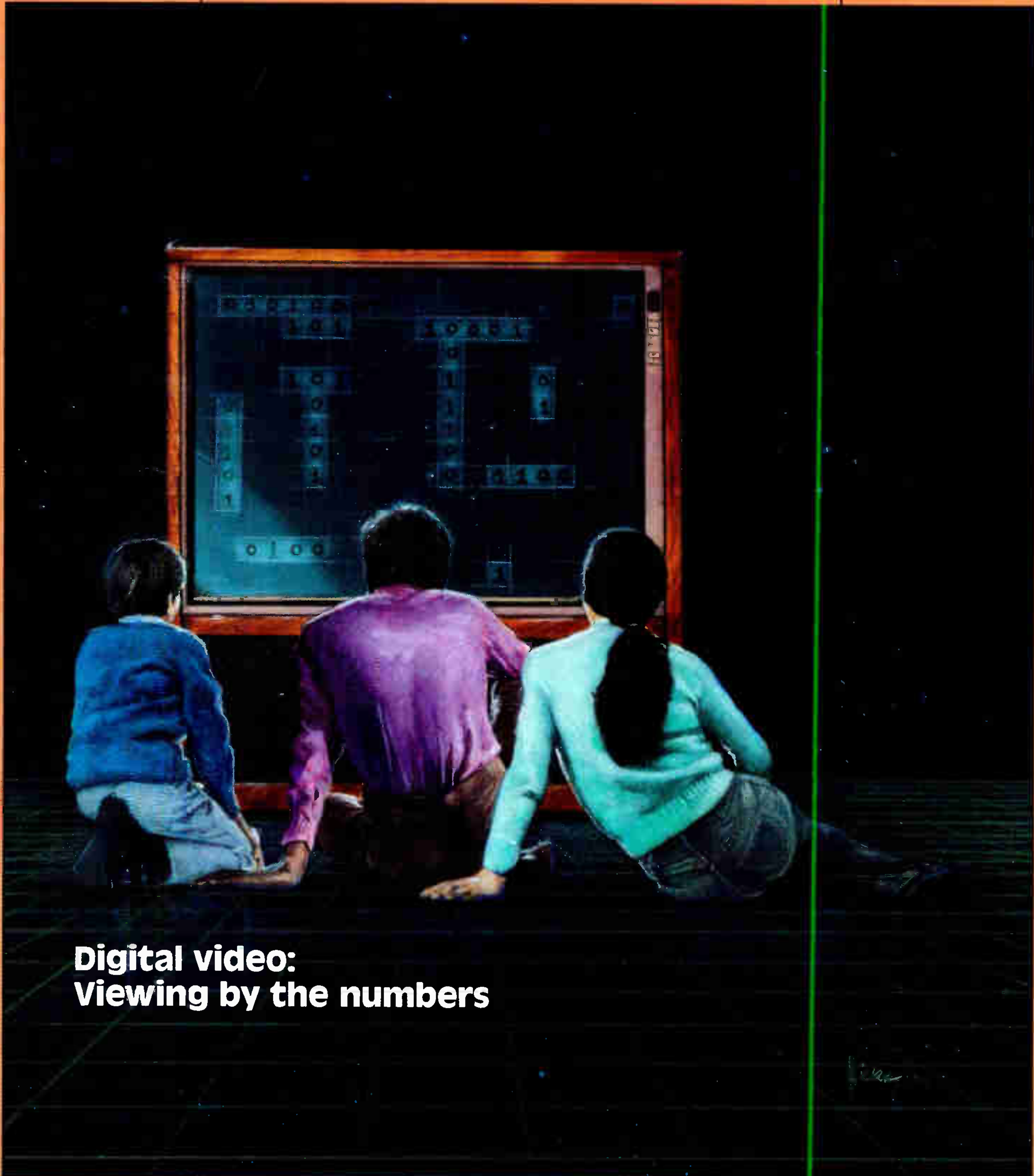
Pull-out RF spectrum wall chart

COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers



Digital video: Viewing by the numbers

February 1990

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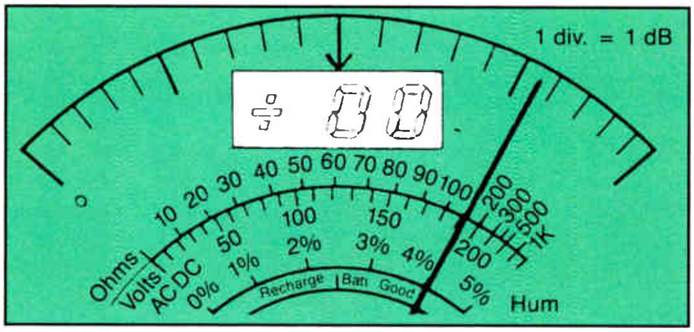

Features

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Welcome aboard the best

Being the best isn't something you're born with, you have to work for it—and work hard. When we started this magazine some six years ago, we set out to give this industry the best technical journal around, which we did. And when we decided to merge our *Installer/Technician* magazine into *CT* we did so to make the best even better and bigger, which we've done. Now, you're probably wondering what more can we do in our quest for the best? The answer: Ron Hranac!

It gives me great pleasure to welcome Hranac aboard as the new executive editor of *Communications Technology*. I'm sure many of you already know this well-respected industry veteran, but nevertheless I though I'd run down the highlights on one of the cable industry's best.

Most recently, Hranac was senior staff engineer at Jones Intercable's corporate headquarters in Englewood, Colo. He has been in cable TV for 17 years and spent five years in commercial broadcasting.

A Senior member of the Society of Cable Television Engineers, he also is the national organization's Region 2 director and immediate past president, and served as its secretary prior to being president. Hranac is a member of SCTE's board of directors and chairs four of the eight Society committees on which he is active. In 1987 he became the first person in the cable industry to be certified in the SCTE's BCT/E program and has since completed certification at both the Technician and Engineer levels of that program. At the local level, Hranac is one of the founders of the SCTE's Rocky Mountain Chapter, is a past chapter vice president, president, treasurer and served four terms on the local board of directors. He recently became the first American to be elected as Honorary Fellow—the highest grade of membership—in the British SCTE.

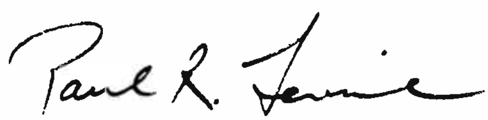
Hranac is past chairman of an NCTA ad-hoc subcommittee to research 75 ohm traceability at the National Bureau of Standards, and now is chairman of a similar subcommittee under the auspices of SCTE. He has been an editorial advisory board member of both *Communications Technology* and *Installer/Technician* magazines, and has written and published more than 70 articles and features in industry trade publications.

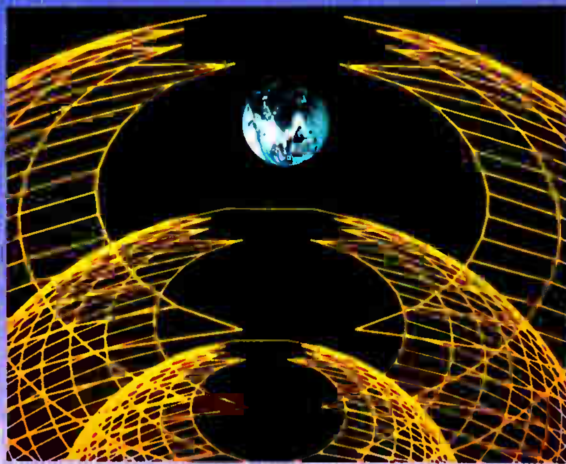

Bob Sullivan

Ron Hranac

As well, Hranac has been a speaker at NCTA conventions, SCTE national and chapter seminars, Women In Cable gatherings and state association meetings. In the community, he is an Eagle Scout (1970) and is active in the scouting program as an assistant scout master for a Denver area Boy Scout troop. Hranac also is a licensed amateur radio operator and is operations manager of an amateur radio group that coordinates a severe storm monitoring network for the National Weather Service using amateur fast-scan TV.

Now that the groundwork has been layed, stay tuned for the best—because the best just keeps getting better.





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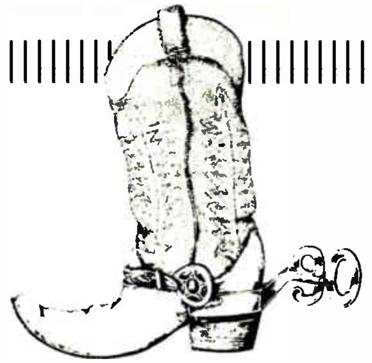


Texas Show turns thirtysomething

SAN ANTONIO, Texas—The Texas Show '90 to be held here Feb. 21-23 at the San Antonio Convention Center marks its 30th anniversary. The event sponsored by the Texas Cable Television Association promises 160 exhibitors and 2,300 attendees.

Exhibits will be open from 12-6 p.m. on Wednesday, Feb. 21, 9 a.m.-12 p.m. and 1:30-6 p.m. on Thursday, Feb. 22 and 8:30 a.m.-12 p.m. on Friday, Feb. 23. The SCTE will sponsor technical sessions on Wednesday and Thursday. The following is a breakdown of those sessions.

Wednesday, Feb. 21

- 3-5 p.m.—BCT/E certification testing

Thursday, Feb. 22

- 9-10:15 p.m.—"Technology in the '90s" with Wendell Bailey, Dan Pike and Tom Elliot
- 10:30-11:45 p.m.—"Signal leakage and CLI" with Ted Hartson and Raleigh Stelle
- 1:45-3 p.m.—BCT/E Category VII review course on "Distribution systems"
- 3-5 p.m.—BCT/E certification testing

SCTE committee elects officers

ANAHEIM, Calif.—The SCTE Interface Practices Committee elected new officers on Dec. 13 at a meeting held here (in conjunction with the Western Show).

Re-elected as committee chairman was Tom Elliot, vice president of engineering for CableLabs. Elected as secretary was Ken Williams, manager of CATV development engineering for Raychem, and John Swinmurn, manager of telecommunications development engineering for Raychem, was elected chairman for the subcommittee on drop interfaces. John Radzick, product manager for Augat/LRC, was elected chairman of the subcommittee on aluminum cable interfaces and Rex Ickes, director of engineering for Pyramid Industries, was elected chairman of the subcommittee on interface testing.

The committee is in its second year of operation and currently is addressing issues associated with the plating of F-connectors and crimp tool calibration. Its next meeting will meet in conjunction with the Texas Show this month. For more information on participation and upcoming events, contact Ken Williams at (415) 361-2213.

Jerrold unveils sub home of future

ANAHEIM, Calif.—The Jerrold Division of General Instrument displayed the "subscriber home of the not-too-distant future" here at the Western Show.

The display's purpose was to show how the company envisions the integration of services in the home over the next few

Reader Service Number 14.

years. Some of the products shown were already in production (such as the company's patented line of A/B switches, the EIA MultiPort unit and the Starport on-premises device), while other products were prototypes or visions of the future.

A part of "the beachhead from which we build in the 1990s" will be impulse ordering, said Ed Ebenbach, vice president of marketing for Jerrold's Subscriber Systems Division. Communications between the cable TV network, the telephone system and the electrical system will be the foundation of an integrated in-home system, he added.

"In the near term, we expect to see the development of this integrated technology into a wireless telephone using the remote control unit," Ebenbach said.

A prototype of this product was part of the display at the Western Show, and he said that the wireless phone was only a small step from the telephone return line already used with Jerrold's Starfone impulse modules.

CableLabs invests in Eidak

CAMBRIDGE, Mass.—CableLabs and Eidak Corp. recently made a joint announcement that CableLabs will join TCI and Continental as minority investors in Eidak.

Richard Leghorn, president of Eidak, said, "We welcome CableLabs' investment particularly because it represents recognition by the labs and the industry as a whole of the importance of copyright protection for the CATV industry."

The Eidak Copyguard system is designed to prevent unauthorized recording of electronically transmitted video signals. The system has been successfuly demonstrated in field and market tests in two sites, and additional technical and market evaluations will be ongoing this year.

First MDU gets Matrix install

CHARLESTON, W.V.—Midwest CATV and Syrcuits International recently announced their jointly developed Matrix, a marriage of standard traps with off-premises addressibility, was installed in a 200-unit apartment complex in Wilkes Barre, Pa., making it the first multiple-dwelling unit with the technology.

The contractor for the apartment complex, Bill Deckman, said the installation is a pilot program and indicated that the total universe of the Matrix system is much larger than the 200 units contained in the apartment dwelling. "With this Matrix installation, our controlling point to turn premium subscribers on and off can go far beyond this apartment complex, extending to other properties of similar interest," Deckman said.

He added that the logistical controls of the system could allow for 250,000 subscribers to be controlled from one office.

Midwest CATV, the exclusive marketer of Matrix, said that the system has continued to prove its value in installations in Alabama and Texas. "Matrix, with a common dwelling-mounted environmental housing and common electronics, addresses up to four tiers of channel security handling two subscribers, or from the common housing up to eight channels can be tiered," said Steve Brazil the company's vice president/marketing. "Matrix contains three levels of broadband signal security, adding to that 'hard' security of the negative and positive trap technologies used in the cable industry for years."

In another Midwest CATV announcement, the company recently finalized an agreement with Sumitomo Electric to distribute its AM (amplitude modulated) and PCM (pulse code modulated) fiber transmission equipment.

Anixter announces FO installs, marketing pacts

SKOKIE, Ill.—Anixter announced that six cable installations activated the company's Laser Link AM fiber-optic systems. These included ATC's Durham, N.C., system, ATC's Oceanic Cable of Hawaii, King Video Cable in Tujunga, Calif., Paragon Cable of Orange County, Calif., TCI's Millbrae, Calif. system and TCI's Galvenston, Texas, system. The last two weathered without damage the San Fransisco earthquake and Hurricane Jerry, respectively.

In other news, Anixter reached an agreement with Photon Kinetics to represent its optical time domain reflectometers (OTDRs) for the first time in the CATV market. Also, Anixter will market Tektronix's FiberScout handheld fiber-optic fault finder.

- According to NuCable, its cable ad channel system (CACS) now permits CACS-created programming to automatically cover program blackouts required under the new syndex rules. The enhancement, called the "Syndex Killer," automatically switches from the blacked out channel to locally produced programming or to the satellite delivered, system-specific listing guide—The Cable Guide Video.

- Texscan reported that operating income for the three months ending Oct. 28, 1989, rose 35 percent over the prior year's second quarter on a 10 percent increase in sales from continuing operations. Net income for the quarter increased almost sixfold.
- Trilithic announced factory upgrades on its Searcher leakage detector. The performance enhancements affect the receiver's post-detection circuitry and its ability to reject false signals without loss of sensitivity. These modifications are currently being installed into Searchers shipped from the company's assembly plant in Indianapolis.
- Standard Communications signed an agreement with Public Broadcasting Service to provide audio/video satellite receivers for its 180 TV station affiliates throughout the United States, Guam and the Virgin Islands. The agreement with Standard is part of a PBS three-year replacement program undertaken to upgrade its existing equipment.
- Magnavox recently announced the establishment of its new subsidary in the United Kingdom, Magnavox CATV Systems U.K. Ltd. It will address the specific needs of Magnavox's U.K. customers and will also carry sweep systems by CaLan, connectors by Gilbert, AML microwave equipment by Hughes and headend equipment by Catel.
- Pioneer and Eidak announced the compatibility of Pioneer's new Laserdisc autochanger system and the Eidak system for copy protected pay-per-view. When the Pioneer system is used in conjunction with the Eidak processor, it provides copy protection of PPV and the ability to eliminate event interruptions.
- Creative Management Systems instituted its new approach to marketing its System 1 software package. Clients will have the option to lump sum purchase the system and the IBM hardware, monthly lease and lump sum purchase the IBM hardware or lease both the system and the hardware. Customers can select from an operating lease (off-balance sheet financing) or a capital lease.
- The Amp Clamp surge supressor will be included in Regal Technology's power inserter, the company recently announced. The Amp Clamp is designed to prevent damage to active and passive devices in CATV systems when voltage surges or transients caused by lightning or power disturbances are coupled onto coaxial cables at power insertion points.

