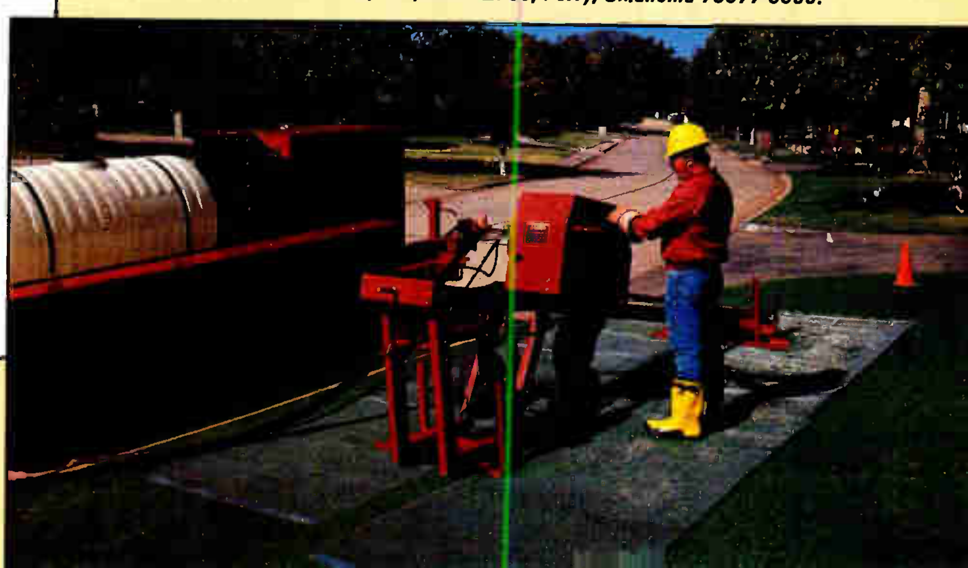

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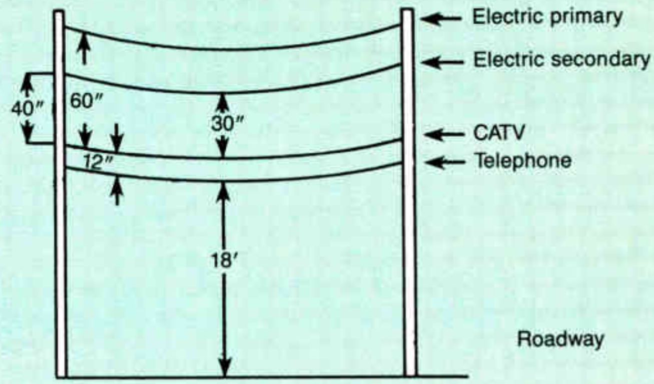
Figure 1: Typical utility pole clearances



sure is not put on the block or guide while the cable is being pulled out.

Pull, lash, bend

After properly adjusting reel brake tension, the cable is then pulled out along the strand from pole to pole to the termination point. As this is done, the coax will tend to sag. Cable blocks are placed every 30 to 50 feet and at each pole to keep the sag to a minimum. (See Figure 3.) At this time the loose nuts on the suspension clamp and machine bolt must be tightened at each pole to secure the strand.

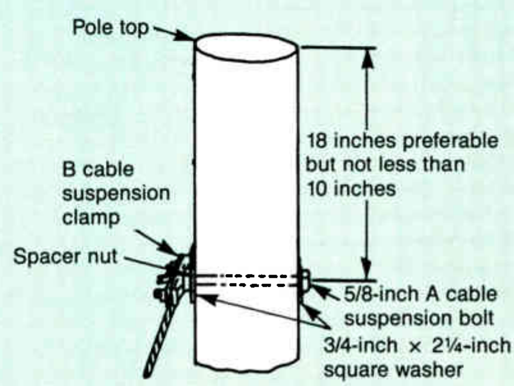
The pulling must be done slowly without sudden starts or stops. When it is not pulled at a slow and smooth speed, it bounces on the blocks and will tend to bend the coax at each block every time you start or stop. These bends stay and give your finished cable an irregular look (commonly called "wee-wahs").

When the cable is pulled out to its termination point, the process of securing the cable to the strand by "lashing" begins. A cable lashing machine is used in this procedure, which holds two reels of fine wire (called lashing wire). The lasher is loaded with wire, placed on the strand and the coax is placed in the slotted barrel. It is held in place by front and rear gates as in the accompanying photograph. The lashing wire is in holders on the outside of the barrel with the ends pulled through rollers to the rear of the lasher.

The wire is then secured to a lashing wire clamp placed on the strand. When the lasher is pulled away from the pole, wheels that ride on the strand spin the barrel. As the lashing wire is pulled from the spinning barrel it wraps around the cable and the strand, binding them together securely. At each pole the lasher has to be transferred from one side to the other. The lashing wire is secured on both sides of the pole to lashing clamps. (See Figure 4.)

Before the lasher is pulled to the next pole an expansion bend must be put in the coax. The purpose of these bends is to absorb the expansion and contraction of the aluminum in the coax caused by

Figure 2: Pole attachment for 6 m or 6.6 m suspension



temperature changes. The larger the diameter of the coax, the larger the bend has to be. In the past these bends were formed by hand, causing each line person to produce a bend different from the next. Although this practice (if done correctly) did not significantly affect the performance of the coax, it did affect the appearance. Today we have mechanical benders that make every bend identical. These new benders not only make bends look better, they also reduce the risk of deforming the coax and reducing the performance. The bends and the coax are then secured to the strand with spacers and straps to reduce damage to the coax from rubbing on the pole, strand or clamps.

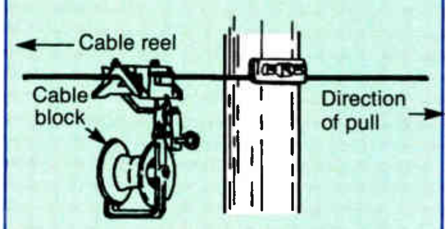
It is important to ensure that each span between poles has the proper amount of sag, usually in the 2 percent range. This means that for each 100 feet of span length, the midspan sag would be 2 feet. While clearance from other utilities may not always allow the necessary sag, it should be incorporated whenever possible. The correct sag also will help to compensate for cable expansion and contraction with temperature changes.

After the fact

After the coax is in place and the actives and passives are spliced in, the plant is activated and installs can begin. Assuming that your system was designed and constructed by competent people it is very important for installer/technicians to maintain the integrity of the outside plant.

Let's consider some of the procedures

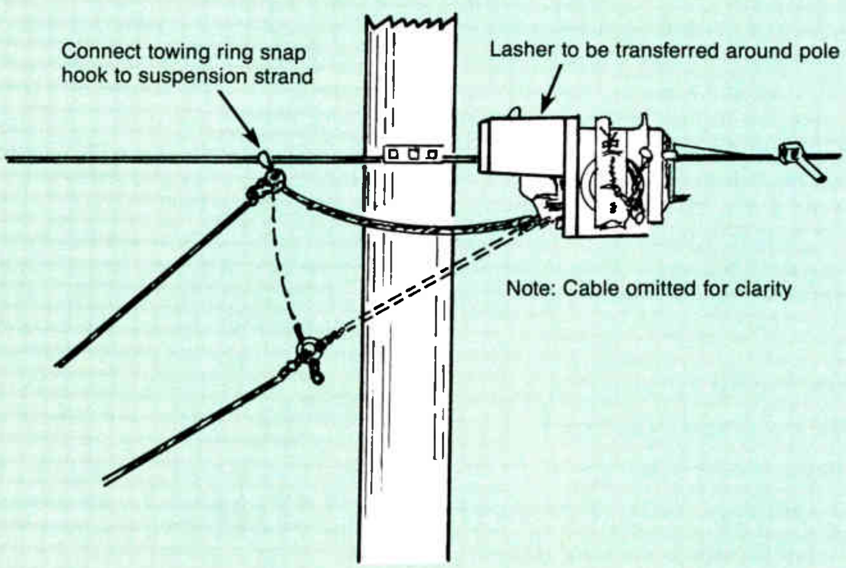
Figure 3: Cable block in place



installer/technicians go through to perform their duties. When you put your ladder up against the pole or system hardware, the placement of the ladder is very important. If you catch the expansion loop or a device with the hooks on the top of your ladder you could change the performance of the system from that point forward. Use care not to change the radius of the bends in the expansion loop. By pulling or pushing on the bottom of the loop you could kink or crack the outer aluminum sheath of the coax. A kink may eventually turn into a crack, and a cracked sheath will result in signal leakage and probable damage to the cable itself. When attaching a drop or checking connectors on a tap be careful not to twist and turn the tap housing; this may cause the same problems as moving an expansion loop.

By taking personal pride in your work and an extra few minutes to be careful and observant, your system will look good and perform at its peak. Remember, it can only be as good as you make it.

Figure 4: Method of D cable lasher transfer




Climbing a pole with hazards.


Attaching drop to strand.


Tossing a tennis ball for balance.

Pole climbing classes: Who needs 'em?

By Kenny Faust
Installation/Safety Director, Heritage Cablevision

Our supervisory staff had reached an unhappy conclusion: We did not have a full staff of technicians that could work from utility poles safely and confidently using climbers and climbing gear. In fact, it was determined that of the 22 people in the technical department, only three actually were certified in an organized training program. Almost everyone else had been taught in a manner that can best be described as "freestyle." From the cable veteran who spent six months in a telephone company's safety program, to the new hire from another system who was handed a set of climbers on the first day of his previous job and told to use them if he needed to, we had them all.

Once we were aware of the need for pole climbing training, what were we going to do about it? Send them off to a training center somewhere to learn the basics? It would take a long time to get a large number of technicians through an off-the-job program, not to mention the loss of productivity while they were away. Teaching one-on-one in the field sounded good, but again the problem of getting around to everyone in a timely manner and being consistent in the training arose.