Is broadcasting doomed to die?

By Isaac S. Blonder
President, Blonder Broadcasting Corp.

U.S. terrestrial broadcasting is a typical example of private enterprise enjoying the use of resources (in this case the radio spectrum) granted by government agencies in the belief that the complex created by the profit motive would better serve the citizen than a monolithic bureaucracy. And indeed American broadcasting, in every aspect, is the world's finest TV service. Contrary to the caustic comments from the learned critics who condemn NTSC picture quality vs. PAL, it is my judgment that NTSC is a better match for the human visual system. NTSC flicker is invisible, the viewer can set the hue to please himself, the picture is much brighter and solid colors may be pure, without the risk of the PAL color crazies.

New and improved

But, to resort to a trite saying, time marches on. Research, mostly sponsored by foreign TV bureaucracies and their commercial clones, has spawned superior systems for the delivery of a TV image to the home viewer. To recount the foreign advantage one more embarrassing time, Japan unleashed a steamroller in 1970 in which an unlimited torrent of money (would you believe $20 billion?), manpower and management produced a quality HDTV system together with all the instruments needed to create the new TV image, deliver and display it. Most of us have seen the Japanese MUSE system at the trade shows and the superiority over NTSC presentations is undeniable.

Europe, in its typical insular fashion, refused to accept foreign technology and mounted a huge continentwide R&D initiative to create its own HDTV. While some of Eureka's rough edges remain to be smoothed and production models are still to be finalized, it has emerged as a viable alternative.

The development philosophy behind both MUSE and Eureka was to achieve the highest picture quality that could be delivered by the current breed of satellites and displayed on available technologies. In none of the literature on HDTV research that crossed my desk did I find any concern for the consumer, whose current stock of incompatible receivers is destined for the graveyard before its time. The master plan seems to assume that HDTV satellite coverage of the population is better and cheaper than the existing terrestrial scheme and that the land stations will cease operating after every home has purchased its HDTV receiver. Cable—also a virtual government monopoly—seems to have been assigned a secondary role, which would be resorted to by the telephone monopoly as the need arose.

Our FCC, in the typical American spirit of free and open competition, has called for a compatible HDTV system from which the consumer can choose the quality, price and method of delivery. The inventors have until 1992 to display their wares. Unfortunately there is virtually no money to support the inventors and the deadline will pass without a winner. The FCC then, in a time bind, will have to resign itself to a de facto standard, which will undoubtedly be a version of the MUSE family capable of both compatible terrestrial delivery and incompatible satellite format.

"Public broadcasters and low power TV catering to special audiences independent of advertising revenue will be the only survivors."

An ill-fated start-up

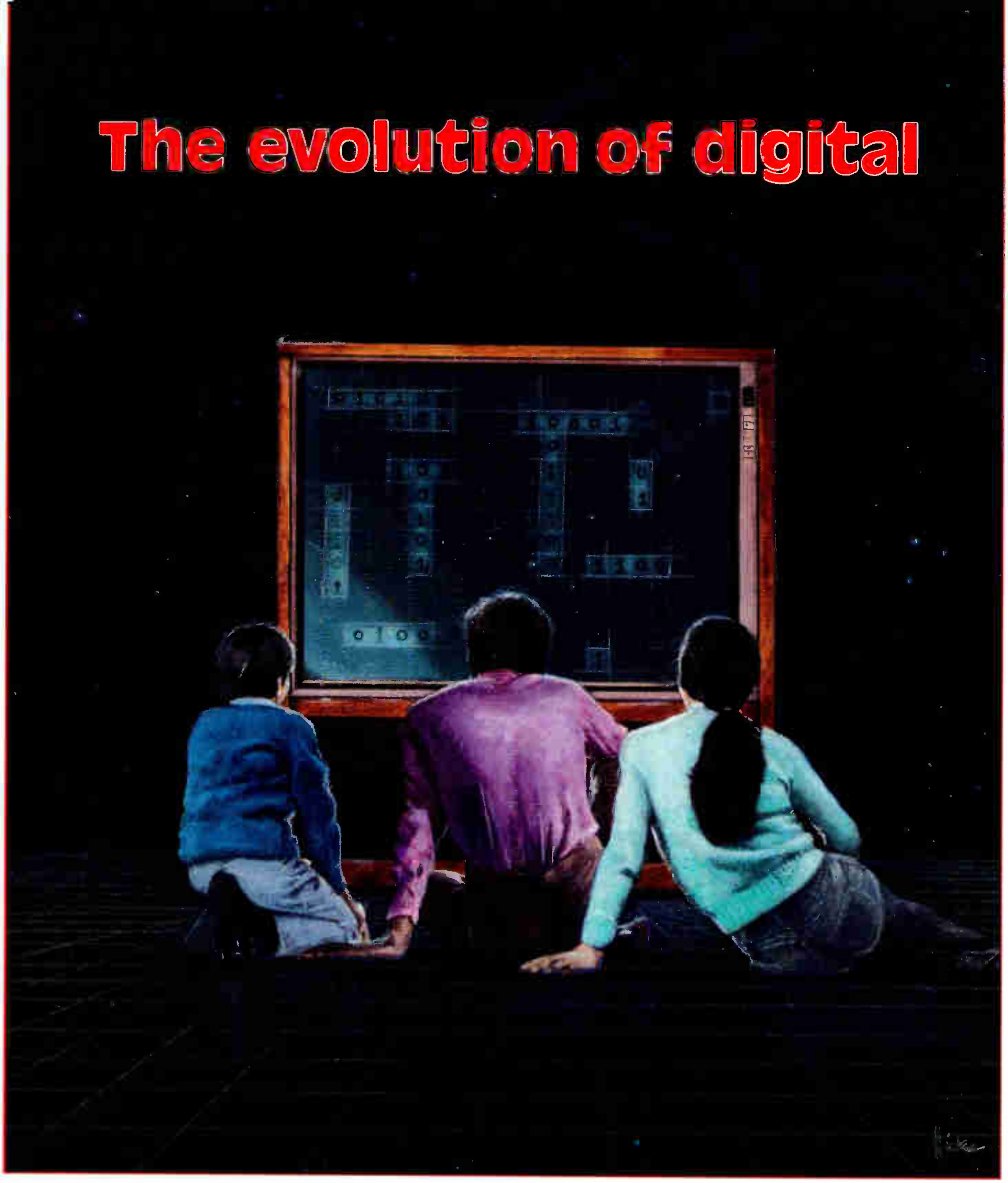
At this stage I have retold a story quite familiar to the reader of *Communications Technology* but I hope to be faithful to the title of this article, "Is terrestrial broadcasting doomed to die?" Having spent a large part of my business career as a struggling UHF broadcaster, there is burned into my subconscious the dogma that your advertiser's budget is your program budget!

Do any of you remember the gory days of the birth of UHF broadcasting? Station after station opened, most of them in major markets, only to fall bleeding from the balance sheets when the lack of TV receivers equipped with UHF tuners resulted in an equal lack of viewers, followed by no advertising revenue. The remedy was an unprecedented act of compulsion by the FCC when it required all TV sets manufactured after May 1964 to possess UHF tuner capability equal to VHF.

In my opinion, enhanced compatible TV will not satisfy enough of the public to stem the tide of HDTV into the U.S. home. Terrestrial TV, now losing market share to cable, will accelerate the downward trend to the point where the income stream from advertisers will resemble the ill-fated UHF start-up scenario. Unlike the generous support to foreign broadcasters, there will be no U.S. government funds to keep the home fires burning. Public broadcasters and lower power TV catering to special audiences independent of advertising revenue will be the only survivors.

This scenario is OK, right? Our good old capitalistic system at work again? Maybe. In my conversations with government and industry top brass on the future of television I have raised the possibility that 40 million families living below poverty level will find the majority of TV programs priced out of their reach since they can only be found on cable or satellite. People, hold on to your wallets, here was the common reply: The government should subsidize a basic telephone and TV service to the poor! At a reasonable figure of $300 yearly per family, our national debt will thus increase by another $12 billion! Add to that deficit a trade deficit many times larger, since the HDTV products will be manufactured abroad. The taxpayer is doomed to be the ultimate victim!

The evolution of digital



Ron Hicks

By Hermann Gysel
Vice President of Engineering, Synchronous Communications Inc.

In the '80s the evolution of digital techniques in television happened at a high speed in the production environment of the TV studio but at a much lower speed in the field of TV transmission. Cable very rarely uses digital transmission formats today. Amplitude modulation (AM) on fiber is becoming increasingly popular with second generation distributed feedback (DFB) lasers, and this puts digital into the supertrunk market where it has to compete with well-established frequency modulation (FM).

In the past, digital links for the transmission of multichannel video rarely exceeded a data rate of 560 megabits per second. If compression is not used, typically four video channels can be transmitted using that data rate. When two wavelengths (1,300 and 1,550 nm) are used, eight channels are possible. For over five years fiber-optic links have been available that use FM and transmit 16 channels per optical wavelength. Digital was therefore not very attractive.

However, digital has been very successful in long haul applications, where its regeneration capability is a must. In CATV systems even the longest supertrunks rarely exceed 30 miles

"Digital has been very successful in long haul applications, where its regeneration capability is a must."

or 23 dB optical loss (at 1,300 nm), which can be accommodated with FM links. In more advanced supertrunk topologies some repeat capability is useful, probably up to three or four repeats. This does not necessarily require the time division multiplex/pulse code modulation (TDM/PCM).

Digital today

Digital post production techniques in broadcasting and program production are one of the most mature applications of digital techniques in television. In 1986 the International Consultative Committee for Radio (CCIR) in Geneva accepted CCIR-Recommendation 601-1, "Encoding parameters of digital television for studios."[1] This recommendation describes a component system with the sampling rate of 13.5 MHz for luminance and half of it for the color difference channels (4:2:2 ratio). This standard is clearly a production standard. If transmitted, it requires 270 megabits per second per channel when 10 bits per sample are used.

Therefore, the development of digital transmission formats focused on the reduction of data rates by means of compression. At the expense of transparency of the transmission process the data rate can be reduced substantially because of the high degree of redundancy in a TV signal. These compression algorithms take advantage of the high correlation of adjacent picture points as well as between frames. Practical problems like accurate transmission of vertical interval test signal (VITS) become apparent immediately.

Nevertheless it is generally agreed that future digital systems for the distribution of TV signals will use some sort of data rate reduction technique. One of the best known encoding algorithms was developed at Bell Labs. A good description can be found in the September '88 *SMPTE Journal*.[2] The video signal is sampled at three times the color subcarrier frequency and uses 9 bits per sample. The coder uses an adaptive combination of pulse code modulation (PCM) and adaptive differential PCM with four predictors. The data stream of one channel is compressed to a DS3 rate (44.736 megabits per second). Fiber-optic links using DS3-rate TV transmission are intended to eventually replace satellite networks, especially for collecting program material for the broadcasters.[3]

Although the digital developments in the studio are not very relevant to the CATV operator, the DS3-rate transmission trials[3] are of some interest to CATV. Eventually nationally compatible multipoint digital networks could compete with today's satellites (even with cable programs).

Digital vs. FM fiber

What was the success of digital in CATV in the '80s? A well-documented trial of digital techniques in CATV was carried out by Jim Chiddix in 1985 and 1986[4]. Four channels were transmitted digitally (two per wavelength) and compared to eight channels transmitted with analog FM (and only one wavelength). The digital system had only one advantage over FM and that was a higher margin in optical loss. The FM system was less expensive, less complicated (no wave division multiplexing) and had better picture quality with 7 dB higher video signal-to-noise

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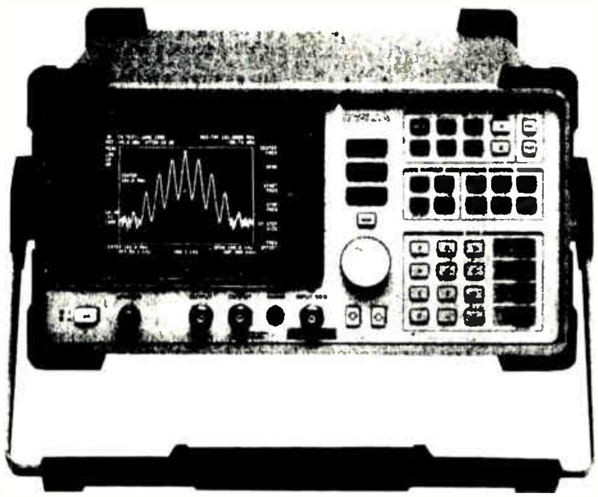
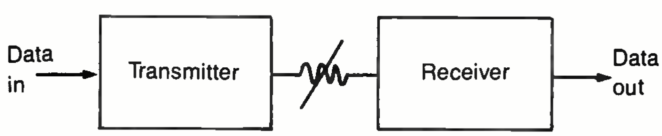


Using spectrum analyzers in microwave digital radio measurements

By Jim Boyer
Signal Analysis Division, Hewlett-Packard Co.

Microwave digital radio measurements often use spectrum analyzers in R&D, manufacturing and production, system installation and field maintenance testing. Figures 1, 2 and 3 (simple microwave digital radio block diagrams) show three levels of testing: system level, individual system modules and components of the microwave digital radio.

Figure 1: System level

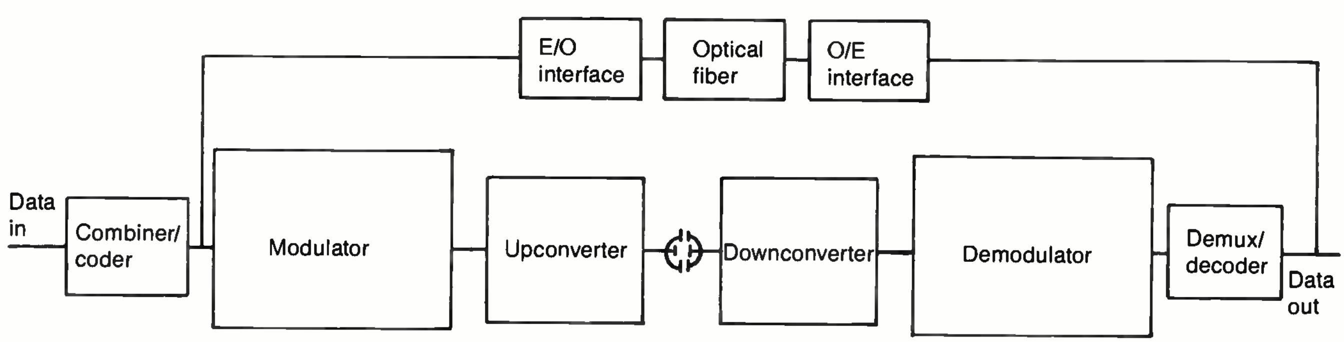


System level tests concern the transmitter, receiver and associated antennas. The tests also include the transmission medium for susceptibility to fade, threshold-to-interference level (affected by the modulation method selected) and multipath loss. System testing is performed during installation and ongoing field maintenance. Spectrum analyzers make system measurements that include output power, transmitter frequency and spectrum conformance, receiver sensitivity, dynamic range and noise figure.

System module testing for the transmitter includes the modulator, upconverter and antenna. Receiver tests include antenna,

(Continued on page 39)

Figure 2: Module level



How to phase out co-channel and other co-frequency interferences

By Glyn Bostick
President, Microwave Filter Co. Inc.

Of the two methods of suppressing co-channel interference—antenna arrays and phase cancellation—the latter is usually quicker and more cost-effective. Phase cancellation can also suppress other types of interference such as ghosting, wideband interference, wide-band noise and radio transmitter harmonics received in the TV channel.

In an attempt to minimize co-channel reception, TV stations of the same frequency are separated by a reasonable distance (see Figure 1) and their radiation patterns are controlled to minimize mutual reception. Despite these efforts, a "far-away" may impact a local channel due to transmission anomalies (most often in warm weather). Lower frequencies travel further, accounting for more frequent cases on low band channels (2-6). CATV systems sometimes use a high gain antenna to acquire a faraway and experience co-channel interference from a local channel. The symptom of co-channel interference is often a "venetian blind" pattern over the desired picture (Figure 2). Signals as weak as −30 dB (relative to desired signals) can cause unacceptable co-channel interference.

Figure 1: Location of licensed Ch. 10 transmitters

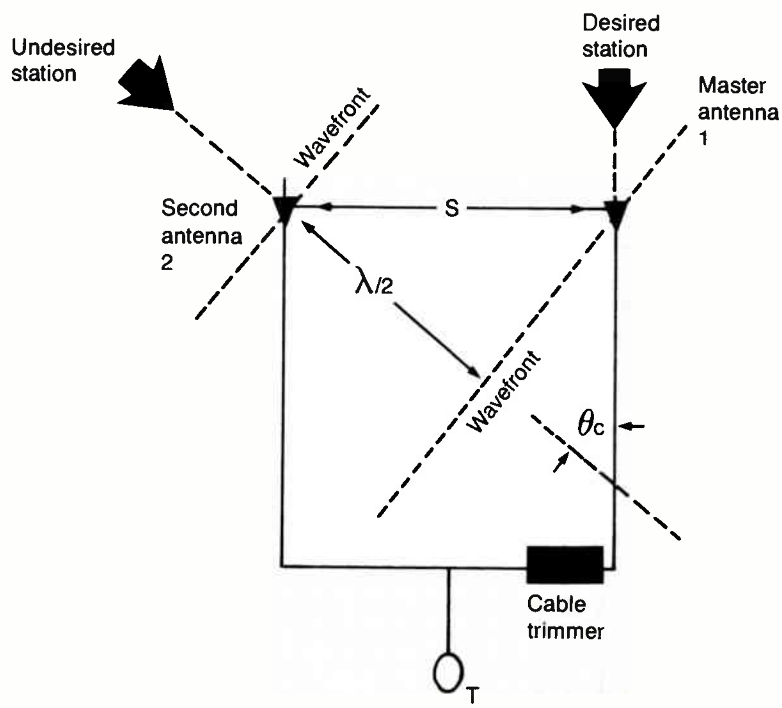
Figure 2: Co-channel interference

Arrays—The historical method

The two antenna array has a long history of use as a co-channel cure. Figure 3 shows a typical arrangement for placing a reception null in the direction of the undesired station. For the co-channel signals received by the two antennas to cancel at the antenna terminal (T), they must arrive at the two antennas in phase opposition (180° difference). This is contrived by spacing them a distance (S) apart so that the two wavefronts containing them are separated by one-half wavelength. Signals of the desired channel received by the two antennas arrive at the common terminal (T) in the phase and therefore add. In this method it is impor-

(Continued on page 45)

Figure 3: Nulling co-channel interference with an antenna array



Part III: Measuring in-depth

This is the third in a series of articles on making technical measurements in cable systems. This month's installment describes carrier-to-noise.

By Bill Benedict
Applications Marketing, Tektronix Inc.

Carrier-to-noise (C/N) as the name implies is a measure of the dynamic range between a carrier and the noise surrounding it, and is referred to as a pre-detection measurement. With an amplitude modulated carrier such as a video carrier, noise looks similar to modulation during the detection process; therefore it is detected and presented as though it were present at the source of the programming.

Signals on a cable system have more than one source of noise. The program material will have a level of noise associated with it due to the studio equipment, the storage process (tape) and the medium used to transport the material to the cable operator's premises (off-air reception or satellite). The ratio of the carrier to the noise at this point is usually large enough that measuring with a spectrum analyzer is difficult—if not impossible—because the system noise level is typically much lower than the level of the spectrum analyzer's internal noise. The second source of noise is the distribution system (plant) itself, including the effects of the cable loss and the noise figure of the amplifiers in the cascade.

Source of noise

Every component or item in a system has noise associated with it. This comes from the electrons within the atoms as they orbit the nucleus. A simple equation easily describes this energy. As an example, we can calculate the thermal noise across a 75 ohm resistor. The equation is:

$P = kTB = E^2/R$, therefore

$$E = \sqrt{kTBR} \qquad (1)$$

where:

- k = Boltzman's constant (1.38×10^{-23} watts/° Kelvin)
- T = temperature in °K where room temperature is 293.15°K (°K = °C + 273.15)
- B = bandwidth of the noise—4 MHz is the bandwidth of most video systems, thus will define the noise voltage in a receiver's intermediate frequency (IF)
- E = voltage
- R = resistance of circuit

Applying the previous formula we get:

$$E = \sqrt{1.38 \times 10^{-23}\ \text{watts/°K} \times 293.15\text{°K} \times 4\ \text{MHz} \times 75\Omega} = 1.1017\ \mu V$$

$$\text{dBmV} = 20\log_{10}(1.1017 \times 10^{-6}\ \text{V}/10^{-3}\text{V}) = 20 \times (-2.96) = -59.16\ \text{dBmV}$$

Thus it can be seen the noise power across a 75 ohm resistor when bandwidth limited to 4 MHz will be theoretically about −59 dBmV. With a perfectly noiseless carrier of +10 dBmV in this theoretical system, a C/N of 69 dB is obtainable. As the signal passes through the cable (where it is attenuated) and amplifiers (where it is amplified), the signal amplitude can be calculated by subtracting the cable losses from the original amplitude and adding the amplifier gains to determine the signal amplitude at any point in the system.

To calculate the noise at any point in the system is more complicated. This is due to the proximity of the noise of the various components and how they combine together. The following equation allows you to calculate the distribution induced noise at any point in the system assuming all amplifiers have the same gain and all amplifiers have the same noise figure:

$$\text{C/N (at any amp output)} = A_s - A_n \qquad (2)$$

where:

- A_n = noise level out of amplifier = −59 dBmV (input noise) + gain (of one amplifier) + amplifier noise figure + 10log(number of amps in a system)
- A_s = carrier level out of amplifier

By applying Equation 2 to the system shown in Figure 1, it can be understood how the noise level increases as a signal progresses deeper into the system while the carrier levels remain the same. What happens if a carrier has excess loss through a portion of the system? The noise adjacent to the carrier would experience the same loss but would never drop below −59 dBmV. Then as the signal is amplified back to its proper level, the noise would be amplified by the same amount; thus once C/N ratio is lost, it cannot be recaptured.

In-band vs. out-of-band

C/N can be defined best in terms of out-of-band C/N and in-band C/N. Out-of-band C/N is a measure of the ratio of a carrier amplitude to the noise adjacent to the carrier, but out of the channel bandwidth. This allows one to measure the degradation of the distribution system indepedent of the source material on the carrier. Since the noise is measured out-of-band, the carrier can be an operational carrier. In-band C/N is a measure of the ratio of a carrier level to the noise level within the band-

Figure 1: Carrier amplitude and noise distribution in plant

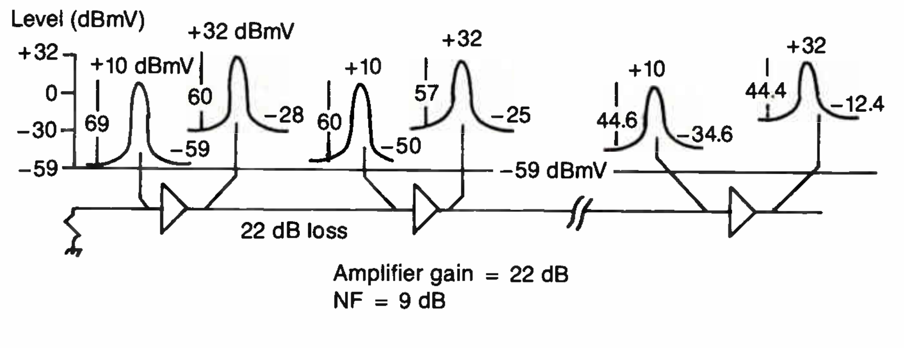
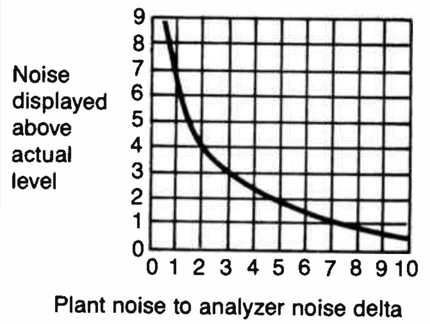


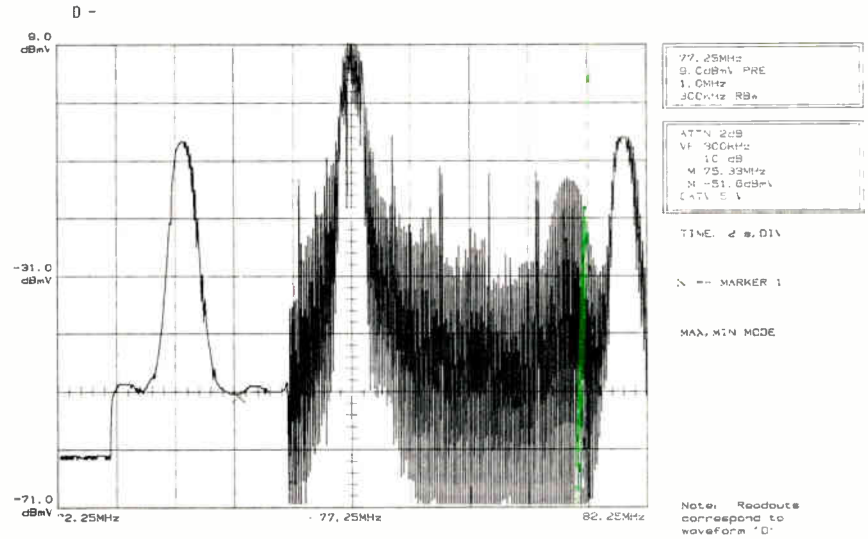
Figure 2: Correction for determining plant noise



width of the carrier channel. This measurement can be made with the standby carrier where once again a measurement is being made of the distribution system degradation.

If the measurement is made with modulation, it requires a visual interpretation of the noise level since the system noise and carrier modulation have the same visual display on the screen of the analyzer. In this case, the measurement is of the ratio of the visual carrier level to the noise level of the source material and the distribution plant. This type of measurement when made in the broadcast industry is referred to as a signal-to-noise (S/N) ratio and is made on the baseband signal with a random noise measuring set. Video S/N is a post-detection measurement.

Figure 3



SA characteristics

How does the spectrum analyzer measure the carrier-to-noise ratio? This is best understood after an explanation of certain characteristics of the analyzer.

Before attempting a C/N measurement, the user must verify that the CATV plant noise is greater than the spectrum analyzer (SA) noise. This is best accomplished by enabling the SA's video filter and observing the level of the system noise, then disconnecting the signal from the analyzer and observing the analyzer noise. If the two levels are greater than 10 dB apart (plant noise higher than analyzer noise), an accurate measurement can be made. If the two noise levels are within 10 dB of each other, the SA will display the system noise higher than it exists because the noise from both analyzer and system will sum together. Figure 2 depicts the amount of the noise that will be displayed above the actual noise based on the difference between the system noise and the analyzer noise. By applying this correction, calibration can be maintained.

An SA has a parameter called "optimum input level." This shows how much power the SA is expecting at the first mixer to provide a full-screen signal and also is the level of the total amount of power the first mixer can handle without producing spurious signals above the instrument specification. Depending on the reference level selected by the user, the analyzer will select the appropriate amount of RF attenuation to attenuate the signal to this level. Most modern RF spectrum analyzers have an optimum input level of about +17 dBmV (−30 dBm). This establishes the best C/N ratio the analyzer is capable of measuring if the analyzer's noise figure (NF) is known. Unfortunately, noise figure is not typically specified, but can be determined from the sensitivity figures given for the analyzer. Due to the wide frequency range of most RF spectrum analyzers, this noise figure is not as good as typical CATV components.

The noise figure can be determined with the following formulas:

$$NF \approx 174 + \text{sensitivity (dBm in any given RBW)} - 10\log RBW, \text{ or} \quad (3)$$

$$NF \approx 125 + \text{sensitivity (dBmV in any given RBW)} - 10\log RBW \quad (4)$$

where:
RBW = any resolution bandwidth

Values of 10 to 40 dB are common noise figures for an SA. Once the NF of the analyzer is known, the largest C/N number the analyzer is capable of measuring can be determined. So:

$$C/N(max) = A_s - (-59\text{ dBmV} + NF + 2.5\text{ dB}) \quad (5)$$

where:
A_s = amplitude of signal—A maximum of +17 dBmV is used since the analyzer will attenuate the signal to this level at the first mixer, if the signal is greater
−59 dBmV = level of the noise normalized to 4 MHz
NF = noise figure of the analyzer as computed from Equations 3 or 4
2.5 dB = correction for the amplitude of the noise as displayed on an SA. (The log circuitry and detector distort noise by this amount when processing.)