In-house group training utilizing our back lot pole farm was the most attractive option. This pole farm consists of five full length utility poles of various diameters set 28 feet apart in an "L" pattern. The heights are marked in 5-foot increments. Two of the poles have PVC pipe attached to simulate real-life climbing hazards and two others are end poles with guy wires and anchors. All have strand attached at telephone height and lashed cable at CATV height.

The training area is a relatively flat, mowed lot that is only a stone's throw from the technical office's back door. This area also contains buried cable that is used in locator training classes.

The first step in getting the program on track was looking inside our organization for someone to take on the responsibility of being the instructor. The list was narrowed quickly to the three certified climbers. We finally decided on Randy Baker, our construction supervisor who had been trained and certified by the phone company. He had a lesson outline prepared almost immediately.

Taking the time

The next step was more difficult because it required finding time to give instruction. This is the biggest impediment to any training program a system wants to undertake. Installs can't wait, trouble calls must be run and maintenance be done. Where do you get that precious commodity called time?

We did it the old-fashioned way—we stole it. We usurped our weekly tech meeting and it became class time. We had techs come in an hour early to climb and then start their work day. We sent home material for them to study and made safe climbing our main safety topic for three months straight. Finally, we worked late to lighten the next day's workload for more class time.

"Our techs now climb with confidence and concentrate on the job at hand rather than nervously hanging onto every pole attachment in sight."

The end result of this thievery was 12 hours of actual supervised pole climbing, one hour of instructional video, countless hours of home study, two hours of classroom time and then the dreaded one-hour final exam.

On the pole

The hands-on climbing portion of instruction was the most critical. Eleven people took the course, which at first was held Wednesdays from 7:30-9 a.m. and then moved to Tuesdays and Thursdays from 7-9 a.m. to speed up the training process.

The first part of the training involved making sure everyone had the correct equipment in the proper sizes and condition. Next, they were shown how to wear the gear and make adjustments when necessary. The name and importance of each item was stressed, from the hard hat to the gaff points. The participants were allowed a 5-foot radius around the pole to put on and take off their hooks. No walking in homes or driving in gaffs for this bunch!

The first step onto the pole and last step off was demonstrated as an introduction to pole contact. Adjusting the safety strap for the diameter of the pole encountered was shown at this point. The required 30° angle for gaff penetration was mastered at the lower five feet of the pole before the student was allowed to progress higher. The majority of instruction during the first half of the course was at this height. In this "comfort zone" three pupils fell, but none was seriously injured and all learned valuable lessons. Belting and unbelting the safety strap was repeated at each level of achievement. Hitchiking was not taught in this course, but is planned for an advanced course.

Circling was done first on poles without hazards and then on the ones with PVC risers. Balance while belted off was taught by having the techs climb adjacent poles and tossing tennis balls to each other for 10 complete throws. When a ball was missed, both climbers came down, swapped poles and the process repeated. This lesson was conducted at the 10-foot level.

The final stages of training involved tying off drop cable to strand and using a handline to bring up material. Handline use was taught with the line attached to a bag full of lashing wire. Each climber had to raise the bag to working position while belted off and then return it to the ground. On the last day of class we had two techs at a time leapfrog each other on the pole and belt off to learn how to work together on a pole simultaneously.

At no time were the students encouraged to take unnecessary risks or cut corners during their climb. Correct form and positioning were the criteria for a good grade. Speed of ascending or descending was not a factor. Each person climbed at a pace that was comfortable; they naturally acquired more speed as confidence increased.

A class act

Classroom instruction included two hours of time spent examining the National Cable Television Institute's pole climbing lesson from the Installer course. We also reviewed the field instruction and presented an overview of the purpose and goals of the class. In addition, the Society of Cable Television Engineers' video, "Confident climbing" (classroom and field version) was shown and discussed.

The final exam was comprehensive and home study of the printed material encouraged. Despite this fact, half the class failed the first time the written exam was administered. The group that failed had to undergo further training and retesting before they passed the second exam. No one was exempt from this requirement. This increased the value of the course because everyone had to earn the completion certificate instead of just attending class.

All of this was for a nominal cost to the company. The incentives for techs to take this course were pay for time spent in the instruction; the certificate signed by the vice president of operations, general manager, chief tech and instructor; and the increase in the graduates' valuable, marketable skills.

The driving factors for success were organization and consistency. Definite times were set for instruction and adhered to, come outages or high water. It took a commitment from everyone from the general manager to the rookie installer to make it work.

Instant results

The benefits were realized immediately. Our techs now climb with confidence and concentrate on the job at hand, rather than nervously hanging onto every pole attachment in sight. I breath a sigh of relief whenever I see an employee negotiate a difficult maneuver on a particularly high pole. The most important benefit is the sense of accomplishment each student who completes the course has. The climbing certificates lining the tech room walls are icing on the cake.

Who needs pole climbing classes? Look around, but don't be surprised to find out the answer is you. ■

OSHA's gonna get you if you don't watch out

By Ralph Haimowitz
Director of Chapter Development and Training
Society of Cable Television Engineers

A recent issue of *Safety and Health* magazine, published by the National Safety Council, had some articles about what we can expect from the Occupational Safety and Health Administration (OSHA) in the 1990s. In general, expect much stronger regulation in some areas and stiffer fines. There are several of these that directly affect cable TV companies and their employees.

Every cable company is required to maintain an OSHA Log of Illness and Injuries. Faulty recordkeeping has shown many companies fail to maintain the log properly by recording all employee illnesses and injuries. In many cases these omissions involve failure to record what is known as "repetitive motion trauma." Often, when a violation of recordkeeping occurs in this area, it results in OSHA initiating what they call an ergonomics investigation.

Ergonomics means cumulative motion trauma and includes various neurological and musculo-skeletal problems primarily of the upper part of the body, such as tendonitis, tenosynovitis, epicondylitis and carpal tunnel syndrome. One of the catches here is that all such problems, except for back problems, are regarded by OSHA as an illness, not an injury. All back problems, however, are regarded as injuries, regardless of the cause.

Caution: Hazardous materials

Another area that we need to be careful of is hazardous material communications and training. This is another area we frequently overlook or just plain ignore. Perhaps the problem is we don't really understand what hazardous materials are and don't believe we have any to worry about. In most cases, however, this is not true.

Some hazardous materials we may come into contact with in our day-to-day operations are flammable liquids stored in drums, cleaning solvents used in converter or equipment repair, materials that are on the OSHA list for maintenance of standby power supply batteries, or wherever we use solder. To find out if your organization is using any materials that are on the hazardous materials list I suggest that you contact the National Safety Council at (800) 621-7619.

The area of hazardous material communications and training is so important to the industry because OSHA now conducts the employer's program as a part of every inspection. This includes a review of the employer's written program, looking for unlabeled hazardous material containers and asking employees questions about their knowledge of the program and the training they have received.

There are two types of violations: *willful* violations and *egregious willful* violations. Any violation of the Hazard Communications Standard is considered serious by OSHA, and serious violations always carry a penalty. Willful violations could incur fines up to $10,000. Egregious willful violations have a maximum possible fine of $10,000 per incident. In the Hazardous Materials Program, the violations count in such a way that the fine is maximized. The example given in *Safety and Health* shows that in the failure to train 100 employees under an egregious willful violation each employee is a separate case. Therefore, if the fine is $10,000, the multiplier is 100, for a total fine of $1 million! This, of course, is worst-case, but why take chances when a little preparation and care can eliminate the problem?

Criminal negligence

Another issue that should be of great concern for this industry is that the U.S. Supreme Court recently upheld a lower court ruling that allows states to file criminal charges against employers accused of neglecting workers' safety and health. Why does this concern me so much? Every time I think about the number of technicians who are issued ladders and pole climbing equipment, but do not receive adequate training from qualified individuals, I see the potential for a strong case of criminal negligence. From one end of this country to another, one of the problem areas most discussed by technicians and engineers I meet is the inadequate training in these areas.

The SCTE has tried to provide as much help as possible in these areas through safety meetings at local chapters and meeting groups, and videotapes available through our publications and tape catalog. This training is excellent and necessary, but it does not do the complete job.

"Using an unqualified trainer could easily be determined to be a case of employer negligence."

Since the SCTE is not an operating cable company under a blanket liability insurance policy, we could not find an insurance company that would reasonably provide a special policy to cover hands-on training in pole and ladder climbing and use. This type of training must be performed at the system level.

There are a couple of major concerns about this training. First, many companies say, "We don't have our people climb poles. We use bucket trucks or ladders." Without even addressing the proper training in the loading, unloading, setup and use of extension ladders, there are always a few places in a system where you cannot get a bucket truck or extension ladder in position to do the needed work. This type of problem is usually caused by interconnecting fences or trees and shrubbery blocking accessability to the pole, and the only way to get there is to climb.

Second, if you have a training program for ladders and pole climbing in your system, what are the qualifications of the person doing the training? Using an unqualified trainer could easily be determined to be a case of employer negligence. Just because a trainer has been climbing for 10 years does not make that individual qualified. Some of the major MSOs, such as ATC and Continental, have established training schools with qualified trainers, and provide a train-the-trainer course to qualify trainers at the local system level.

Another great source of the necessary training has recently been made available through the Atlee Cullison Training School in New Jersey. Through a recent agreement with the SCTE, Atlee Cullison will provide a four-day pole climbing course for $300 per person (limited to six trainees), and a one-day course on extension ladders for $75. If the trainee is signed up for both courses consecutively the total cost is reduced to $325.

One advantage that Cullison offers is that he prefers to do the training at the system location. Prices remain the same, but you only have to pay for the trainer's travel and expenses instead of the cost for six people to attend the school in New Jersey. The local system, of course, also would provide a classroom area, poles, ladders, climbing equipment, a VHS tape player and monitor, and a video camera to record the students' progress and skills.