By overdriving the analyzer's first mixer

Figure 4

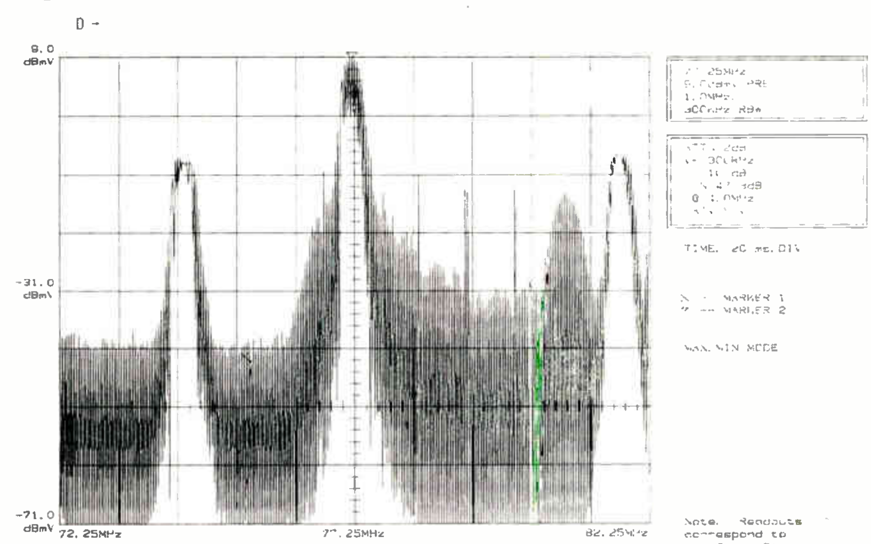
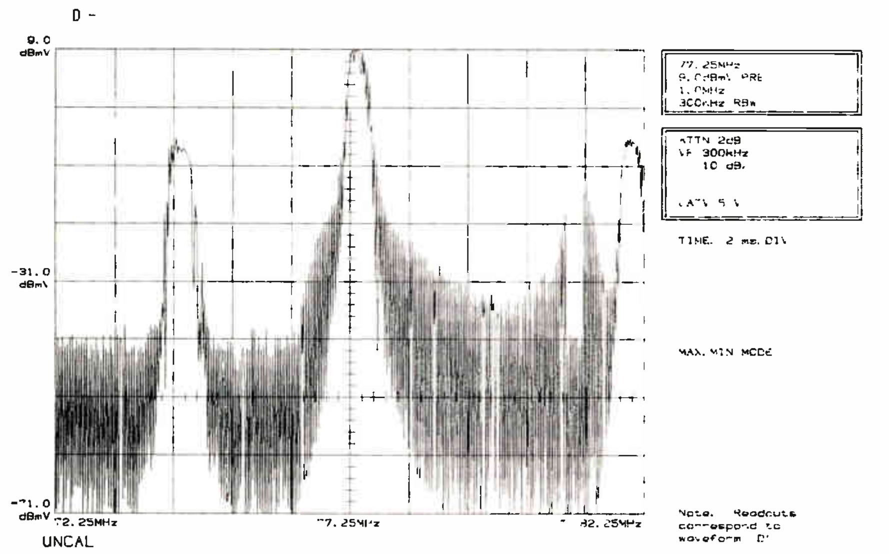


Figure 5



by 10 dB, an increase of 10 dB in C/N capability is obtained. This capability exists in some analyzers, but may cause spurious signals to appear on the screen. Since this measurement is one of carriers and noise, the spurious signals (if present) can be ignored. A typical analyzer has a noise figure of 30 dB that calculates to a maximum C/N capability on a +10 dBmV signal in a customer's home of 36 dB without using external preamplifiers.

As previously mentioned, a noise bandwidth of 4 MHz is used in the C/N measurement. Unlike a coherent signal that has the same amplitude regardless of the bandwidth used to measure the signal, the level of noise power is directly related to the bandwidth the noise is measured through. Since historically the video signal was processed in a receiver with a bandwidth of 4 MHz, this value is used as a reference when measuring noise. In addition, the bandwidth is the noise bandwidth, which differs from the resolution bandwidth of the spectrum analyzer. Noise bandwidth is defined as the amount of power detected through a rectangular filter. Since the SA filter is not rectangular and is defined in terms of its 3 dB or 6 dB bandwidth, a factor must be included to convert the resolution bandwidth into the noise bandwidth. Documents are available from various vendors describing these conversion factors.

Making the measurement

In manually determining the C/N ratio of a signal, several factors must be taken into account. Figure 3 shows SA noise (first division), plant noise (second and fourth division) and carrier amplitude (center of screen). The following amplitudes were taken from Figure 3 using the marker function of the analyzer, since markers correct for non-linearities in the log amplifier and the CRT geometry. These values are:

Signal amplitude: 9.3 dBmV
Noise amplitude: −51.6 dBmV
Analyzer noise floor: −62 dBmV
Analyzer RBW used: 300 kHz
Analyzer measured BW: 333 kHz
NBW/RBW ratio: 0.83*

We can calculate C/N using the following formulas:

$$C/N = A_s - (A_n - K_{pn/an} + 2.5\text{ dB} + 10\log[4\text{ MHz/NBW}]), \text{ or} \qquad (6)$$

$$C/N = A_s - (A_n(\text{corrected}) - 2.5\text{ dB} + 10\log[4\text{ MHz/NBW}]) \qquad (7)$$

where:

A_s = signal peak amplitude. (When measuring peak amplitude, use a 300 kHz RBW with no video filter to obtain the peak amplitude of the sync pulses.)

A_n = average displayed noise amplitude. (When measuring noise, use maximum video filter to obtain the average noise level.)

$K_{pn/an}$ = correction for ratio between plant noise and spectrum analyzer noise.

2.5 dB = correction for analyzer error in detecting noise. (This factor is common to all vendor's spectrum analyzers.)

*NBW = noise bandwidth of the resolution bandwidth filter being used.

NBW ≈ measured RBW × 0.83 for the 6 dB bandwidth of the 300 kHz filter on the Tek 2710 spectrum analyzers.

NBW ≈ measured RBW × 1.05 for the 3 dB bandwidth of the HP spectrum analyzers.

10log(4 MHz/NBW) = normalizing from the RBW filter used to the specified 4 MHz.

A_n(corrected) = plant noise corrected for proximity to analyzer noise floor.

$= 10\log(10^{\text{measured noise}/10} - 10^{\text{analyzer noise}/10})$

Now we can use the previous values from Figure 3 to calculate the C/N ratio. So:

$$C/N = 9.3\text{ dBmV} - (-51.6\text{ dBmV} - 0.4\text{ dB} + 2.5\text{ dB} + 10\log[4\text{ MHz}/333\text{ kHz} \times 0.83])$$
$$= 9.3\text{ dBmV} - (-51.6\text{ dBmV} - 0.4\text{ dB} + 2.5\text{ dB} + 11.61\text{ dB}) = 47.2\text{ dB}$$

or using the alternate equation we get:

$$C/N = 9.3\text{ dBmV} - (10\log[10^{-51.6/10} - 10^{-62/10}] + 2.5\text{ dB} + 10\log[4\text{ MHz}/333\text{ kHz} \times 0.83])$$
$$= 9.3\text{ dBmV} - (-52\text{ dBmV} + 2.5\text{ dB} + 11.61\text{ dB}) = 47.2\text{ dB}$$

Fortunately, the modern spectrum analyzers from several vendors are capable of making the C/N measurement by performing the above calculations, reducing the probability of error. Figure 4 shows the same signal being used with the Tek 2710 SA indicating a C/N of 47.3 dB.

C/N on active video signal

Figure 5 is a plot of the Ch. 5 carrier where the vertical interval was captured approximately 3.6 MHz above the video carrier. During the vertical interval, the chroma or color burst is inhibited on the baseband signal; thus the analyzer detects no energy being modulated during this brief period of time. Since a video filter could not be used to filter the noise to an average value at the sweep speed necessary to capture the vertical interval, the operator would have to visually determine the value of this noise. Typically, the average value of non-filtered noise will be 10 dB lower than the peak of the noise. In this case, the average noise would be −51 dBmV, which is very close to the value of −51.6 dBmV found by using the markers on the filtered noise from Figure 3. Using this approximation, the results indicate only a 0.6 dB degradation in the C/N ratio using an active carrier, thus checking both the source material and the plant distribution quality.

Pay-per view technologies: Making the right choice

In the last several years numerous articles have been written regarding pay-per-view (PPV). The following will review the available technologies and present some cost guidelines. Actual costs will vary with company affiliation, equipment make/model and volume purchases. These figures therefore are guidelines and not absolute values.

By Fredrick Alex Rosales
Staff Engineer, Northeast Division
United Artists Cablesystems Corp.

The economics and effectiveness of pay-per-view depends on numerous factors, including subscriber base, addressable converter penetration, system architecture and converter technology. All these parameters must be properly weighed and assessed before launching any PPV program.

There are five different techniques, ranging from technology-driven store and forward to good old-fashioned customer service representatives (CSRs), available to launch pay-per-view services. Each has distinct advantages and disadvantages that make one more appropriate than another depending upon the system environment.

The techniques include ANI (automatic number identification), store and forward, ARUs (automatic response units), CSRs and real-time two-way. Store and forward is available with either telephone or RF return. Real-time two-way addressability is available but not considered due to the ingress problems inherent in two-way systems and the small market share it holds.

The advantages and disadvantages of the five different technologies are covered in Table 1. A quick comparison can be accomplished by glancing at this tabulation. Careful evaluation is necessary in choosing a consumer-friendly "box" that will facilitate purchases—in person and with a VCR timer. It's recommended all systems perform this task in light of their market requirements. Though virtually all converters will work with any chosen technology, some converter features are specialized for the manufacturer's proposed technology.

RF and phone store and forward converters are available from several manufacturers. These converters are preauthorized to operator-specified purchase limits allowing subscribers to make instantaneous buys. Because of preauthorization these converters also can be used to launch impulse pay-per-view services. The purchase information is retrieved periodically through the return path. Only two-way active cable systems can employ RF return. Since most systems are one-way active a telephone return must be employed. This requires a telephone jack to exist or be installed near the converter and a phone line connected to the converter. A computer-driven modem can automatically poll converters and retrieve purchase information for proper billing.

Alternatively, automatic response units can be employed to automate order taking. The subscriber simply responds by entering an event code, ID number, or other code on the phone's touch-tone key pad. This system also can handle rotary dial telephones.

Automatic number identification also automates order taking with the subscriber dialing a phone number corresponding to the desired event. The cable operator must purchase and install the central office switcher and pays 25 cents per transaction. The switcher cost plus installation is roughly $100,000.

CSRs also can be used to launch pay-per-view. This is a cost intensive but fair-

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Table 1: Pay-per-view technology comparison

	Advantages	Disadvantages
ANI	Low capital cost No additional sub equipment Compatible with all converters	High cost per event Sensitive to peak traffic, limited by telco capacity Telco has access to sub list Interrupts sub viewing Conflicts with phone use
ARU	Very low variable capital cost Compatible with all addressable converters	Sensitive to peak traffic Interrupts sub viewing Conflicts with phone use
CSR	Interaction with sub Multifunctional	High cost Sensitive to peak traffic Possible inaccuracies
Real-time RF	Automatic credit check No transaction cost Remote authorization/status check possible	High converter cost High plant cost High maintenance cost Ingress can cause errors and/or disrupt operation Peak traffic sensitive
Store and forward RF	Instantaneous authorization Insensitive to peak traffic Automatic credit check No transaction cost Remote authorization/status check possible	High converter cost High plant cost High maintenance cost Ingress can cause errors and/or disrupt operation
Store and forward Phone	Instantaneous authorization Insensitive to peak traffic Automatic credit check No transaction cost Remote authorization/status check possible	High converter cost Telephone extension installation cost Conflicts with phone use

Digital video

(Continued from page 23)

ratio (SNR) than the 7 bit per sample digital signal.

Therefore, the reasons why digital technologies in CATV had only limited success include the following:

- Insufficient channel capacity per fiber,
- Higher cost than FM,
- Lower video SNR (7 bits per sample), and
- Key advantages of digital transmission (like unlimited repeat capability) irrelevant to CATV.

A good comparison of analog FM and digital links can be found in "Cost and performance comparison of fiber-optic CATV supertrunks utilizing FM and digital transmission techniques"[5]. In order to compete with FM, digital needs at least a 16-channel capacity per wavelength. If compression is not used, a data rate of 1.4 to 2.1 gigabits per second has to be implemented (depending on the number of bits per sample and the clock rate). If the laser is pulse code modulated a carrier-to-noise ratio (CNR) of 16 to 18 dB is desirable for adequate margin. FM (using satellite FM parameters) with 39.5 dB FM improvement in a 36 MHz wide intermediate frequency (IF) channel needs a CNR of 20.5 dB for 60 dB weighted video SNR in 36 MHz or 6 dB in 1 GHz (which is the transmission bandwidth needed for a 1.5 gigabits per second NRZ signal). Despite widespread beliefs, FM has no inherent sensitivity disadvantage over digital. Nevertheless, in practice digital links are more sensitive than analog FM links for the following two reasons:

1) Some people like to compare the sensitivity of four-channel digital links with 16-channel analog FM links. Four-channel FM links (with a transmission bandwidth of 160 to 200 MHz) perform as well as four-channel digital links.
2) In the past many FM links were designed for optical losses below 15 dB. These links were designed for high linearity rather than for high sensitivity. They can be 6 to 10 dB less sensitive than a design for optimum sensitivity.

Digital vs. AM fiber link

First generation AM fiber links showed the following problems:

- 5 to 7 dB laser RIN (relative intensity noise) variation between lasers as well as operating conditions
- More than 10 dB variation in composite triple beat (CTB) and composite second order (CSO) between lasers as well as operating conditions

With new lasers that are specifically designed for AM these problems could become a thing of the past[6].

AM will always have one advantage over any other modulation format and that is that TV receivers are AM (or vestigal sideband) receivers. But AM will always have two basic limitations too. These are the non-linear effects in the fiber with high optical power levels and detector quantum noise.

Non-linear effects can become a problem at optical transmit powers around 10 mW in links exceeding 20 km in length[7]. In suboctave links where very sensitive transimpedance amplifiers can be used we can assume detector quantum noise to be predominant. At an optical receive power level of −8 dBm, a 16-channel AM system will approximately achieve a 60 dB quantum limited weighted video SNR. Under these assumptions the longest 16-channel AM links will therefore not exceed an 18 dB

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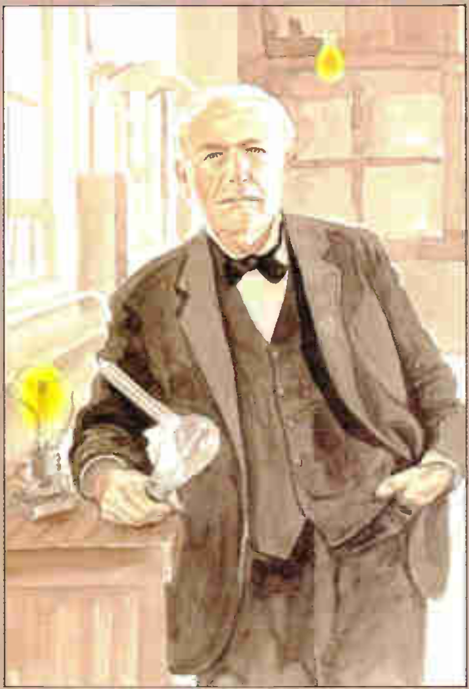

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loss budget or a length of 22 miles when RS250B medium haul performance is the goal.

An equally performing digital link would probably use a 1 mW Fabry-Perot laser. One of the best commercially available optical digital receivers has a sensitivity of −29 dBm for a 1.6 gigabits per second rate. Approximately 11 dB longer links can therefore be realized with digital than with AM. You would of course rather use repeaters with digital. This increases the reach of such a fiber link to all practical lengths needed without any penalty in video SNR.

Digital tomorrow

Today several chipsets are available that make the implementation of 1.2, 1.6 and 2.4 gigabits per second possible. In the next one to three years it can be expected that several manufacturers will introduce high capacity digital links into the CATV market. This market is probably not too big if AM is as successful in supertrunk applications as some believe it has the potential to be. Only the longer links (exceeding 15 to 18 dB optical loss) or the ones requiring higher specifications (video SNRs better than 60 dB) will use FM or digital.

It is not very probable that in the near future supertrunks will be designed making use of compression algorithms. The supertrunk is the piece of the entire system where the best possible transparency is desirable. Compression algorithms that are inexpensive to implement suffer from visible artifacts and subjectively transparent algorithms like the 45 megabit per second (DS3) encoding algorithm are much more expensive to implement than FM.

TDM high data rate links will probably be more expensive than FM for some time to come. The most important reason for their implementation is their nearly unlimited repeat capability. New network topologies would be required (or are made possible) if that unique feature of PCM should be used.

What about SCM?

In the past two years more and more attention has been drawn to the fact that TDM is not the only way to transmit digital data. Digital was the method of choice in the '70s when lasers had kinks at low power levels and noise was predominately modal noise in multimode fibers. Today's lasers have become so linear and low-noise that they can be compared to other CATV components like hybrid amplifiers. Not making use of the high dynamic range of fiber links is a waste that can only be justified by the nearly unlimited repeatability of direct PCM transmission.

So the question is, how many repeats does a CATV system (or today's supertrunk) really need? If redundancy is not of concern then distance is the issue. Supertrunk distances of 50 miles will probably never be exceeded. A carefully designed FM link with one repeat can still do 60 dB video SNR with 16 channels per fiber. PCM has no clear advantage in this situation. In topologies that require several repeats the distances are probably short (repeats for redundancy). FM will produce SNRs in the upper sixties. Three to four repeats are probably needed.

How do subcarrier multiplexing (SCM) techniques using digital modulation compare to AM or FM? If digital modulation of radio frequency (RF) carrier is used instead of FM then the following differences appear:

- Shorter links show no SNR improvement over longer links. This is not very significant as long as the link is transparent. (Video SNR > 60 dB.)
- The video parameters will not depend on the performance of the fiber link any more as long as a certain bit error rate is guaranteed. →

- Depending on the digital modulation format at least as much transmission bandwidth will be used as with FM. An equal or lower number of channels per fiber will be achieved than with FM.
- A 4 GHz microwave subcarrier link exceeds the transmission capacity of any TDM/PCM link for some time to come.

SCM links can use mixed modulation formats. It is thinkable that additional channels using digital modulation are placed above 1 GHz in existing FM fiber supertrunks. New modulation formats like high definition TV (HDTV) or MAC can immediately be transmitted.

What this basically means is if a high capacity fiber link has to be built that does not need more than let's say five repeats but needs very stable performance, a very high degree of flexibility and low maintenance, then SCM links using analog or digitally modulated carriers are a good choice. Olshansky shows in his article on microwave subcarrier multiplexing[8] that RF or microwave subcarriers make a better use of a fiber link than PCM/TDM does. He suggests FM or frequency shift keying (FSK) as the modulation format. Phase shift keying (PSK) and especially quadrature phase shift keying (QPSK) have a better spectral efficiency than FSK but they are more expensive to implement.

Frequencies up to approximately 1.5 to 2 GHz can be transmitted using Fabry-Perot lasers at a reasonable cost. Using FM or digitally modulated carriers, the following number of channels can typically be tranmitted: FM, 36; FSK, 8; PSK, 16; QPSK, 32. Minimum optical receive powers are around −21 dBm when an avalanche photodiode (APD) followed by a low noise amplifier are used.

In CATV, fiber supertrunk digital techniques will be used increasingly in the '90s. The standard will probably be uncompressed until a compression algorithm finds widespread acceptance in the industry. Because of better flexibility and higher channel capacity as well as because of compatibility with existing fiber links using FM, it is more probable that microwave subcarrier multiplexing (using analog and/or digital modulation) will be used than straightforward PCM/TDM. And finally, there is still nothing wrong with FM.

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Digital testing

(Continued from page 24)

downconverter and demodulator of the receiver. These tests can be done during production, manufacturing or field maintenance of the microwave digital radio system. Digital radio component testing during R&D, production and manufacturing includes filters, amplifiers, mixers, oscillators and intermediate frequency (IF) circuitry. New, programmable spectrum analyzers not only measure digital radio transmitter frequency, stability, power level, occupied bandwidth, spurious signals, harmonic distortion and local oscillator stability, but they do so with high speed. More complex measurements, such as mean power level, occupied bandwidth and filter leakage become simple automated tests. Single key automated tests run faster and are easier to perform.

Automating mean power level measurement

Before looking at how to program the analyzer for the mean power level measurement it is useful to review some basics.

Microwave digital radio output is non-coherent random noise. Therefore, the displayed amplitude will change by 10 dB for a decade change in analyzer resolution bandwidth as long as analyzer bandwidths stay much narrower than the digital signal main lobe width. The displayed main lobe amplitude therefore depends on the analyzer bandwidth. The difference between the displayed main lobe level and the mean power level in the unmodulated carrier is desensitization and is the factor of 10 log (Fs/BWn) in Equation 1.

Mean power level is easily measured; simply turn off the modulation and then measure the mean power level of the unmodulated carrier. This process works fine if the system is out of service. If the system cannot be removed from service, the power level of the modulated spectrum main lobe can be measured. The mean power level can be calculated using the following equation:

$$\text{Mean power} = \text{main lobe level} + 10 \log(F_s/BW_n) + 2.5\ \text{dB} \quad (1)$$

where:

Fs = signalling rate (symbol or baud rate)
BWn = equivalent spectrum analyzer noise power bandwidth
2.5 dB = correction for noise response of the logging amplifier and detector

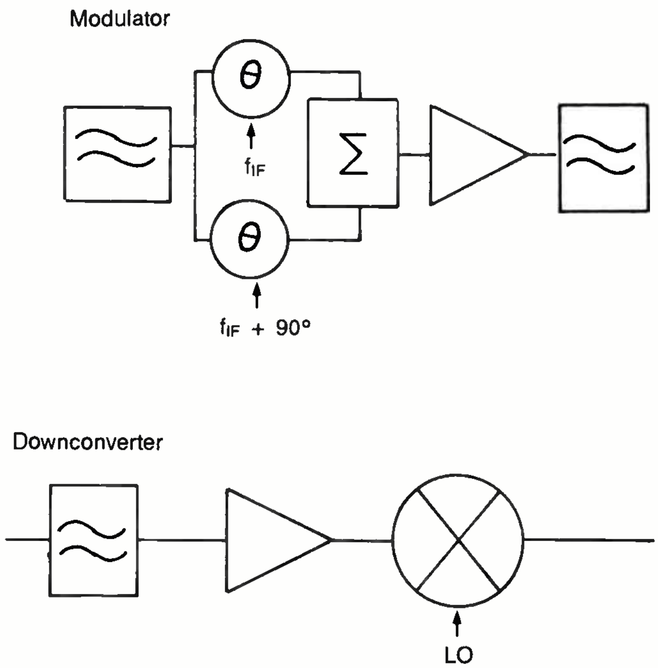
Fs is determined by measuring the side lobe spacing or half of the main lobe width. Digital radio signals—like random noise—consist of frequency components that are random in amplitude and phase. Since the phase of spectral components are random, doubling the bandwidth doubles the measured power. Noise power bandwidth is defined as an ideal rectangular filter bandwidth with the same power response as the actual spectrum analyzer IF bandwidth filter. For Hewlett-Packard spectrum analyzers the equivalent noise bandwidth[1] (BWn) is approximately 1.2 times the actual analyzer 3 dB resolution bandwidth. Spectrum analyzer detectors and log amplifiers tend to limit the peaks of random noise, so a 2.5 dB correction factor must be added to the level of the digital radio signal for the absolute amplitude.

Programming the spectrum analyzer

To program an HP 8592A spectrum analyzer for the mean power level measurement, each factor of the equation is con-

AD INDEX

Figure 3: Components of modules

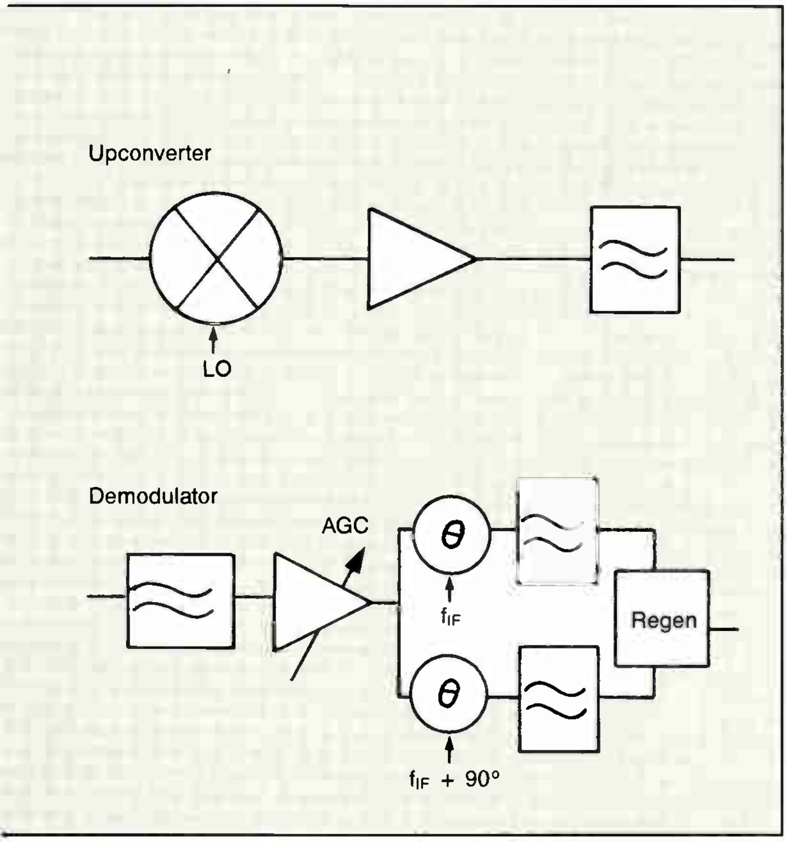


sidered separately as the formula is converted to a program useful to the spectrum analyzer. A digital radio signal can be assumed to be displayed on the analyzer as in Figure 4.

To illustrate how a spectrum analyzer performs this function, a detailed discussion of a mean power level program listing is presented. Once loaded in the spectrum analyzer memory, the following program will remain until erased or written over:

```
800  ASSIGN @Sa=718 ! sets @Sa = bus address 718
900  OUTPUT @Sa;"VARDEF IX;VARDEF D_M;VARDEF P_R;"
910  OUTPUT @Sa;"VARDEF T_WO;VARDEF P_WR;VARDEF T_RD;"
920  OUTPUT @Sa;"IP;" ! performs instrument preset
930  OUTPUT @Sa;"SNGLS;TS;" ! sets single sweep, takes a sweep
1000 OUTPUT @Sa;"FUNCDEF P_OWER,@"
1010 OUTPUT @Sa;"VIEW TRA;MKPK HI; MOV TRD, TRA;"
1020 OUTPUT @Sa;"SUB D_M, 9000, TRD[MKP];MKOFF;"
1030 OUTPUT @Sa;"ADD TRD, TRD, D_M;"
1040 OUTPUT @Sa;"EXP T_RD, TRD, 2000;"
1050 OUTPUT @Sa;"MOV IX, RMS T_RD;"
1060 OUTPUT @Sa;"LOG IX, IX, 2000;"
1070 OUTPUT @Sa;"SUB IX, IX, D_M;"
1080 OUTPUT @Sa;"CTA IX, IX;"
1090 OUTPUT @Sa;"MPY P_R, RB, 1.2;" ! P_R = BWn
1120 OUTPUT @Sa;"DIV T_WO, SP, P_R;" ! Fs/BWn
1130 OUTPUT @Sa;"EXP P_WR, IX, 10;"
1140 OUTPUT @Sa;"MPY P_WR, P_WR, T_WO;"
1150 OUTPUT @Sa;"LOG P_WR, P_WR, 10;"
1160 OUTPUT @Sa;"ADD P_WR, P_WR, 2.5;"
1170 OUTPUT @Sa;"PUPA10,160;TEXT/MEAN POWER LEVEL=/;"
1180 OUTPUT @Sa;"DSPLY P_WR,5.1;TEXT/dBm/;"
1190 OUTPUT @Sa;"@"
1200 END
```

The mean power level program begins with line 800, which sets @Sa=718 the controller bus address. Lines 900 and 910 define the variables. Line 920 does an instrument preset, "IP." Line 930 sets the analyzer to single sweep mode "SNGLS," and



then takes a sweep, "TS." The function definition, "P_OWER," is line 1000. The actual function defined is contained between the delimitor, "@," in line 1000 and line 1190 of the program.

Next, the signal trace shown in Figure 4 is taken, and with command "VIEW TRA" the trace is stored in trace memory to prevent it from being changed. A marker is placed at the signal peak with the command "MKPK HI" and trace data is stored in data storage location "TRD." (See lines 1000 and 1010.)

The top of the CRT (or reference level) is the most accurate display position. Therefore, lines 1020 through 1060 move the trace to the reference level and measure the signal peak using a short routine to obtain the best integer precision possible. Lines 1070 and 1080 move the signal back to the original level and then convert the display data to dBm. Line 1020 uses the marker position command "MKP," subtracts it from 9,000 (reference level in display units) and places the value into variable "D_M." The command "MKOFF" turns off the marker.

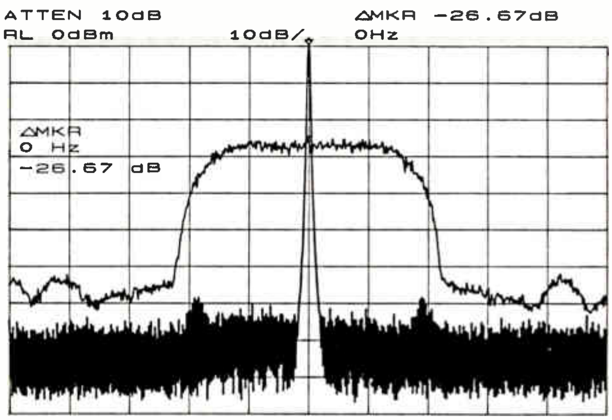
Since the value "D_M" is the difference between the reference level and the marker's current position, this value is added to the stored data, "TRD." This moves the trace up so that the marker at the signal peak is on the reference level. (See line 1030.)

Because the values are integers, a short antilog/log routine gives the greatest precision possible. Lines 1040 to 1060 convert log data to linear data (voltage) using a scaling factor of 2,000 and then determine the root mean square (RMS) values of the data. Finally, the same scaling factor in reverse logs the data.

Completion of the main lobe power level calculation occurs by subtracting the previous signal, "D_M," from the current point, "IX" in line 1070. This returns the signal peak to its original position, where it is converted to dBm in line 1080.

The solution for 10 log (Fs/BWn) is completed by determining Fs and BWn in lines 1090 and 1120. The signalling rate (Fs) is half the main lobe width. The equivalent noise bandwidth (BWn) is 1.2 times the 3 dB resolution bandwidth. →

Figure 4: Modulated digital radio spectrum after truncation filters



The mean power level equation is solved by exponentiating the value of the main lobe power level, multiplying it by the factor (Fs/BWn), taking 10 times the log of the product and adding the 2.5 dB correction factor. (See lines 1130, 1140, 1150 and 1160.)

Lines 1170, 1180 and 1190 output the mean power level (of the unmodulated carrier) to the display, which is the last step. Line 1170 tells the processor where to start plotting the output text and value with "PUPA" (pen up plot absolute) to horizontal position 10 and vertical position 160 on the display CRT. This result can be printed to a line printer or plotter directly from the display. Line 1180 contains the format for the value outputted; "5.1" means five digits displayed including sign and decimal point with one significant decimal (e.g., "−29.6" dBm). The terminator, "@;" in line 1190 completes the function that was defined in line 1000.