I strongly urge you to obtain qualified training and trainers if they are not already available to you. There is no acceptable excuse if you fail to protect your employees' health and safety because you did not provide them with the proper equipment and training. The training sources are:

- ATC National Training Center
  2180 S. Hudson St.
  Denver, Colo. 80222
  Phone: (303) 753-9711
- Continental Regional Training Center
  180 Greenleaf Ave.
  Portsmouth, N.H. 03801
  Phone: (603) 436-7161
- Atlee Cullison Training School
  Route 581, Box 167-D
  Mullica Hill, N.J. 08062
  Phone: (609) 478-4134 ■

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2) Jim Castelli, "SH Watch," *Safety and Health*, December 1989.

A guide to fiber lingo

By Todd Jennings
Product Specialist, Siecor Corp.

- *Attenuation*—Optical power loss between two points. Measured as a ratio of light input to light output in dB or dB/km. The term dB is used as the unit of measure for total system loss for a given length of fiber. The term dB/km is used as a fiber specification.
- *Cladding*—The material surrounding the core of an optical fiber consisting of glass with optical properties to contain light in the core.
- *Core*—The center of the fiber. It carries the light and is surrounded by the cladding.
- *Connector*—A mechanical junction allowing the user to quickly and easily connect or disconnect a fiber to a transmitter, receiver or another fiber.
- *dB (decibel)*—The standard unit used to express the logarithmic ratio between two optical power levels.
- *dBm*—The standard unit used to express an absolute optical power level relative to 1 milliwatt; 0 dBm = 1 mW. Positive dBm indicates a power greater than 1 mW and negative dBm indicates power less than 1 mW.
- *Dispersion*—A measure of the spreading of the light pulse in a fiber specified in ps/nm-km. It is a function of the fiber design, length and laser spectral width.
- *Micron*—A measure of length equal to one millionth (10^{-6}) of a meter or also defined as a micrometer (μm). Used to designate core and cladding size.
- *Mode*—A light path through a fiber.
- *Multimode*—An optical fiber in which light travels in multiple modes or paths.
- *Nanometer*—Unit measure of length equal to a billionth of a meter. Used to designate wavelength of light.
- *Optical power meter*—Optical test equipment that measures the optical power level in dBm or μW.
- *Optical time domain reflectometer (OTDR)*—Optical test equipment that characterizes a fiber via a laser pulse transmitted down the fiber, resulting in backscatter. Backscatter and reflections are measured as a function of time and displayed as attenuation vs. distance. The OTDR successfully measures loss and distance of fiber, splices, connectors and other components. It also identifies and locates faults and breaks.
- *Return loss*—The log ratio of reflected light to transmitted light measured in dB.
- *Single mode*—An optical fiber in which light travels in one mode or path.
- *Splice*—The physical or mechanical joining of two optical fibers for permanent connection.
- *Wavelength*—The distance between the crests of the light waveform. Typically thought of as the "color" of light or corollary of electrical frequency and measured in nanometers. Standard wavelengths for single-mode are 1,310 and 1,550 nm. ■

Converting dBmV to μV/m

By Ron Hranac

Channel 39 or CC (313.2625 MHz)

dBmV	μV/m	dBmV	μV/m	dBmV	μV/m	dBmV	μV/m
−60	6.58	−36	104.26	−10	2080.31	16	41507.61
−59	7.38	−35	116.98	− 9	2334.14	17	46572.30
−58	8.28	−34	131.26	− 8	2618.95	18	52254.98
−57	9.29	−33	147.27	− 7	2938.51	19	58631.05
−56	10.43	−32	165.24	− 6	3297.07	20	65785.13
−55	11.70	−31	185.41	− 5	3699.37	21	73812.12
−54	13.13	−30	208.03	− 4	4150.76	22	82818.57
−53	14.73	−29	233.41	− 3	4657.23	23	92923.96
−52.84	**15**	−28	261.90	− 2	5225.50	24	104262.40
−52	16.52	−27	293.85	− 1	5863.11	25	116984.33
−51	18.54	−26	329.71	0	6578.51	26	131258.58
−50	20.80	−25	369.94	1	7381.21	27	147274.55
−49	23.34	−24	415.08	2	8281.86	28	165244.76
−48	26.19	−23	465.72	3	9292.40	29	185407.67
−47	29.39	−22	522.55	4	10426.24	30	208030.83
−46	32.97	−21	586.31	5	11698.43	31	233414.43
−45	36.99	−20	657.85	6	13125.86	32	261895.30
−44	41.51	−19	738.12	7	14727.46	33	293851.36
−43	46.57	−18	828.19	8	16524.48	34	329706.65
−42.38	**50**	−17	929.24	9	18540.77	35	369936.94
−42	52.25	−16	1042.62	10	20803.08	36	415076.08
−41	58.63	−15	1169.84	11	23341.44	37	465723.02
−40	65.79	−14	1312.59	12	26189.53	38	522549.82
−39	73.81	−13	1472.75	13	29385.14	39	586310.54
−38	82.82	−12	1652.45	14	32970.66	40	657851.25
−37	92.92	−11	1854.08	15	36993.69		

Channel 40 or DD (319.2625 MHz)

dBmV	μV/m	dBmV	μV/m	dBmV	μV/m	dBmV	μV/m
−60	6.70	−36	106.26	−10	2120.15	16	42302.61
−59	7.52	−35	119.22	− 9	2378.85	17	47464.31
−58	8.44	−34	133.77	− 8	2669.11	18	53255.84
−57	9.47	−33	150.10	− 7	2994.80	19	59754.03
−56	10.63	−32	168.41	− 6	3360.22	20	67045.13
−55	11.92	−31	188.96	− 5	3770.22	21	75225.87
−54	13.38	−30	212.02	− 4	4230.26	22	84404.81
−53.01	**15**	−29	237.89	− 3	4746.43	23	94703.76
−53	15.01	−28	266.91	− 2	5325.58	24	106259.36
−52	16.84	−27	299.48	− 1	5975.40	25	119224.97
−51	18.90	−26	336.02	0	6704.51	26	133772.61
−50	21.20	−25	377.02	1	7522.59	27	150095.34
−49	23.79	−24	423.03	2	8440.48	28	168409.74
−48	26.69	−23	474.64	3	9470.38	29	188958.84
−47	29.95	−22	532.56	4	10625.94	30	212015.30
−46	33.60	−21	597.54	5	11922.50	31	237885.08
−45	37.70	−20	670.45	6	13377.26	32	266911.45
−44	42.30	−19	752.26	7	15009.53	33	299479.57
−43	47.46	−18	844.05	8	16840.97	34	336021.61
−42.55	**50**	−17	947.04	9	18895.88	35	377022.44
−42	53.26	−16	1062.59	10	21201.53	36	423026.14
−41	59.75	−15	1192.25	11	23788.51	37	474643.14
−40	67.05	−14	1337.73	12	26691.15	38	532558.36
−39	75.23	−13	1500.95	13	29947.96	39	597540.31
−38	84.40	−12	1684.10	14	33602.16	40	670451.25
−37	94.70	−11	1889.59	15	37702.24		

Channel 41 or EE (325.2625 MHz)

dBmV	µV/m	dBmV	µV/m	dBmV	µV/m	dBmV	µV/m
−60	6.83	−36	108.26	−10	2160.00	16	43097.62
−59	7.66	−35	121.47	− 9	2423.56	17	48356.33
−58	8.60	−34	136.29	− 8	2719.28	18	54256.69
−57	9.65	−33	152.92	− 7	3051.08	19	60877.01
−56	10.83	−32	171.57	− 6	3423.37	20	68305.13
−55	12.15	−31	192.51	− 5	3841.08	21	76639.61
−54	13.63	−30	216.00	− 4	4309.76	22	85991.06
−53.17	**15**	−29	242.36	− 3	4835.63	23	96483.55
−53	15.29	−28	271.93	− 2	5425.67	24	108256.33
−52	17.16	−27	305.11	− 1	6087.70	25	121465.60
−51	19.25	−26	342.34	0	6830.51	26	136286.64
−50	21.60	−25	384.11	1	7663.96	27	152916.13
−49	24.24	−24	430.98	2	8599.11	28	171574.72
−48	27.19	−23	483.56	3	9648.36	29	192510.00
−47	30.51	−22	542.57	4	10825.63	30	215999.77
−46	34.23	−21	608.77	5	12146.56	31	242355.73
−45	38.41	−20	683.05	6	13628.66	32	271927.60
−44	43.10	−19	766.40	7	15291.61	33	305107.79
−43	48.36	−18	859.91	8	17157.47	34	342336.57
−42.71	**50**	−17	964.84	9	19251.00	35	384107.95
−42	54.26	−16	1082.56	10	21599.98	36	430976.20
−41	60.88	−15	1214.66	11	24235.57	37	483563.25
−40	68.31	−14	1362.87	12	27192.76	38	542566.89
−39	76.64	−13	1529.16	13	30510.78	39	608770.07
−38	85.99	−12	1715.75	14	34233.66	40	683051.25
−37	96.48	−11	1925.10	15	38410.79		