Making other measurements

A spectrum analyzer based program provides a method and procedure for measuring the mean power level of a digital radio unmodulated carrier that has been determined from the modulated signal spectrum. The program can operate as part of a larger program or as a stand-alone single test resident in the analyzer memory. Several other digital radio functions are ideal for automation. A mask can be created that centers the desired signal and compares it to relative (referenced to signal peak) or absolute (referenced to peak of unmodulated carrier) mask limits for occupied bandwidth and filter leakage.

Many more digital radio measurements can be made using a spectrum analyzer. The frequency of the transmitted signal can be measured. Linear distortion such as co-channel interference, and non-linear distortion such as third-order intermodulation or gain compression can also be measured.

References

[1] *Spectrum Analysis....Noise Measurements*, Hewlett-Packard Application Note 150-4, 1974.

[2] Walker, Hugh, *Digital Radio Theory and Measurements*, Hewlett-Packard Application Note 355, 1987.

[3] Feher, Kamilo, *Digital Communications Microwave Applications*, Prentice-Hall Inc., 1981.

[4] Proakis, John C., *Digital Communications*, McGraw-Hill Inc., 1983.

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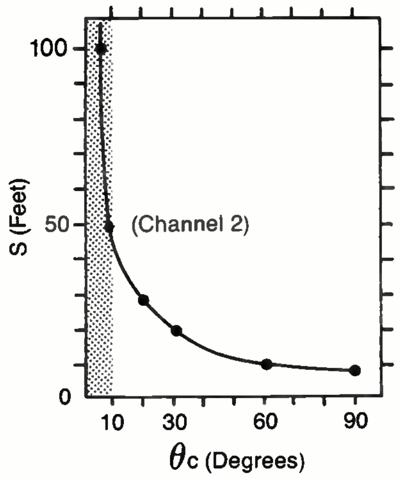
Figure 4: Antenna spacing (S) as a function of off-angle of co-channel source (θc)



Co-channel interference

(Continued from page 26)

tant that the two antennas have identical radiation patterns and gain.

Note from Figure 4 that the spacing (S) becomes large for small co-channel off-angle (θc) and that accuracy of fixing the exact bearing (θc) and corresponding spacing (S) becomes increasingly critical. At small θc a cable trimmer (trombone or other type of adjustable phase shifter) is often used to adjust out inaccuracies in θc and S. In practice, a solution becomes difficult for θc less than about 10°, as indicated by the shaded area of Figure 4.

Phase cancellation—A newer method

While the phase cancellation method (Figure 5) is used in a significant number of cases, it is not as widely known. We still have a two antenna array, but the two antennas need not be identical in gain and radiation pattern. In most cases, an inexpensive low gain subscriber antenna will suffice for the test antenna. Hence, no modification to the master antenna is necessary.

In addition, antenna spacing or cable lengths are not critical. These are absorbed by the phase and amplitude adjustments on the *phasor*—a series combination of adjustable attenuator and adjustable phase shifter. Properly installed and adjusted, the two co-channel signals (from master and test antennas) "destroy" one another at the input to the processor without impact on the desired signal. This occurs because the two signals (desired and undesired) have different modulation envelopes. Hence, when the two co-channel signals are of equal amplitude and opposite phase, they cancel one another exactly with nothing left over to harm the desired signal.

Adjusting test antenna and phasor

The test antenna should point directly at the undesired station. It is often possible to identify it from the specific programming carried. If you have the Biro Co-Channel Locator Maps printed in *CT* (see Figure 1), you can determine the most likely source and lay out its bearing. Lacking these maps, swing the test antenna for worst co-channel. This is the most useful method since angle of arrival often differs from the geometric bearing due to terrain influences such as reflections.

It is desirable that the test antenna pick up a maximum of the undesired signal (it can be reduced with the variable attenuator) and a minimum of the desired signal to prevent the possibility of down phasing the desired signal at the processor. Using readily available antennas, this problem is seldom encountered for off-angles (θc) greater than about 30°. For smaller angles, if a problem is encountered, try tilting the test antenna for vertical polariza-

PPV technologies

(Continued from page 32)

ly effective option, especially if capital dollars aren't available or a small operation with relative few transactions is planned.

Application and cost

Store and forward has the greatest flexibility and highest per subscriber cost. The two most important advantages are that it's not traffic-sensitive and all transactions are instantaneous. This is significant in that potential "buyers" aren't lost in heavy phone traffic as may be the case when ARUs, CSRs and possibly ANI are employed.

Systems employing ARUs and CSRs are traffic-sensitive and limited. Both will be overwhelmed by last minute buys that may result in the loss of some purchases. ARUs may be a good choice to implement PPV in small systems where small capital investment is required and peak traffic isn't a concern. In large systems where small PPV penetration is expected ARUs also may be preferable. An ARU with eight phone lines can handle approximately 16 transactions per minute, or about 30 seconds per transaction per phone. Providing the "human touch" with CSRs is slower, with one minute per transaction typical.

ANI requires greater capital and operating expenditure and may be a good compromise between store and forward and ARUs. The cable company also pays 25 cents per completed transaction and must project this cost for all future PPV channels and price increases. Note: Operating phone charges can quickly erode initial capital savings.

Most converter features are fairly standard as is their performance; thus a system's current and future needs also must be considered when choosing a particular technology. Careful selection can maximize profitability while increasing long-term subscriber satisfaction and value.

The per subscriber cost to implement PPV has been calculated for two models: a 2,600-mile system with 160,000 subs and a 1,000-mile system with 60,000 subs. Both models are calculated with the same addressable converter penetration and buy rates. Depending on roll-out procedures not all subs may have addressable converters and access to PPV. These models are guidelines and new calculations should be performed for each system considering its specific requirements.

Capital and operating expenses for both models are summarized in Table 2, which lists per subscriber cost for each technology, thus allowing an economic comparison. Ranking technologies highest to lowest by per subscriber cost yields the following: store and forward (RF return and phone return), CSRs, ANI and ARUs. The ranking is based on the expected expenses over a one-year period and may change with longer evaluation periods. In evaluating per subscriber costs, both short- and long-term costs should be included.

Table 2: Capital and operating expenses for PPV

System #1: 2,600 plant miles, 160,000 subscribers

	Store and forward				
	Phone	**RF**	**ARU**	**CSR**	**ANI**
Capital					
Home	213	194	174	174	174
Headend/office	162,578	142,428	132,392	106,548	217,048
Plant	0	780,000	0	0	0
Operational					
Home	52,664	0	0	0	0
HE/office & phone	9,065	5,478	9,104	432,478	6,784
Plant	0	69,888	0	0	0
Cost per PPV sub	$216	$207	$176	$181	$177

System #2: 1,000 plant miles, 60,000 subscribers

	Store and forward				
	Phone	**RF**	**ARU**	**CSR**	**ANI**
Capital					
Home	213	194	174	174	174
Headend/office	96,083	88,023	65,897	52,143	162,643
Plant	0	300,000	0	0	0
Operational					
Home	19,749	0	0	0	0
HE/office & phone	4,750	3,386	4,789	162,648	2,544
Plant	0	26,880	0	0	0
Cost per PPV sub	$218	$209	$177	$182	$180

A merging of the minds

Though possible to select a technology purely from a technical aspect other considerations exist. Input from marketing and operations is desirable to make the best overall selection and ensure everyone's concerns are adequately weighed and addressed. Marketing's input is important in identifying the most consumer-friendly converter. Since operations must respond and treat addressable customers their comments also should be obtained to avoid unforeseen problems.

A successful launch of pay-per-view requires good marketing strategy and customer acceptance. Accordingly, technological requirements vary between systems and proper choices should be made jointly by engineering, marketing and operations. The merged and uniform working of these departments are requirements for launching a profitable pay-per-view or impulse PPV service.

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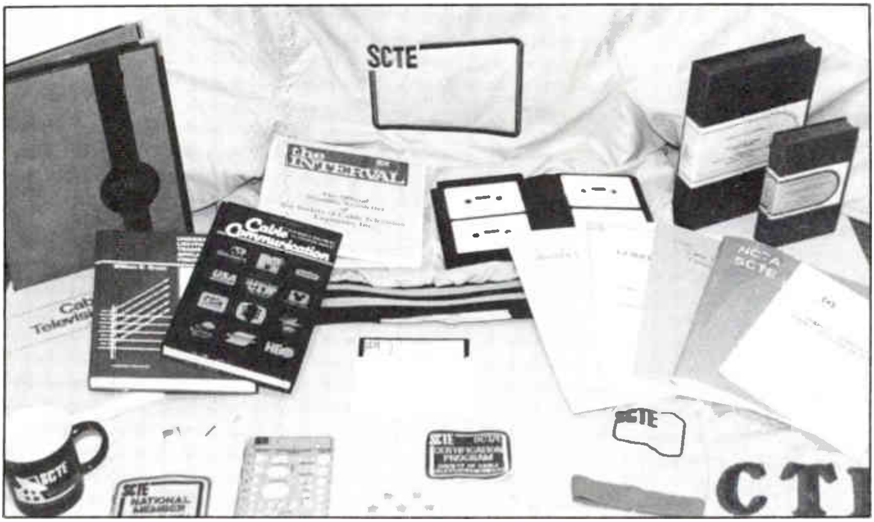
SCTE

February 1990



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DT-2, *Graphic Symbols for CATV Systems*--This thorough compilation of graphic symbols currently used in cable system drawings and diagrams was jointly developed by SCTE and the National Cable Television Association. Includes fiber-optic symbols and 22 other groups of symbols. Member: $5, Non-Member: $7.

DT-3, *NAB Engineering Handbook for Radio and Television*, Seventh Edition--Over 1,200 pages of information vital to industry engineers. This special handbook was published by the National Association of Broadcasters and is a recommended reference for Category II of the BCT/E Certification Program. Member: $160, Non-Member: $220.

DT-4, *Glossary of Cable Television Technical Terms*--Jointly published by SCTE and NCTA, this book contains over 60 pages of technical terms used daily by the cable TV engineering community. Member: $5, Non-Member: $7.

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

TM-2, *Introduction to Digital Electronics* by Joseph Carr, MSEE--A basic course in digital electronics including logic theory, logic families, gates, flip-flops, multivibrators and digital circuit design. Member: $12, Non-Member: $17.

TM-3, *Operational and Linear IC Amplifier Circuit Design-A Practical Short Course for Engineers* by Joseph Carr, MSEE--Provides basic theory and practical application for technicians and engineers, including various circuit designs, operational amplifier problems, audio amplifiers and video and wideband amplifiers. Member: $12, Non-Member: $17.

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

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

TM-6A, *System Design Program - IBM Compatible Version*--A hard copy printout of a computer program facilitating system design. Created by Steve Johnson of ATC and the Society's Rocky Mountain Chapter. Member: $12, Non-Member: $20.

TM-7, *CATV Wizard*--This IBM-compatible computer disk containing 30 CATV formulas is a vital resource

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for industry personnel. Compiled by SCTE member Jim Kuhns, *CATV Wizard* is a collection of thoroughly researched and well-tested programs submitted by SCTE members and other industry leaders. Includes formulas for CATV sytems, earth stations, attenuators, decibel conversions, CLI, Ohm's and Watt's laws, microwave path clearance and many more! Member: $15, Non-Member: $22.

TM-8, *Biro Co-Channel Atlas* by Steven Biro--This manual shows the location of VHF television transmission stations in the continental United States and Canada to help identify probable sources of co-channel TV interference. Also included is helpful theory of antennas and hints on how to reduce the effects of or eliminate co-channel interference. Member: $12, Non-Member: $20.

New Item! TM-9, *Apogee*--A new IBM-compatible computer disk from Jim Kuhns containing formulas for calculating microwave path loss, azimuth and elevation for earth stations, site plotting on maps' fresnel zones and a C-Band transponder frequency chart. Member: $15, Non-Member: $22.

New Item! TM-10, *Installer Certification Manual*--Published as a comprehensive reference for the Society's Installer Certification Program, this manual offers recommended installation practices that will be invaluable to all installers. (Manual is included in $25 Installer Membership fee) Member: $15.

TF-1, *Test Form: 24 hour System Variations Data* (50/pad)--Loose-leaf binder forms for recording data on system variations over a 24-hour period. Member: $7, Non-Member: $9.

TF-2, *Test Form: 24 hour System Variations* (50/pad)--Loose-leaf binder forms for testing system variations. Member: $7, Non-Member: $9.

TF-3, *Test Form: Subscriber Tests Data* (50/pad)--Loose-leaf binder forms for recording data from subscriber tests. Member: $7, Non-Member: $9.

TF-4, *Test Form: Headend Tests Data* (50/pad)--Loose-leaf binder forms for recording data from headend tests. Member: $7, Non-Member: $9.

TF-5, *Test Form: System Test Data* (50/pad)--Loose-leaf binder forms for recording data from system tests. Member: $7, Non-Member: $9.

TF-6, *Signal Leakage Log Sheets* (50/pad)--Forms for the periodic logging of signal leakage. Member: $7, Non-Member: $9.

NB-2, *3" Loose-Leaf Binder: System Tests*--Holds forms listed as TF-5. Member: $10, Non-Member: $15.

NB-3, *3" Loose-Leaf Binder: Subscriber Tests*--Holds forms listed as TF-3. Member: $10, Non-Member: $15.

NB-4, *3" Loose-Leaf Binder: Headend Tests*--Holds forms listed as TF-4. Member: $10, Non-Member: $15.

NB-5, *The Interval Loose-Leaf Binder*--This special binder will hold your collection of *The Interval*, the official SCTE monthly newsletter. A perfect way to catalog the Society's events. Copies of *The Interval* not included. Member: $8, Non-Member: $12.

HS-2, *CATV Health and Safety Compendium*--A concise compendium of proper safety practices to be utilized in the operation of CATV systems. Member: $12, Non-Member: $18.

TR-3, *Report on a Field Test Program to Evaluate the REA Design Concept for Rural Cable Television Systems* by William Grant--A study on test evaluations of rural cable systems using the tapped trunk design outlined in the author's publication of *Cost Effective System Design for Rural Cable Television*. Member: $12, Non-Member: $18.

TR-4, *Primer on CATV Signal Leakage-Methods of Managing and Controlling CATV-RFI*--This publication is possibly the most complete study in print on signal leakage and CATV systems. It includes signal leakage programs established by some of the industry's leading engineers, understanding and correcting plant signal leakage and standards of good engineering practices for measurements on cable television systems. This book should be a must for every cable system engineer, chief technician and system technical library. Member: $20, Non-Member: $45.

TR-5, *Cable Television* by William Grant--A comprehensive guide to CATV technology, examining its equipment, systems and methodology, as well as many other important facets of the workings of cable TV. Perfect for beginners and veterans alike. Second edition. Member: $30, Non-Member: $35.

TR-6, *Understanding Lightwave Transmission: Applications of Fiber Optics* by William Grant--An introduction to lightwave transmission systems and the equipment and optical fibers used in such systems. It also explains the characteristics of lightwaves and optical fibers themselves. This excellent book will give you the edge on this important technical area. Member: $37, Non-Member: $43.

TR-7, *Cable Communications* by Thomas F. Baldwin and D. Stevens McVoy--An insightful look at the CATV industry, encompassing its technology, services, organization, operations and future. Features special appendices on cable regulations, networks, policies, costs and audience survey methods. Second edition. Member: $39, Non-Member: $45.