Channel 42 or FF (331.275 MHz)

dBmV	µV/m	dBmV	µV/m	dBmV	µV/m	dBmV	µV/m
−60	6.96	−36	110.26	−10	2199.93	16	43894.28
−59	7.81	−35	123.71	− 9	2468.36	17	49250.20
−58	8.76	−34	138.81	− 8	2769.54	18	55259.63
−57	9.83	−33	155.74	− 7	3107.48	19	62002.32
−56	11.03	−32	174.75	− 6	3486.65	20	69567.75
−55	12.37	−31	196.07	− 5	3912.08	21	78056.30
−54	13.88	−30	219.99	− 4	4389.43	22	87580.61
−53.33	**15**	−29	246.84	− 3	4925.02	23	98267.06
−53	15.57	−28	276.95	− 2	5525.96	24	110257.45
−52	17.47	−27	310.75	− 1	6200.23	25	123710.90
−51	19.61	−26	348.66	0	6956.78	26	138805.91
−50	22.00	−25	391.21	1	7805.63	27	155742.79
−49	24.68	−24	438.94	2	8758.06	28	174746.29
−48	27.70	−23	492.50	3	9826.71	29	196068.56
−47	31.07	−22	552.60	4	11025.75	30	219992.54
−46	34.87	−21	620.02	5	12371.09	31	246835.69
−45	39.12	−20	695.68	6	13880.59	32	276954.20
−44	43.89	−19	780.56	7	15574.28	33	310747.72
−43	49.25	−18	875.81	8	17474.63	34	348664.68
−42.87	**50**	−17	982.67	9	19606.86	35	391208.21
−42	55.26	−16	1102.57	10	21999.25	36	438942.83
−41	62.00	−15	1237.11	11	24683.57	37	492501.95
−40	69.57	−14	1388.06	12	27695.42	38	552596.28
−39	78.06	−13	1557.43	13	31074.77	39	620023.22
−38	87.58	−12	1747.46	14	34866.47	40	695677.50
−37	98.27	−11	1960.69	15	39120.82		

(For the formula used to derive the conversion data in these charts, see May 1989 *Installer/Technician*'s "Installer's Tech Book.")

Hands On

dB or not dB?

By Jud Williams
Owner, Performance Technologies

Probably the most important measurement to be made in cable TV is signal strength. Fortunately a very simple system was established by the telephone companies some time ago and has been adapted by our industry, both of which use the decibel.

"By simple addition and subtraction...we can determine what is needed to set our levels properly."

The interesting thing about this measurement system is that it deals in relationships some of the time and absolutes the rest of the time. This leads to some confusion, which certainly needs clarification. We refer, of course, to the designation *dB vs. dBmV*.

dBmV

Let's explore the decibel millivolt (dBmV) first since it deals in absolutes similar to using a regular voltmeter. In fact, when measuring in dBmVs we are measuring voltage. This voltage is different from the usual concept of voltmeter measurements in that it is expressing a ratio to a reference. The dBmV is not a true unit of voltage; technically it is a unit of power expressed in terms of a voltage. In CATV, it refers to measurements made across a 75 ohm impedance. This contrasts with the normal voltmeter since it doesn't matter what the voltage source is, although in order to make a measurement using a standard voltmeter the impedance (or resistance) of the potential being measured must be something less than the input impedance of the meter being used. This is necessary so the meter does not load the circuit under test (thus producing an erroneous reading.)

We said earlier that dBmV measurements are used in systems that have a constant impedance of 75 ohms. Way back when, it was established that 0 dBmV would be a potential of 1 mV measured across 75 ohms. It was found that such a signal level would produce a noise-free signal at the input of a standard black and white TV receiver. If the signal was less than 1 mV, there would be traces of noise detectable on the TV screen.

Instead of constantly referring to voltage levels in the system as so many millivolts or microvolts of signal, we use a meter that says it in dBmVs instead. The reason this is so convenient is that by making our reading in dBmVs, we are in effect saying that the signal level is twice as much as our reference, or maybe half as much as our reference (or whatever the case may be.)

As an example, let's say that we are measuring a signal level of 6 dBmV. That is approximately twice the voltage of the 0 dB reference level referred to earlier. If our meter tells us that a particular signal level is 20 dBmV, then it is telling us that the signal's voltage is 20 dB—or 10 times—more than 0 dBmV. See how simple it is to determine how much greater a signal is by using terms such as twice as much or 10 times as much of some value?

It is sort of like how speed is described these days. We hear that something moves at the speed of sound. Then we hear of something moving at twice the speed of sound. That is like saying that the speed of sound is 0 dBmph (dB-miles per hour) and twice the speed of sound is 6 dBmph (actually 6.02 dBmph). If something were to move at half the speed of sound we would of course say that it was going –6 dBmph. So it is in our systems' measurements. We can go either plus or minus and the concept is still the same. We talk about something being twice as much or half as much, and we know that we are saying ±6 dBmV.

Some other examples of approximate dBmV equivalents are:

6 dBmV	=	twice as much
12 dBmV	=	four times as much
18 dBmV	=	eight times as much
20 dBmV	=	10 times as much
40 dBmV	=	100 times as much
46 dBmV	=	200 times as much (Note: By adding 6 dB to 40 dBmV, we see 46 dBmV is twice as much as 40 dBmV.)
60 dBmV	=	1,000 times as much

So there you have it. Using dBmVs is

really simple when you think about it. By the way, when we use this chart for determining the amount of gain or loss for dBmVs, the same applies for ordinary dBs. Remember, we have been talking about a concept that has a reference so that we always were talking about dBmVs being derived from the absolute of 1 mV measured across 75 ohms.

dB

Now we will go to the ordinary dB or decibel. When we eliminate the mV from dBmV, we are left with a rather different concept. We are no longer working with an absolute value such as used in measuring potential (voltage).

We are now going to think in terms of what are called gain and loss. We know when we talk about amplifiers, we are referring to devices that amplify or have gain. When we talk about a passive device such as a splitter or attenuator, we are talking about loss. Loss in this case means that the signal on the output side of the device is less than on the input. The question is: How much loss or gain does a certain device have?

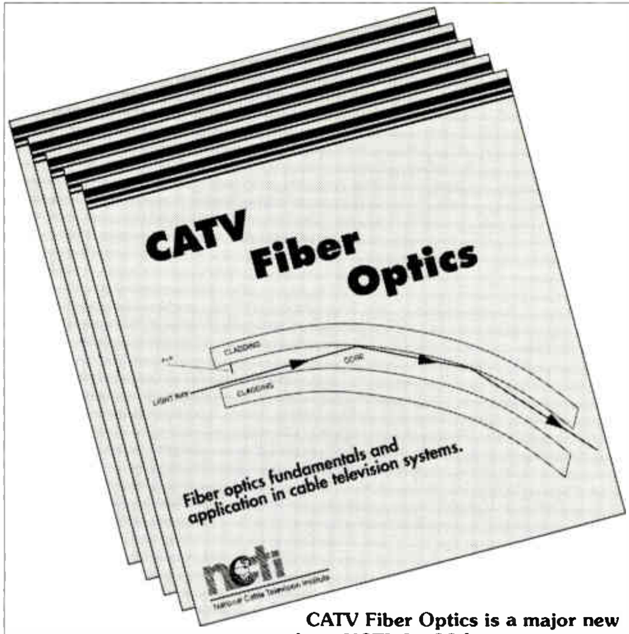
Here's where the dB comes into play. Let's say we are confronted with a situation where we have −20 dBmV of signal at a certain point. (Note that we said dBmV here.) And let's say that we need +20 dBmV. It is easy to see that we need an amplifier that has a gain of 40 dB.

From the example, we see we are talking about the gain as being the amount needed to make up for the loss we have at this particular point. Determining the required gain becomes simple addition. The amount of gain required to go from −20 dBmV to +20 dBmV is 40 dB.

Let's look at another example. When designing a 75 ohm system, we often begin at the final destination of the system. By definition, the final TV set to receive a signal needs a 0 dBmV level to have a noise-free picture. Here we make our measurement in terms of dBmVs to determine the required voltage level at this point. The subscriber's house is connected to a tap by a length of cable that presents a loss of so many dBs. The tap itself has what is called insertion loss. The length of feeder cable between the tap and the closest amplifier again has losses designated in dBs. The amplifier has a particular gain, also specified in dBs. The signal at the amplifier location would be measured in so many dBmVs.

We now have two points where it is relevant to know the signal level in absolute terms, so we use the dBmV. The difference between these two dBmV level readings indicates the loss that takes place between the amplifier location and the subscriber. The loss may be determined by subtracting the subscriber reading from the amplifier output reading. If the level at the subscriber is less than 0 dBmV, then we know that the gain of the amplifier must be increased to bring it up to that level, or the losses between the amplifier and the subscriber reduced to raise the level.

If for example, the level at the subscriber is −6 dBmV, then we know that the amplifier must be adjusted so that it will have 6 dB more gain. If there is enough excess gain in the amplifier, replacing the existing attenuator pad with one with 6 dB less loss should rectify the problem, assuming, of course, that doing so would not be a "quick fix" for a different problem. Alternatively, the loss between the amp and the subscriber could be reduced 6 dB to achieve the same result. But is it really necessary to know that 6 dB is twice as much gain or twice as much loss? Maybe not. What is important is we know, by simple addition and subtraction, that we can determine what is needed to set our levels properly. ■



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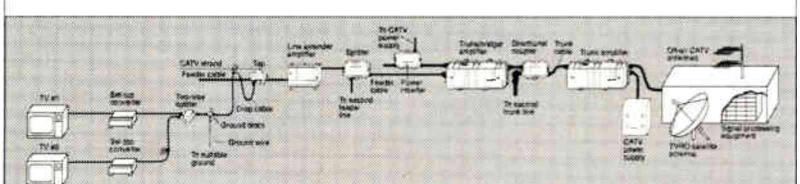

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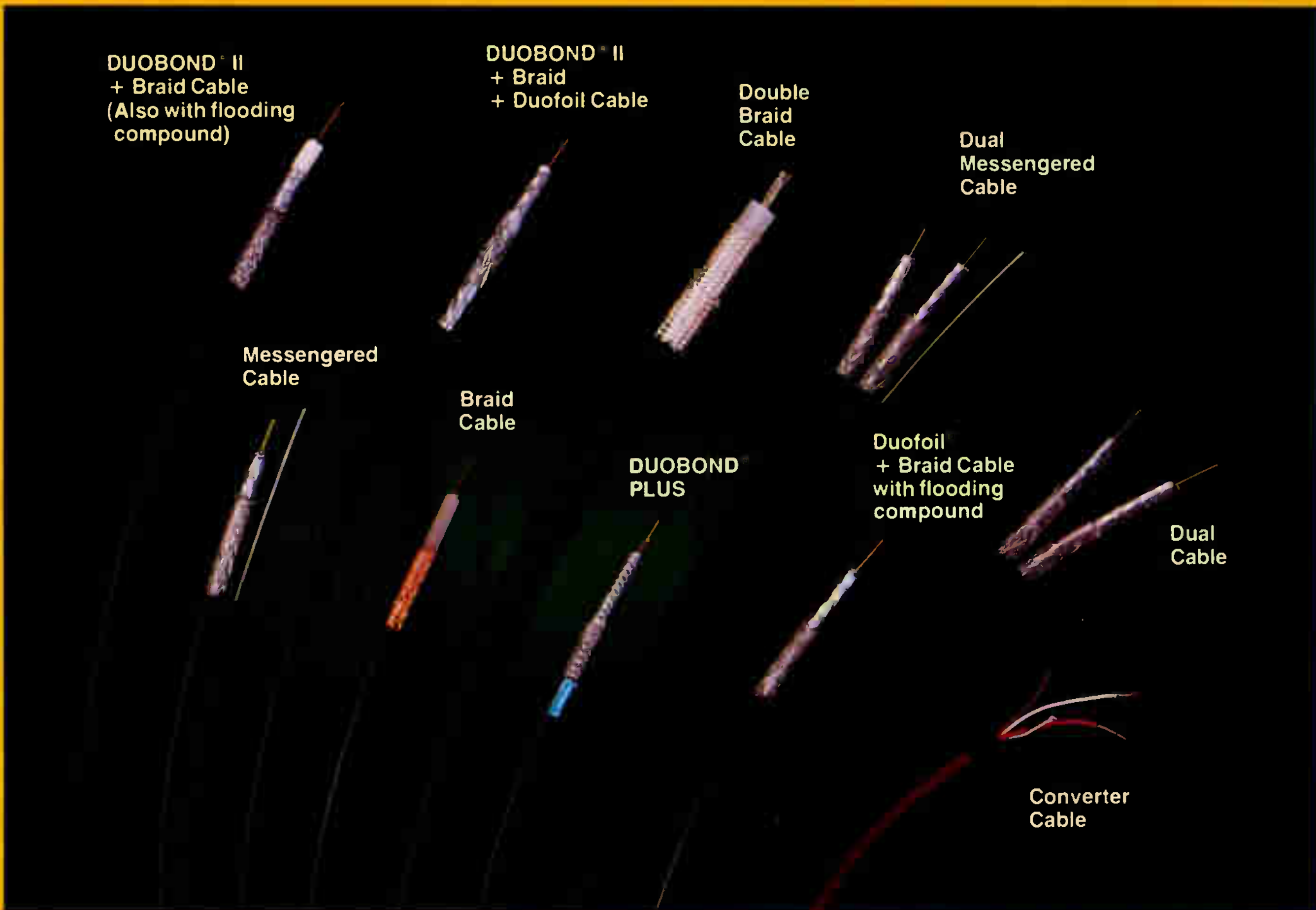
Reader Service Number 61.

When yesterday isn't good enough.



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Reader Service Number 62.

Satellite receiver

Standard Communications announced its C-band/Ku-band multiformat satellite rebroadcast reception system. It incorporates a PLL RF (phaselock loop radio frequency) center and audio subcarrier tuning and front panel indications of satellite format, channel number, upper/center/lower transponder plus antenna polarity, audio subcarrier frequency and six IF (intermediate frequency) bandwidths.

According to the company, the operator only has to select the transponder number and satellite format due to the automatic tuning. Then, the EPROM satellite format takes over and sets satellite RF center frequency, full/half transponder channel spacing, up to six 70 MHz IF filters, antenna polarity, audio center frequency with three selections of audio IF bandwidth and audio de-emphasis, video polarity and C/Ku-band relays.
Reader Service # 119.

FO magazine

The current issue of Corning's *Guidelines* magazine discusses the benefits of using optical fiber in CATV systems and forecasts the future of fiber in the industry.

Included in this issue is an article on differences in AM and FM fiber-optic transmission, a pocket guide to optical cable manufacturers that lists companies from which you can purchase cabled optical fiber and a step-by-step guide on how to specify fiber from those cable manufacturers.

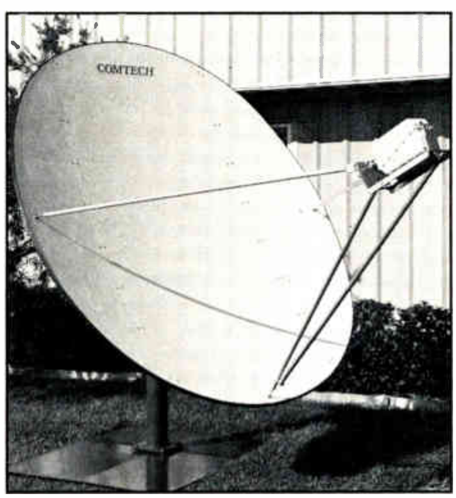
The magazine is published by Corning for customers, end users and those interested in the optical communications industry.
Reader Service # 120.

Demod board, firmware upgrade

Tektronix announced an option to its Model 751 BTSC aural modulation monitor/decoder and an upgrade to its Model 1780R series video measurement set.

With the Option 01 4.5 MHz demodulator board installed, the Model 751 accepts a 4.5 MHz aural carrier with or without video present. According to the company, this allows outputs from a number of demodulators, modulators and BTSC encoders to feed the Model 751. Also with the option installed, the Model 751 can accept the Tektronix 1450-1 demodulator's 4.5 MHz aural intercarrier output, which makes it possible for the demodulator and the Model 751 to be placed a considerable distance apart without appreciable line loss or possible ground loop problems.
Reader Service # 121.

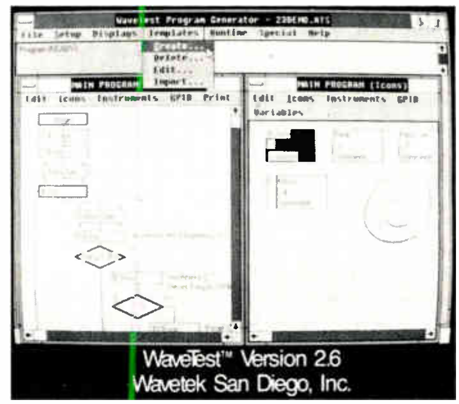
The latest firmware upgrade allows the Model 1780R series video measurement set to use electronic graticules to perform K-factor, short time distortion and ICPM measurements. After installation of the upgrade, the Model 1780R then displays electronic graticules accompanied by numeric readouts for both new measurements. According to the company, unlike fixed graticule lines, the electronic graticules change size incrementally to fit the waveform, eliminating the need to estimate the amount of distortion when the trace falls between the fixed lines.
Reader Service # 122.



VSAT antenna

Comtech Antenna Systems announced its 2.4-meter VSAT satellite antenna system that uses a three-piece composite reflector. According to the company, the reflector is manufactured in one piece and then cut for ease of installation.

The 2.4-meter antenna employs an offset feed system that is said to comply fully to the Federal Communications Commission's requirements. Transmit/receive and receive-only feeds are available and optional interface HPA brackets were designed for compatability with various manufacturer's products. The elevation over azimuth mount is available for ground or roof-mount applications.
Reader Service # 123.



Software

The WaveTest Version 2.6 software application program announced by Wavetek is a complete and modular environment for VXI and GPIB test program development. The product allows direct VXI instrument control using computer generated front panels. After the initial configuration setup it handles all communication protocols and details, and VXI and GPIB instruments can be supported in one system using the same controller.

WaveTest is an icon-based programming environment that runs under Microsoft Windows and generates automatic test programs. The syntax-free programming allows the user to develop and edit test programs using flowcharts or modules, which according to the company allows a productivity boost of up to five times faster than writing test patterns in BASIC.
Reader Service # 124.

Suppress option

Lindsay Specialty Products began installing the Alpha Technologies ACL amp clamp surge suppressor in its Model LPD-100 power delays and LPI-100 power inserters to protect them from surges or transients. According to Lindsay, the amp clamp provides handling capability, fast response time and small size.

The clamp shunts surge current to ground when the trigger point (104-115 volts) is reached, protecting the distribu-

tion electronics from overvoltage conditions. It operates at a steady state of 35 amps and can withstand single cycle (8 ms) pulse ratings of 500 amps.
Reader Service # 125.

Traps

Microwave Filter has added the hyperband traps 5KV to its Fastrap line of negative, positive and tiering filters for 54-300 MHz. The product comes weatherized with type F male/female connectors for 75 ohm impedence. Bandwidth is up to 550 MHz and channels available are AA (300-306 MHz) to NN (378-384 MHz). One upper adjacent and two lower adjacent channels are sacrificed using this trap.
Reader Service # 126.

Cable locator

The Model 480B pipe and cable locator introduced by Metrotech features a passive 50/60 Hz operating mode that permits the operator to verify the location of energized power lines by tracing the electromagnetic field generated by those lines. The dual coil design is said to enable it to distinguish between underground and overhead power lines.

A no-drift response is provided by the crystal control design and the narrow noise bandwidth of the transmitter. An automatic battery test feature measures the amount of voltage present in the batteries and automatically displays the value on the meter when the product is turned on. It also features an automatic shut off with a time-out alert.
Reader Service # 127.