PD-1, *Secrets of Supervision-A Concise Guide to Good Management*--This National Safety Council publication is an excellent guide for supervisors at any level. It contains all of the basic rules and requirements of being an effective supervisor in simple, easy-to-understand language. Member: $4, Non-Member: $6.

PD-2, *Employee Management and Personnel Development*--An excellent publication for managers and supervisors. Includes information on good personnel and management practices, developing job descriptions, providing employee motivation, delegating authority, training programs and much more. Member: $15, Non-Member: $22.

PD-5, *Equal Employment Opportunity in Cable Television-SCTE Guidelines on Women and Minorities in CATV*--An excellent guide for meeting the industry's obligations under the EEO requirements, as well as establishing and operating an effective Affirmative Action program. Member: $10, Non-Member: $17.

New Item! PD-7, *Handbook: NCTA Recommended Practices for Measurements on Cable Television*

Systems (Second Edition)--A looseleaf binder containing recommended measurement procedures for system proof-of-performance and guidelines for acceptable results. Provides detailed information on how to perform the measurements listed on SCTE test forms TF-1, TF-2, TF-3, TF-4, TF-5 and TF-6. Also includes NTC-7 measurement guidelines for baseband signals. Member: $55, Non-Member: $75.

MD-1, *SCTE 1986-1987 Membership Directory and Yearbook*--Contains list of active members and review of Society activities from 1986 and 1987. Member: $50, Non-Member: $65.

MD-2, *SCTE 1988-1989 Membership Directory and Yearbook*--Over 160 pages of information and photos of Society activities. Member: $50, Non-Member: $65.

New Item! MD-2, *SCTE 1990 Membership Directory and Yearbook*--The latest edition of this now-annual publication, this directory features new photos, additional features, updated information and a revised listing of SCTE's 6,000 active members. Member: $50, Non-Member: $65.

Videotapes

T-1001, *Diagnosing Common Cable Faults*--Shows basic FCC and Canadian Radio-Television and Telecommunications Commission standards for proper cable system operation levels on various distortions. Distortions are identified and explained. An excellent training tool for all system employees and local community groups to explain how the cable system functions within its environment. (30 min.) VHS: $40. **B-I**

T-1002 *Confident Climbing: Classroom Session*--Produced by Viacom Communications. Classroom setting covers basics of theory, equipment, safety and clothing, climbers, body belts, hard hats, straps and gaffs. Safe climbing techniques such as proper aim, angle and depth of penetration are discussed. Detailed instructions include hand and foot movements, balancing, knee and leg angles, posture, ascending and descending the pole. (30 min.) VHS: $40. **I/T**

T-1003, *Confident Climbing: Field Demonstration and Technique*--Produced by Viacom Communications. On-the-pole demonstrations emphasize proper footwear, what to avoid, setting the gaff and physical stress. Hazards of hesitation, proper belting-in procedures, maintaining balance, estimating clearance, circling the pole and work positioning are included. Practice exercises, "hitchhiking" and "reaching out" are demonstrated. (30 min.) VHS: $40. **I/T**

T-1005, *CATV Signal Level Meter Basics*--Basic definitions, design techniques, features, limitations, controls and functions of the signal level meter. Detailed discussion focuses on tuned radio frequency, superheterodyne-downconvert and upconvert-downconvert. Explains signal reception and effects of the SLM. Accuracy, visual/color, types and amount of frequency and amplitude modulation are discussed. (30 min.) VHS: $40. **I/T**

T-1006, *CATV Signal Level Meters: Errors and Accuracy*--Graphics and discussion cover linearity, calibration, measurement range and increments, resolving power capabilities, attenuator steps and peak detector error. On-camera demonstration shows proper use of meter scale. Program covers gain changes, temperature and calibration, shape factors and intermediate frequency (IF) bandwidth. (30 min.) VHS: $40. **B-IV**

T-1007, *Video Test Signals*--Program concentrates on evaluation of video testing techniques. Blackboard presentations examine frequency domain, baseband video signals and Institute of Radio Engineers (IRE) unit scales. Common video waveforms are defined, including multiburst, sine pulse, window, line time distortion, modulated stair step/differential gain and phase, luminance non-linearity, modulated 12 1/2T, modulated pedestal, field rate square wave and vertical interval reference (VIR). (30 min.) VHS: $40. **B-II**

T-1008, *Video Waveform Measurements*--Using actual equipment setups, various measurements are discussed. Topics include baseband video, demodulators, envelope-type detection, synchronous detection, depth of modulation on radio frequency (RF) signals and zero choppers. Full-field video waveform testing includes multiburst, depth of modulation, sine pulse, 2T window, field rate square wave and tilt. Includes information on use of vectorscope, average picture levels and video signal-to-noise. (30 min.) VHS: $40. **B-II**

T-1009, *High Frequency RF Sweep Generator Basics*--Using test setups, graphics and blackboard discussion, tape details major measurements by comparison, attenuators as precision instruments, measuring gain and flatness, peak-to-valley, loss, return loss/voltage, standing wave ratios on passives and cable and delay scan loss. (30 min.) VHS: $45.

T-1010, *RF Sweep Generator Applications*--System sweeping shown with graphics and discussion on low-level vs. high-level sweeping. Measuring at the headend and at the cable is shown. Equalizers, trunk measurements, mismatch in cable and swept response are covered. (30 min.) VHS: $45.

T-1011 *CATV Converter Repair Procedures*--Basic block diagrams explain multichannel varacter converters, RF modules, power supply and control box functions. Electrical and mechanical features, tuning voltages, disassembly and testing, meter leads, lifting loads on power supply and troubleshooting are addressed. Test points are identified. Overall converter repair procedures are presented. (30 min.) VHS: $45.

T-1012, *Multichannel Cable Converter Alignment*--The setting for this video program is the converter repair bench. Block diagrams, demonstrations of alignment techniques and procedures and final assembly are presented. The videotape stresses the importance of following proper procedure in order to maintain low service call rates. (30 min.) VHS: $45.

T-1013, *Cable Television Relay Station (CARS) Application*--This videotape is a step-by-step review of FCC Form 327 and its requirements. The complete series of five schedules included in Form 327 (A through E) are covered in detail. Checklists are provided and relationships of exhibits to required schedules are explained. Federal Aviation Administration requirements, environmental studies, use of government property and tower heights are included. (1 hr.) VHS: $45.

T-1014, *Developing an Effective Preventive Maintenance Program*--Planning and forecasting problems and formulation of solutions are addressed. Distortion, electrical specifications, mechanical bugs, signal leakage and ingress measurement are discussed. Proper testing and test equipment are stressed. Functions of signal level meters sweep devices, cross-modulation and hum or low-frequency tests are covered. (30 min.) VHS: $45.

T-1015, *Construction Techniques for Extended System Life*--Cable, strand, connectors and mechanical devices are detailed. Loop configurations, bonding clamps, lashing wire and strand are examined. Construction techniques to minimize plant problems are outlined. The program also deals with placement of loops and installation of equipment on the pole. (30 min.) VHS: $45.

T-1016, *Safety Awareness Around Electrical Conductors*--Using slides, movies and demonstrations, this videotape provides information about the hazards of working around power. It reviews amperage and its effects and graphically depicts the results of injuries and burns. Clearances and dangers of energized conductors are discussed. Power line handling techniques, clothing, flashes and insulators, wire, aerial and underground cable and wire, conductors and their hazards are included. Produced by the New Jersey Cable Television Association with the cooperation of the Office of Cable Television of New Jersey, New Jersey Bell, Public Electric and Gas, Suburban TV-3 and Maclean Hunter. (30 min.) VHS: $45.

T-1017, *Broadband Cable System Spare Parts and Documentation Procedures*--Procedures to develop, document and maintain a spare parts program are outlined. Program stresses importance of proper training in a spares program. Suggestions are offered on what the CATV field technicians should carry on the job. Cannibalization of stock items is discussed. Various recommendations of stock levels for trunk-related materials, distribution equipment, passives, trunk cable and feeder are provided. (30 min.) VHS: $45.

T-1018, *Broadband Coaxial Cable Basics*--Addresses proper handling techniques of coax. Cable construction is detailed and special features explained. Dielectrics, adhesion and compression are covered. Hazards of improper unloading procedures are outlined. Stacking and storage of reels, wrapping, dealing the rolling edge and benefits of lagging are included. Velocity of propagation, TDR settings and testing problems are highlighted and techniques for moisture protection are covered. (30 min.) VHS: $45.

T-1019, *Selecting Mechanical Equipment to Ensure Extended System Life*--Mechanical integrity and environmental considerations of housings, sealings, elastic limits, pressure, volume, finish, alloys, heat and moisture are outlined. Problems that may cause signal leakage are included. Clamps, pressure deformed sheaths, deterioration problems, tightening, equilibrium of pressure and torque are discussed. Preventive maintenance on mechanical components is stressed. (30 min.) VHS: $45.

T-1020, *Broadband Coaxial Cable Handling and Installation*--Techniques used to pull cable into the pole line, locating cable reels, separation and placement, angle, bending the cable, and using the reel for support are displayed with graphics. Short clearances, "chutting" to the first pole, braking and pressure are explained. Sag and temperature, cable twisting or swivel, single and multiple cables, tools, backlash, playing the loop, lashing techniques and internal tension are covered. Temperature coefficients are explained and shown on graphics. (30 min.) VHS: $45.

T-1021, *Signal Leakage, CLI and the FCC*--A complete three-camera video production of SCTE's technical seminar on signal leakage held September 1985 in Denver. This 12-hour program includes presentations by Bob Luff, Sruki Switzer, Robert V.C. Dickinson and Cliff Paul concerning leakage monitoring practices, plus a satellite teleconference with engineers from the FCC discussing compliance with the commission's new rules regarding cable system leakage. (12 hrs.) VHS: $250.

T-1021A, *Signal Leakage, CLI and the FCC Teleconference*--This excerpt of T-1021 features the live satellite teleconference between the seminar in Denver and members of the FCC in Washington. Panelists include John Wong, Ralph Haller, Wendell Bailey and Archer Taylor. Tom Polis moderates. (2 hrs., teleconference only) VHS: $65.

T-1022, *Video Signals and their Measurement*--This four-hour seminar features instructors from Tektronix and provides an in-depth discussion of baseband video signals and their components, proper usage of video test equipment and recommended procedures for making measurements. (4 hrs.) VHS: $110. **B-II**

T-1023, *dBs and dBmVs*--Veteran instructor Richard Covell discusses the mathematical theory behind the "decibel" and its use in basic engineering calculations. System performance measurements also are covered during this seminar. (1 1/2 hrs.) VHS: $55. **B-IV**

T-1024, *Basic System Design*--Sally Kinsman of Kinsman Design Associates reviews the various approaches to coax plant design. System extensions, rebuilds and new construction are discussed during this seminar. (1 hr.) VHS: $45.

T-1025, *Developing a Preventative Maintenance Program*--Ron Hranac of Jones Intercable discusses one of the most important aspects of subscriber satisfaction: system preventive maintenance. Recommended practices for the reporting and correction of system problems are addressed in this seminar, which also includes maintenance procedures for correcting potential problems before they occur. (1 hr.) VHS: $45.

T-1026, *Choosing Advanced Amplifiers for Your Cable Television System*--Herb Longware of Magnavox CATV Systems discusses the theories behind push-pull, feedforward and power doubling amplifier technologies. These three technologies are then evaluated as to their advantages or disadvantages in a wide variety of plant design applications. (30 min.) VHS: $35.

T-1027 *SCTE Chapter Development Workshop*--The Delaware Valley Chapter's John Kurpinski and the Golden Gate Chapter's Pete Petrovich discuss recommended procedures for starting a local SCTE meeting group and offer tips they have used in presenting quality technical seminars to area technicians and engineers. (A dub of this tape is available free of charge if tape stock is supplied to SCTE in advance.) VHS: $20.

T-1028, *Cable Preparation and Connector Installation*--This three-part presentation, produced by Augat/LRC Electronics, discusses recommended practices for preparing the ends of coax and proper methods for the installation of cable connectors. (30 min.) VHS: $35.

T-1029, *Video and Audio Signals and Systems (BCT/E Review Course)*--Category II Curriculum Committee Chairman Paul Beeman presents this overview of Category II of the BCT/E Certification Program. Emphasis is placed on audio and video terminology, plus test and measurement procedures. From Cable-Tec Expo `86. (1 1/2 hrs.) VHS: $55. **B-II**

T-1030, *Basic Electronic Fundamentals in the Analysis of Cable System Powering*--National Cable Television Institute's Ray Rendoff discusses the fundamental characteristics of AC and DC voltage, AC, standby power supplies, coaxial cable and various amplifier configurations that establish overall system powering requirements. Mathematical calculations using Ohm's law are performed on a sample system powering configuration. Typical powering problems and corresponding troubleshooting techniques conclude this technician level program on system powering analysis. (1 hr.) VHS: $45.

T-1031, *One-on-One with the FCC*--Former FCC engineer and current consultant Cliff Paul and the FCC's Syd Bradfield discuss how to deal with current regulatory changes and answer questions from the audience concerning their own systems compliance in this workshop from Cable-Tec Expo `86. (1 hr.) VHS: $45.

T-1033, *Category IV Review Course: Distribution Systems*--Category IV Curriculum Committee member Bill Grant presents a five-hour review course on the basics of distribution systems in preparation for technician level certification exams. (5 hrs.) VHS: $130. **B-IV**

T-1034, *Category II Review Course: Video and Audio Signals and Systems*--Category II Curriculum Committee Chairman Paul Beeman presents an in-depth look into his committee's category. Information concerning both technician and engineering level certification exams is presented in this tape. (4 hrs.) VHS: $110. **B-II**

T-1035, *Engineering and Technical Management Development Seminar*--This seminar, sponsored by national SCTE and its Chattahoochee Chapter, features a university professor and several industry personnel and management specialists in a series of discussions on how to improve your effectiveness as a manager. (5 hrs.) VHS: $145.

T-1036, *Ku-Band Technology and TVRO Calculations*--HBO Vice President of Engineering Paul Heimbach discusses the technical characteristics of this new satellite technology and the proper preparations for being able to receive Ku-Band transmissions in this workshop from Cable-Tec Expo `87. (1 hr.) VHS: $45.

T-1037 *Interference Elimination with Antennas and Antenna Array*--Biro Engineering's Steven Biro conducts a workshop from Cable-Tec Expo `87 on antenna array and phasing techniques for use in interference elimination at headend sites. (1 hr.) VHS: $45.

T-1038 *Performing Measurements on Basic Test Equipment*--Wavetek's Terry Bush reviews operation of cable system test equipment and proper measurement techniques in this workshop from Cable-Tec Expo `87. (1 hr.) VHS: $45.

T-1039 *Questions and Answers with FCC Engineers*--Former FCC engineer and current consultant Cliff Paul and FCC Engineering Advisor John Wong discuss FCC rules and regulations with Cable-Tec Expo `87 attendees in this interactive workshop. (1 hr.) VHS: $45.