Optical meter

Antritsu introduced the Model MF91A that measures the wavelength and optical power of light-emitting diodes and employs three plug-in modules to handle wavelengths from 400 to 1,600 nm. It accepts plug-in modules Model MH930 for 400 to 800 nm, Model MH931 for 600 to 1,000 nm and Model MH932 for 1,000 to 1,600 nm.

Wavelength measurement accuracy is ±0.5 percent with any of the modules. The power level measurement range is −60 to +10 dBm, with ±0.3 dB level accuracy and measured power can be displayed in watts or dBm.
Reader Service # 128.

Fusion splicers

The Models M90, M91 and M92 fusion splicers introduced by Siecor are said to offer productivity advantages to make fusion splicing a cost-efficient splicing solution. The M90 unit has both LID-System unit and profile alignment for all types of fibers. The M91 unit's projection screen with 30 times magnification allows the user to preset Z-alignment and check fiber cleaves. The M92 unit features automatic fiber feed and fixed V-groove alignment.

All three units are designed for actual field use conditions and standard 110/220 VAC power is used. The M90 has a built-in rechargeable battery pack and the M91 and M92 have an optional rechargeable 12 VDC power supply.
Reader Service # 129.

Low pass filter

North Hills Electronics' new video low pass filter is designed to pass the entire video band (0-4.2 MHz) and suppresses the audio carrier (4.5 MHz) and higher frequencies. It has a 30 dB stopband from 4.5 to 1,000 MHz and is available from stock.

It is available in both 50 ohm and 75 ohm impedences and in either BNC or type F connectors.

Reader Service # 130.

FO line expanded

Gould announced a new line of fiber-optic connectors, cable assemblies, adaptors and receptacles to complement its existing product line of fiber couplers and wavelength division multiplexers/demultiplexers. This line includes connectors in both single-mode and multimode styles and features low insertion loss and high stability, according to the company.

Assemblies are available in a variety of CATV diameters including 3.0 mm and 0.9 mm versions and lengths specified by the customer.

Reader Service # 131.

Amp monitor

The Model TMC-8052 amplifier monitoring and control transponder for C-COR's trunk amplifier was announced by AM Communications. The product is controlled by the LANguard operating system and software. It is a plug-in replacement for C-COR's SMT 3000 series monitor.

Reader Service # 132.

FO stripping kit

Klein Tools' kit for stripping fiber-optic cable has a selection of components for stripping both jackets and buffer/coatings. It includes two stripper-handle assemblies, seven different tube guides and five different sets of stripping blades ranging in diameter from 0.0063 to 0.054 inches. Also included is a cleaning brush and blade push-out tool.

One handle assembly is designed for buffer/coatings ranging from 0.0050 to 0.0096 inches in diameter and has a built-in fiber support channel that guides the cable in a straight line path to prevent damage to the core from flexing or bending while stripping. The other assembly is designed for stripping fiber jackets and has a calibrated cable support channel that measures stripped lengths.

Reader Service # 133.

Catalog

L-com is offering its 1990 catalog of interconnection products, detailing the L-com line of components and accessories for the electronic, computer and communications markets. Featured in this edition is L-com's line of ready-made coax and data cables, plus connectors, IEEE-488 cables and line testers.

A variety of new products are listed including a new series of coax switches made specifically for panel mounting. Product description, information and pricing are included.

Reader Service # 134.

FO test kit

Noyes Fiber Systems introduced Models MLP1-1 (850 nm) and MLP1-2 (850 and 1,300 nm) fiber-optic test kits for FDDI, LAN and local loop testing. The kits offer SMA or ST (a trademark of AT&T) connectors on the source and a choice of adaptor cap for the power meter. Also available are single-mode test kits.

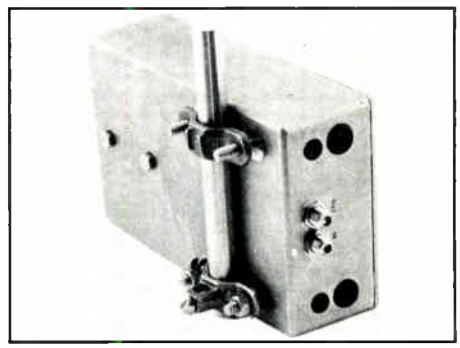
Reader Service # 135.

Technical bulletin

Cablewave Systems announced its Technical Bulletin 120 that describes the features of Models WE78 and WEP78 Flexwell elliptical waveguide. It also highlights the specifications of the waveguide, including frequency range, attenuation and installation accessories.

The bulletin describes the elliptical waveguide as a product designed for government band applications operating in the 7.125 to 8.5 GHz frequency range. It is constructed from a seam welded high conductivity copper tube that is corrugated and precision formed into an elliptical cross-section.

Reader Service # 136.



Dish protector

PolyPhaser introduced its IS-TVRO multistrike series of satellite dish/receiver protectors. The protectors have an RF protection circuit that passes DC and starts protecting LNBs at the +22 VDC, −1 VDC levels. They are designed to withstand a maximum surge current on the center conductor of 13,000 amps.

These modular protectors are said to ensure that LNBs that downconvert to the 400-1,450 MHz range will survive a direct lightning strike. Using type F-59 connectors, the VSWR is 1.2-to-1 and the insertion loss is less than 0.5 dB.

Reader Service # 137.

Footwear tester

Plastic Systems introduced its FT-2630 footwear tester designed to check dissipative properties quickly in any static-safe area. The unit provides visible and audible indication of whether footwear is conductive within acceptable limits and verifies resistance through a footplate and touch strip.

According to the company, the product

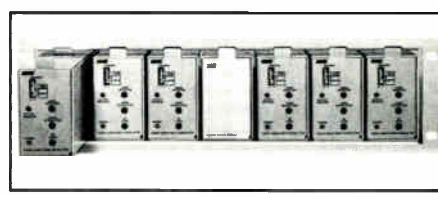
is ideal for use where electrostatic discharge is a concern. The user can select the upper and lower limits of the tester in order to test all types of footwear. The unit comes with a UL listed 12 V power adapter, footplate and cord, and a wall-mount bracket.
Reader Service # 138.

Circuit cards

Noise reduction cards for satellite, microwave and cable links have been developed by THAT Corp. and are upgrades originally developed by dbx for National Public Radio Satellite Network. The cards are designed to provide encoding and decoding for preserving the quality of audio signals. The new cards are compatible with other dbx 321 models currently in use.
Reader Service # 139.

Video control

Iris Technologies announced its Video Commander touch screen video routing, switching and distribution system. The software can control, route and switch 32 video inputs and 64 audio inputs to any of up to 32 outputs. According to the company, a "smart switch" allows one person to handle up to 16 jobs at once and the system is programmable to customize to your equipment. Features include removable circuit board for service without unplugging cables, a documentation and training video and a "mouse" menu-driven option.
Reader Service # 140.



Modulator

According to R.L. Drake, its Model VM200 frequency agile video modulator is ideal for small private cable installations such as in motel or industrial facilities. The unit covers the VHF band of Chs. 2-13.

Features include DIP switch selection of channels on the front panel, a frequency stability of ±5 kHz and a noise floor (from visual carrier) of −60 dB. Power is provided by an accessory power pack. The unit weighs 1.3 pounds and is 2.4 inches wide by 3.8 inches high by 8.4 inches deep.
Reader Service # 141.

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   ☐ 6. Microwave or Telephone Company
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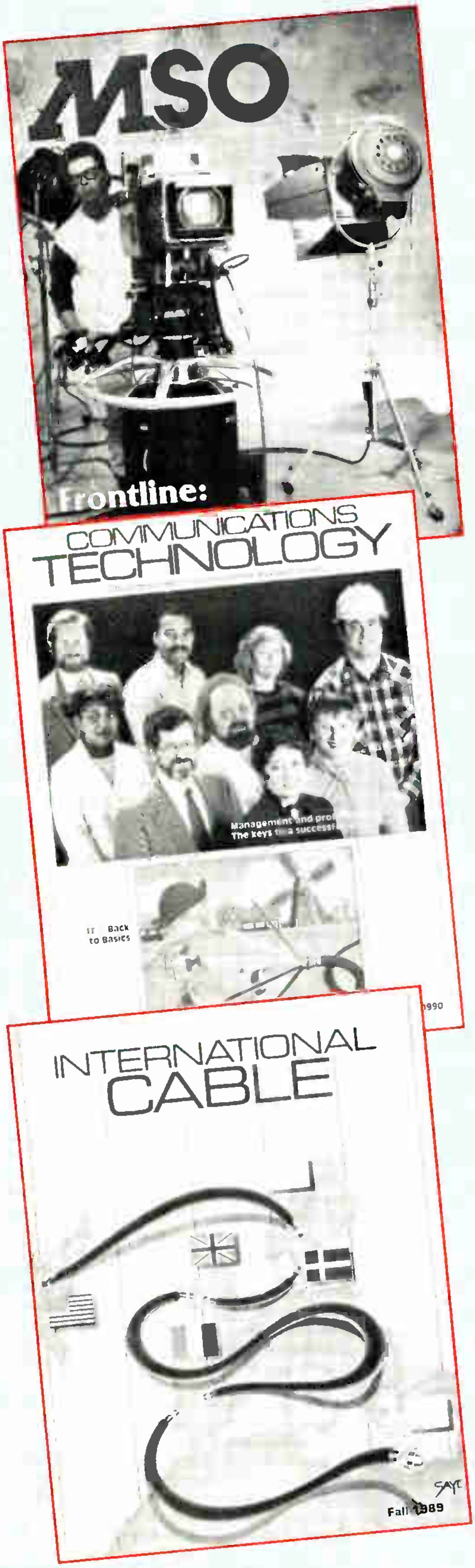

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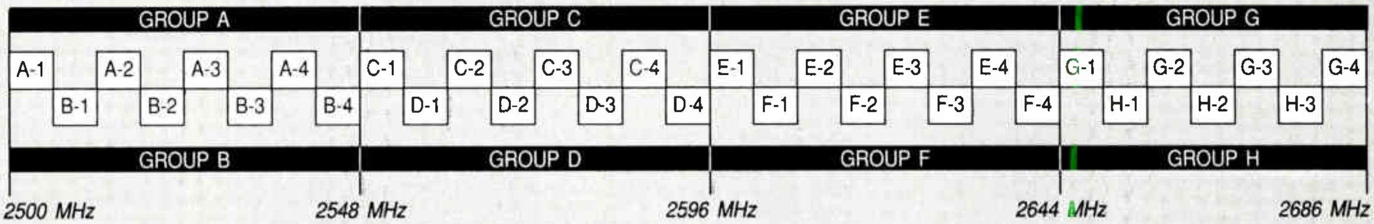

GROUPS A-B-C-D-G available for primary ITFS - unused capacity leased to MMDS (47CFR Part 74:900)
GROUPS E-F available for primary MMDS - one group only to a single entity (47CFR Part 21:900)
GROUP H available for MMDS - one channel in 50 mile radius (47CFR Part 94)
MDS channels 1-2 available for MMDS (2150-2162 MHz) (47CFR Part 21:900)

MMDS and Ollie North

By Archer S. Taylor
Senior Vice President, Engineering
Malarkey-Taylor Associates

It has been written that MMDS—officially designated "multichannel multipoint distribution service," but loosely called "multichannel microwave distribution service"—is capable of providing a 33-channel cable TV-type service, called "wireless cable" by its proponents. In a sense, this is true. But to provide 33 channels legally, in full compliance with the letter and spirit of FCC Rules is not a simple matter.

Channel 1 (2,150-2,156 MHz) may be assigned to any eligible MMDS applicant, shared with users in certain other licensed services. Channel 2 (2,156-2,162 MHz) may only be assigned to an eligible MMDS applicant in one of the 50 designated metropolitan areas, also on a shared basis. From here on, the story gets complicated.

All other channel assignments are made in groups of four alternating 6 MHz channels, as shown in the accompanying diagram. (In the diagram, 47 CFR refers to the code of Federal Regulations. Cross-references to Pike & Fischer, FCC Rules and Regulations, are: 47 CFR 21—RR Part 71; 47 CFR 74—RR Part 54; and 47 CFR 94—RR Part 56.) This permits block downconversion to non-adjacent standard VHF (or cable) channels. Group E (2,596-2,638 MHz) may be licensed to one MMDS applicant and Group F (2,602-2,644 MHz) may be licensed to a different MMDS applicant in the same community. These groups are shared with the instructional television fixed services (ITFS). Written statements must be obtained from existing ITFS licensees that they will not suffer interference from the MMDS service, or that any interference will be accepted. New ITFS licenses will not be assigned Groups E or F.

Thus, Channels 1 and 2 and Groups E and F comprise the 10 primary MMDS channels available in the top 50 metropolitan areas. They are divided between two separate, unrelated entities. Not more than 1 percent of the owners, officers or shareholders of one entity can hold a similar interest in the other.

There are 20 additional ITFS channels, in Groups A, B, C, D and G, that can only be licensed to bona fide accredited educational institutions, or to governmental organizations engaged in the formal education of enrolled students, or to non-profit organizations whose purpose includes providing instructional material to accredited institutions. In general, no single ITFS entity will be licensed for more than one group of four channels. These groups will not be licensed for MMDS service.

Section 74.931(a) states, quite clearly: "Instructional television fixed stations are intended primarily to provide a formal educational and cultural development, in aural and visual form, to students enrolled in accredited public and private schools, colleges and universities. *Every channel authorized must be used to transmit formal educational programming offered for credit to enrolled students of accredited schools.''*

Each of the 20 ITFS channels must be used for narrowly defined ITFS purposes for at least three hours a day, for a total of 20 hours per week, between 8 a.m. and 10 p.m., excluding Saturdays, Sundays, holidays and vacation days. An additional 20 hours per week must also be preserved on each of the channels licensed in these groups, subject to ready recapture for ITFS programs without economic or operational detriment to the ITFS licensee. Surplus capacity exceeding these requirements may be used for any other purpose, including lease to MMDS operations.

Finally, there are three channels in the private microwave operational fixed service designation that can be licensed for ITFS or MMDS service. These comprise Group H (2,650-2,680 MHz), interleaved with Group G. At the present time, FCC policy allows only one of the three channels to be assigned within any 50-mile range.

The formidable task

Thus, in order to package a ''wireless cable'' with up to 33 channels, as has been reported, an entrepreneur has a lot of arrangements to make:

"Putting together a 33-channel MMDS operation may require a sort of 'Ollie North' approach to legal restrictions."

1) He would have to apply for Channel 1 and either Group E or F, but not both.

2) He would then have to find some other unaffiliated entity to apply for Channel 2 and the other group (E or F) who would be willing to lease the five-channel capacity to him, for an acceptable fee. Or he might negotiate a lease with an existing, unaffiliated licensee. Even as a lessor, however, this other entity would still be held accountable to the FCC for compliance with the regulations including reports, notifications, license renewals, technical requirements and so forth.

3) He would have to find five, bona fide, unrelated, accredited educational institutions who had already applied for, or would be willing and qualified to apply for, Groups A, B, C, D and G. Each would need to have a credible program for using television to deliver educational program material to students enrolled for credit.

4) He would have to negotiate with the five educational institutions to lease the unpreserved program time on each of the 20 channels, recognizing that at a minimum three hours a day, totalling 20 hours a week, on each channel would not be available for entertainment programming, and that an additional 20 hours a week would be pre-emptible for educational purposes, without notice or recourse.

5) He could only apply for one channel in Group H, since only one could be assigned within a 50-mile radius.

This is a formidable task. If all goes well, the entrepreneur would have the full-time use of perhaps 10 or 11 channels, plus part-time use of 20 channels shared with five separate educational institutions.

It is reported that some MMDS facilities are actually in place with capacity approaching the theoretical 33 channels. One has to wonder about the extent to which these operators have conformed with the intricate maze of restrictions on licensing ITFS facilities and the use of ''surplus capacity'' for commercial purposes. Is the second MMDS licensee really a separate entity? Are the five ITFS licensees really unrelated, bona fide educational institutions? Is the leased capacity that is required to be "preserved" for educational programs really used for "...formal educational...development to students enrolled in accredited...schools"? Or are such programs as Nickelodeon, Lifetime, The Nashville Channel and The Weather Channel counted as qualified educational programming? Are the students actually enrolled, or are they only "wireless cable" subscribers? Has the FCC quietly and without public notice, adopted a relaxed interpretation of its eligibility and permissible service rules where a strictly bona fide educational interest in ITFS does not seem to exist? Does the FCC make any effort to enforce its capacity "preservation" rules?

The 'Ollie North' approach

I get the impression that putting together a 33-channel MMDS operation may require a sort of "Ollie North" approach to legal restrictions that get in the way: Do whatever you must to get the job done, even if you have to bend the law (or regulations).

In establishing MMDS regulations, the FCC explicitly states its intent to authorize five channels for each of two competing entities in the top 50 metropolitan areas. Desiring to encourage the expanded utilization of ITFS spectrum for formal instructional purposes, the FCC also authorized bona fide ITFS licensees to seek additional funding by leasing idle capacity to MMDS operators.

Obtaining the license for five clearly available MMDS channels does not require bending or stretching the rules. Combining two sets of five channels into a single 10-channel operation by leasing the other licensee's facilities could be seen to conflict with the spirit, if not the letter of the independent entity rule.

It is in the matter of leasing surplus ITFS capacity that the potential for bending the rules seems most apparent. I doubt the FCC expected potential MMDS operators to virtually take over all ITFS facilities in their communities or even promote filings for unlicensed groups. On the other hand, appropriate arm's length arrangements can probably be negotiated in some cases with bona fide educators, to the benefit of both parties, without violating the spirit of the regulations. Such an arrangement would be considerably enhanced if the ITFS and MMDS transmitting sites happened to coincide. It does seem quite unlikely that many 31- to 33-channel MMDS operations could be established without a good deal of creative bending of the rules.

Finally, do not underestimate the ingenuity of the marketing department. By adding a few simple VHF and UHF antennas to the MMDS mast, local TV signals can be multiplexed with the downconverted microwave signals to provide five to 15 or so program channels in addition to whatever can be negotiated with the ITFS licensees. Thus the "wireless cable" can be properly promoted as a 25- or 30-channel system, even though only 10 or 15 of the channels are delivered by FCC licensed microwave.

At deadline: FCC has just issued a Notice of Proposed Rulemaking and Notice of Inquiry seeking to relax these requirements in order to promote competitive alternatives to franchised cable TV systems. The proposed rules would prohibit cross-ownership of MMDS by cable TV systems in their franchised areas, increase power and authorize signal boosters. The Notice of Inquiry seeks comment on permitting MMDS use of ITFS frequencies until applied for by an educational institution. Wireless Cable Association President Bob Schmidt (former NCTA president, 1976-1979) says this is a step toward making the MMDS industry viable, but still does not address the restricted availability of fairly priced programming.

March

March 6-8: Magnavox mobile training center seminar, Chicago. Contact Amy Costello Haube, (800) 448-5171.

March 6-9: Siecor Corp. technical seminar on fiber-optic installation and splicing for LAN, building and campus applications, Hickory, N.C. Contact (704) 327-5539.

March 7: SCTE Sierra Meeting Group technical seminar on trunk sweeping and preventive maintenance, Oxford Suites Hotel, Roseville, Calif. Contact Steve Allen, (916) 786-2469.

March 7-9: AT&T fiber-optic seminar on splicing and testing, AT&T Regional Product Training Center, Atlanta. Contact (800) TRAINER.

March 8: SCTE Big Country Meeting Group technical seminar, Abilene, Texas. Contact Albert Scarborough, (915) 698-3585.

March 10: SCTE Chaparral Chapter technical seminar, Howard Johnson Plaza, Albuquerque, N.M. Contact Brian Throop, (505) 761-6289.

March 12-13: AT&T fiber-optic training on testing fiber, AT&T National Product Training Center, Dublin, Ohio, and AT&T Regional Product Training Center, Atlanta. Contact (800) TRAINER.

March 12-15: Siecor Corp. technical seminar on fiber-optic installation and splicing for outside plant applications, Hickory, N.C. Contact (800) 634-9064.

March 12-15: AT&T fiber-optic training on splicing fiber, AT&T Regional Training Center, Atlanta. Contact (800) TRAINER.

March 13: SCTE Central Illinois Chapter technical seminar on CLI, Sheraton Normal Hotel, Normal, Ill. Contact Ralph Duff, (217) 424-8478.

March 13: SCTE Florida Chapter's Central Group technical seminar, Holiday Inn North, Lakeland, Fla. Contact Denise Turner, (813) 626-7115.

March 13: Fotec seminar on fiber-optic basics and FDDI, Denver. Contact (617) 241-7810.

March 13: Ohio Cable Television Association annual meeting, Hyatt on Capital Square, Columbus, Ohio. Contact Maryann Kafer, (614) 461-4014.

March 13-15: Magnavox mobile training center seminar, Lincoln, Neb. Contact Amy Costello Haube, (800) 448-5171.

March 14: SCTE Mount Rainier Chapter technical seminar. Contact Sally Kinsman, (206) 821-7233.

March 14: SCTE Wyoming Chapter technical seminar on system powering and time domain reflectometers. Contact J.R. Johnston, (307) 632-8114.

March 14: Fotec seminar on fiber-optic basics and FDDI, San Francisco. Contact (617) 241-7810.

March 14-16: SCTE Razorback Chapter technical seminar to be held in conjunction with L'Ark Cable Convention and Show, New Orleans. Contact Jim Dickerson, (501) 777-4684.

March 14-16: Louisiana/Arkansas Cable Television Associations' L'Ark Cable Convention and Show, Sheraton New Orleans Hotel. Contact LCTA, (504) 387-5960.

March 14-17: AT&T fiber-optic training on splicing fiber, AT&T National Product Training Center, Dublin, Ohio. Contact (800) TRAINER.

March 15: SCTE Southeast Texas Meeting Group technical seminar, Warner offices, Houston. Contact Tom Rowan, (713) 580-7360.

March 15: Fotec seminar on

fiber-optic basics and FDDI, Seattle. Contact (617) 241-7810.

March 19-23: Fiberoptics Communications Corp. workshop on fiber-optic splicing and termination, Sturbridge, Mass. Contact Elaine Robinson, (508) 347-7133.

March 19-23: AT&T fiber-optic training on installation and splicing, AT&T Regional Product Training Center, Atlanta, and AT&T National Product Training Center, Dublin, Ohio. Contact (800) TRAINER.

March 20: SCTE Rocky Mountain Chapter technical seminar, Clarion Hotel Southeast, Englewood, Colo. Contact Steve Johnson, (303) 799-1200.

March 20-22: C-COR technical seminar on basic theory, installation and maintenance of CATV systems, Atlanta. Contact Teresa Harshbarger, (814) 238-2461.

March 20-22: Magnavox mobile training center seminar, Spokane, Wash. Contact Amy Costello Haube, (800) 448-5171.

Planning ahead

May 21-23: NCTA National Show, Atlanta.
June 21-24: SCTE Cable-Tec Expo, Nashville, Tenn.
Sept. 16-18: Eastern Show, Washington, D.C.
Sept. 18-20: Great Lakes Expo, Indianapolis.
Sept. 25-27: Atlantic Cable Show, Atlantic City, N.J.
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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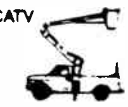

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Make your voice heard

By Jack Trower
President, Society of Cable Television Engineers

Those of you who are members of the SCTE have by now received your 1990 election package. These elections are very important since six region director and one at-large director positions are being contested. The nominating committee did an outstanding job in putting together a slate of candidates who are dedicated to the goals of the Society and have agreed to the hard work necessary when serving on the board of directors. The problem is that some very good, qualified people do not get elected.

The key to this process is your vote. In the last election, 31 percent of the membership returned their ballots. I was informed that this is the best percentage we had in any election since 1984. I also was reminded that this is very near to the response that can be expected in a U.S. national election. These statistics, however, do not keep me from wanting to see a better participation.

Part of the election package is a membership survey. The results of this survey are used by the various committees and the board to prepare the programs, policies and procedures of the Society. More member response to the survey gives the board a broader range of ideas to work with. This results in a better response to the desires of the membership. So, if you have not yet returned your ballot and survey to be counted, I urge you to do it now so your voice will be heard.

Come on down to Nashville

Let's change the subject and talk about Cable-Tec Expo '90. This year's version of the SCTE Annual Engineering Conference and Cable-Tec Expo will be held at the Nashville Convention Center, Nashville, Tenn., June 21-24. Hoping not to sound too biased, I must say that this year's conference and expo will be the biggest and best ever. The outstanding program committee put together an engineering conference program that is on the leading edge of what is happening in the cable industry today.

The expo workshops are another area to be proud of. The topics covered are wide-ranging and will provide something for everyone. There also will be live, hands-on demonstrations on the exhibit floor.

I'm particularly excited that the last subject for the day of the Engineering Conference will be a true SCTE general membership meeting. The plan is to have the entire board available to make comments about what is going on with the Society and answer questions from the floor. The goal, of course, is to extend communication from the membership to the board.

The hardware vendors will, I believe, be extremely pleased with the exhibit hall. There seems to be ample room for everyone and it is well laid out. Bill and Anna Riker, along with the rest of our staff, worked very hard in organizing an outstanding expo. If you have your registration package and have not yet sent it in, I would encourage you to do so. Don't be left out by waiting too long. Register now and avoid the rush.

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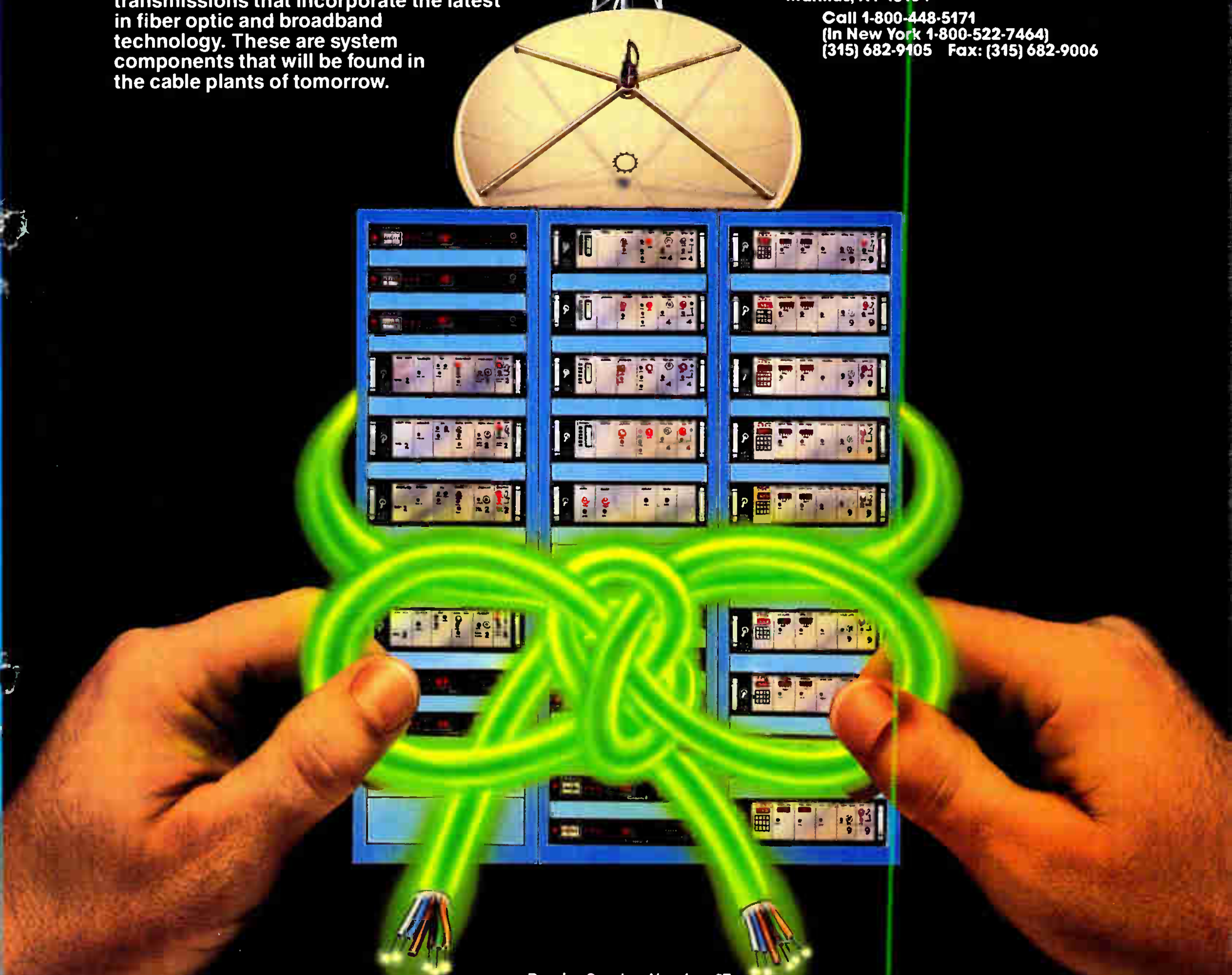

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