T-1040 *Category I Review Course: Signal Processing Centers* (Technician Level)--Category I Curriculum Chairman Alex Best presents a one-hour review course on the technician level of his committee's category. This workshop from Cable-Tec Expo `87 offers technicians an overview of material contained in the certification exam. (1 1/2 hrs.) VHS: $55. **B-I**

T-1041 *Category VII Review Course: Management and Professionalism*--Category VII Curriculum Committee Chairman Wendell Bailey discusses the purposes and prerequisites for his category's essay examination. A sample question is presented and discussed with BCT/E candidates in attendance. (1 hr.) VHS: $40. **B-VII**

T-1042 *Pole Climbing*--A comprehensive course produced by the Atlee Cullison Training School that develops climbing skills and safety habits. Includes valuable information on climbing apparel and equipment, safe methods of ascending, descending and testing poles to ensure safe climbability. *Previously sold at $250!* (1 hr.) VHS: $195. **I/T**

T-1043 *Extension Ladders*--A course designed to provide thorough and comprehensive instruction on the safe use of extension ladders. Includes segments on ladder positioning, transporting and carrying, securing, climbing and safety. Produced by the Atlee Cullison Training School. *Previously sold at $175!* (35 min.) VHS: $145. **I/T**

T-1044 *Digital TDRs, an Investment You Can Find Fault With*--Riser-Bond presents a discussion and instruction on the proper use of its line of digital time domain reflectometers. From SCTE's Product-Specific Tele-Seminar Program. (Approx. 20 min.) VHS: $35

T-1045 *Balance and Alignment Techniques for Scientific-Atlanta Series 6500 and 6800 Distribution Equipment*--Scientific-Atlanta engineers discuss components and proper alignment techniques for this particular series of distribution equipment in this video produced exclusively for SCTE's Product-Specific Tele-Seminar Program. (30 min.) VHS: $35.

T-1046 *Implementing Stereo Headend Equipment*--Audio engineers Tom Williams and Steve Fox discuss BTSC stereo technology and its proper testing through specific headend equipment in this workshop from Expo '87. (1 hr.) VHS: $45.

T-1047, *Category V Review Course: Data Networking and Architecture*--Category V Curriculum Committee Chairman Ernie Tunmann presents an overview of material covered in his category's BCT/E certification examination. (1 hr.) VHS: $40. **B-V**

T-1048, *Category VII Review Course: Engineering Management and Professionalism*--Category VII Curriculum Committee Chairman Wendell Bailey presents an in-depth discussion of his committee's BCTE certification category. (Similar material to T-1041 except covered in greater detail.) (2 hrs.) VHS: $55. **B-VII**

T-1049, *Florida Chapter Fiber-Optics Seminar*--Over 400 cable engineers were in attendance at this national seminar jointly sponsored by national SCTE and its Florida Chapter. The entire seminar was videotaped, and 10 hours of presentations by experts in the field of fiber optics are offered in this video. *Note: The quality of this recording is fair.* (10 hrs.) VHS: $250.

T-1050, *Signal Leakage Detection*--Equipment used in locating leakage problems within a cable system is discussed by ComSonics in this video produced for SCTE's Product-Specific Tele-Seminar Program by ComSonics. (30 min.) VHS: $35.

T-1051, *Channel Deletion and Reprocessing Networks*--Microwave Filter Co. explains the construction of RF filters and their applications in cable system headend processing in this video produced by Microwave Filter Co. for the SCTE Product-Specific Tele-Seminar Program. (30 mins.) VHS: $35.

T-1052, *Standby Power Supply Maintenance*--Alpha Technologies produced this in-depth program on this important topic, which features company representative Bob Bridge, for the SCTE Product-Specific Tele-Seminar Program. (1 hr.) VHS: $35.

T-1053, *RF Field Strength: Principles and Practices*--An effective presentation of the basics of an RF field - what it is and how it reacts both inside and outside of a cable.

Ron Adamson of Texscan covers the principles of shielding, wavelength and the use of a dipole antenna for detection. In addition, the terminology of the FCC's "microvolt per meter" is discussed in relation to cable's "dBmV." (1 hr.) VHS: $45.

Note: T-1056 to T-1065 were video-taped at Cable-Tec Expo '88 in San Francisco.

T-1056, *High-Definition Television Technology*--This panel discussion from the 1988 Engineering Conference features Walt Ciciora of ATC, Donald Wilkinson of Fisher Broadcasting Co., Lawrence Lockwood of Contel, Paul Resch of The Disney Channel and William Thomas of Nielsen Media Research.(1 1/2 hrs.) VHS: $65.

T-1057, *Frontline: Senior Cable Engineers*--This video features technical leaders from the cable industry and related fields in a panel discussion moderated by Wendell Bailey of NCTA. The discussion focuses on changes in delivery systems, as well as interfacing newer consumer equipment to CATV systems, issues that every cable engineer and technician will face in years to come. (1 1/2 hrs.) VHS: $65.

T-1058, *Fiber Optics - Here and Now*--Jim Chiddix of ATC, David Grubb of General Instrument/Jerrold Division, James Hood of Catel, Vince Borelli of Synchronous Communications and Lawrence Stark of Ortel discuss this vitally important topic. (1 hr.) VHS: $65.

T-1059, *The Future of the CATV Business*--Industry leaders Edward Allen of InterMedia Partners, John Goddard of Viacom Cablevision, Bill Johnson of Scientific-Atlanta and Hal Krisbergh of General Instrument/ Jerrold Division discuss the industry's future horizons. (1 hr.) VHS: $65.

T-1060, *Signal Leakage and CLI Testing*--A basic presentation of signal leakage and CLI testing - what they are and how to deal with them. This program, which features Tom Polis of Communications Construction Group and Robert V.C. Dickinson of Dovetail Systems provides necessary information concerning FCC rules and limits, grandfathering, filing and equipment. Ground measurement techniques and flyover procedures also are discussed. This is a useful tool for developing your own plan to deal with FCC requirements. (1 hr., 10 min.) VHS: $65.

T-1061, *Category V Review Course: Data Networking and Architecture*--Al Kuolas of American Cablesystems discusses digital data and methods of transmission, covering such topics as bits and bytes, parity bits, verification, formats of information, networking, modulation and multiplexing. *Note: This updated version of T-1047 features a different instructor.* (1 hr.) VHS: $40. **B-V**

T-1062, *Category VI Review Course: Terminal Devices*--William Cohn and Mike Long of Zenith Electronics Corp. discuss regulatory agencies and standards, signal levels, noise figures, locating the source of ingress, installation equipment and practices, converters, remote controls, interfacing with consumer equipment and emerging technologies. (1 1/2 hrs.) VHS: $55. **B-VI**

T-1063, *Category III Review Course: Transportation Systems*--Dr. Tom Straus of Hughes Microwave provides a technical look at transportation systems, including the benefits and trade-offs of different methods. This program begins with a basic discussion of the decibel and then goes on to cover baseband video and its waveform, distortion, harmonics, ingress and satellite transmission. It also deals with microwave transmission and refraction, including AM & FM transmitters and receivers. (1 hr.) VHS: $40. **B-III**

T-1065, *Developing a Technical Training Program*--Roger Keith, formerly of Warner Cable Communications, discusses the design and development of a system level CATV technical training program. (1 hr.)VHS: $45.

New Videos
from Cable-Tec Expo '89

Note: T-1066 to T-1078 were videotaped at Cable-Tec Expo '89 in Orlando, Fla.

T-1066, *High Definition Television*--Walt Ciciora of ATC, Wayne Luplow of Zenith Electronics and Norman Hurst of David Sarnoff Research Center briefly review the basics of high definition television (HDTV), going on to discuss intermediate technologies such as advanced TV (ATV) and ACTV. Delivery of these signals by cable, as well as competitive technologies, are also discussed. This program provides an understanding of how HDTV can affect your systems in the years to come. (1 1/2 hrs.) VHS: $65.

T-1067, *Digital Video, A Future Alternative*--Steffen Rasmussen of ABL Engineering discusses the basics of digital video signals, including generating a digital signal from an analog source, coding and decoding, time division multiplexing and some attributes of digital signals. This program explores how digital video can be used in the present and future. (1 hr., 10 mins.) VHS: $65.

T-1068, *Cable vs. the Telcos*--Will the telephone companies emerge as a major competitor with cable technology in the next two years? Is the end of the cable TV industry just around the corner? Gary Kim of Focus Communications, Steve Wilkerson of Florida Cable Television Association, Gary Moore of Southern Energy Consultants Ltd. and Mark Balmes of Southern Bell discuss these issues from political and economic viewpoints. (1 hr., 20 mins.) VHS: $65.

T-1069, *Fiber-Optic Technology*--Jim Chiddix of ATC and Scott Esty of Corning Glass review the basics of fiber-optic communications-how it works, how fiber is constructed and some of the design parameters for using fiber technology in your system. This program also examines, from an operator's point of view, what fiber will mean to the cable industry in the next five years. (1 hr., 5 mins.) VHS: $65.

T-1070, *Cable-Tec Expo Keynote Address*--Paul Weitz, former astronaut and Deputy Director of the Johnson Space Center, provides a break from the day-to-day business of CATV with this candid discussion of the present and future goals of the U.S. Space Program. (37 mins.) VHS: $35.

T-1071, *SCTE Installer Certification, Assuring Quality Performance*--SCTE Director of Chapter Development and Training Ralph Haimowitz provides an overview of the Society's new Installer Certification Program: What it is, what it covers and how it works. The Installer Program fills a critical need in the industry, and this videotape will aid in the implementation of this program in your company. (A dub of this tape is available free of charge if tape stock is supplied to SCTE in advance.) (45 mins.) VHS: $20. **I/T**

T-1072, *Local Origination Equipment and its Use*--Jay Dorman of MPCS Video Industries and Lenny Melamedas of United Artists Columbia Cablevision give an overview of video production and post production equipment, discussing topics ranging from tube vs. chip cameras to various types of editing equipment and video formats. (1 hr., 15 mins.) VHS: $65.

T-1073, *Signal Leakage, CLI and the FCC*--Robert V.C. Dickinson of Dovetail Systems, Brian James of NCTA and John Wong of FCC give a frank discussion of the new rules for signal leakage, including maximum leakage levels, methods of measuring, computations and offsets. Wong and James humorously act out scenarios of both positive and negative FCC system evaluations. (1 hr., 20 mins.) VHS: $65.

T-1074, *Supervisory and Management Skills*--Rollins University Professor Dr. Bill Brown deals with such topics as employee turnover, absenteeism and poor job performance. How can you turn these problems around? Is money the answer? What do employees hope for in an ideal effective and motivating leader? This program provides insight to these problems that face every cable operator. (1 hr., 15 mins.) VHS: $55. **B-VII**

T-1075, *AM Fiber-Optic Transmission*--Wes Schick and J.R. Anderson of Anixter Cable TV join Clive Holborow of AT&T Bell Labs to explore the integration of AM technology into a system, discussing its benefits, architectures and applications, as well as lasers, NCTA fiber optic symbols, AM technology as compared to FM and digital technologies and actual performance experience. (1 hr.) VHS: $65.

T-1076, *Data Transmission Techniques*--Anixter Cable TV's Andy Paff and Don Patton discuss alternative access and the CATV industry's competition with the telcos for the lucrative data transmission market, providing an analysis of the regulatory and operational problems that CATV companies will face in this market. Required equipment is also discussed. (1 hr., 10 mins.) VHS: $55. **B-VII**

T-1077, *Installing Fiber Optic Cable*--If your system is planning to install fiber, or would just like to see the techniques, this presentation, which features Ken Carter of ATC, Larry Nelson of Comm/Scope and Dan Pope of AT&T Bell, is for you. This practical overview also offers solutions to common problems encountered in such installations. (1 hr.) VHS: $65.

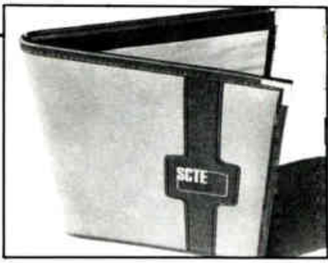
T-1078, *NCTA Signal Leakage Seminar*--The NCTA Science and Technology Department's "Signal Leakage Seminar" was presented throughout the country last year. SCTE videotaped the Atlanta presentation and offers it in its entirety. This seven-hour video discusses the rules, requirements for compliance and methods of performing leakage measurements. (7 hrs.) VHS: $195.

New Video! T-1079, *SCTE Promotional Tape*--This videotape features three programs produced for SCTE, including a promotional video that describes the Society's history and its goals in providing technical training. The "Tech Marketing Training Tape," produced by Metrovision through a grant from CCI, provides information on customer relations for installers and technicians. "The SCTE Music Video" features the SCTE Band and is sure to inspire enthusiasm for the Society. (A dub of this tape is available free of charge if tape stock is supplied to SCTE in advance.) (1 hr.) VHS: $20.

Notes on Videos

The appearance of the symbol **B-** indicates a videotape relating to a certain Category (noted by a roman numeral **I-VII**) of the BCT/E Certification Program. Videotapes relating to the Installer Certification Program are noted by the symbol **I/T**. These tapes have been discounted to aid

Bill Riker



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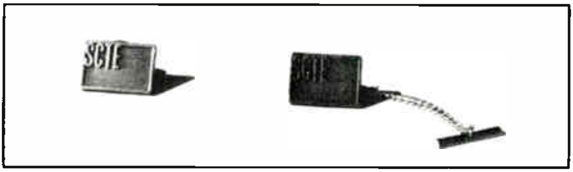

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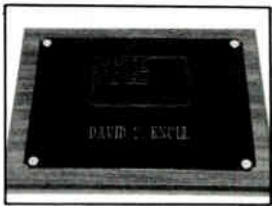

Bill Riker

candidates for certification in the programs in their studies.

Non-members must add 20 percent to the listed prices when ordering videotapes. Orders without a valid SCTE member number will be invoiced at the non-member rate.

All videotapes listed from T-1001 to T-1020 were produced in 1981. Additionally, it should be noted that videotapes T-1021 to T-1032 were produced prior to 1988.

All SCTE videotapes are in color and are available in the 1/2" VHS format only. Payment must accompany all orders, in U.S. funds *only*. Orders without full and proper payment will be returned. Videotapes are available in stock and will be delivered approximately three weeks after receipt of order with full payment.

Shipping Policy

Videotapes are shipped UPS. No post office boxes, please. SCTE pays surface shipping charges within the continental United States only. Orders to Canada or Mexico: Please add $5 U.S. for each book or videotape. Orders to Europe, Africa, Asia or South America: SCTE will invoice recipient for additional air or surface shipping charges (please specify).

While we recognize that "rush" orders are sometimes necessary, a $15 surcharge will be collected on all such orders. The surcharge and air shipping cost can be charged to a VISA or MasterCard.

Promotional Items

PR-1, SCTE T-Shirt (Specify S,M,L,XL). Member: $7, Non-Member: $9.

PR-2, SCTE ceramic mug. Member: $7, Non-Member: $9.

PR-3, SCTE binder (with pad). Member: $17, Non-Member: $21.

PR-4, SCTE lapel pin. Member: $8, Non-Member: N/A.

PR-5, SCTE tie tack. Member: $9, Non-Member: N/A.

PR-6, SCTE embroidered emblem. Member: $1, Non-Member: N/A.

PR-7, SCTE nylon jacket--Made of quality gray nylon with black trim and blue embroidery, this jacket has a heavy lining and an embroidered SCTE logo. Available in small, medium, large, extra large and 2XL sizes. Member: $39, Non-Member: N/A. Personalization (optional): $5 (one name only).

PL-1, SCTE member plaque (Logo Only). Member: $30, Non-Member: N/A.

PL-2, SCTE member plaque (Personalized). Member: $40, Non-Member: N/A.

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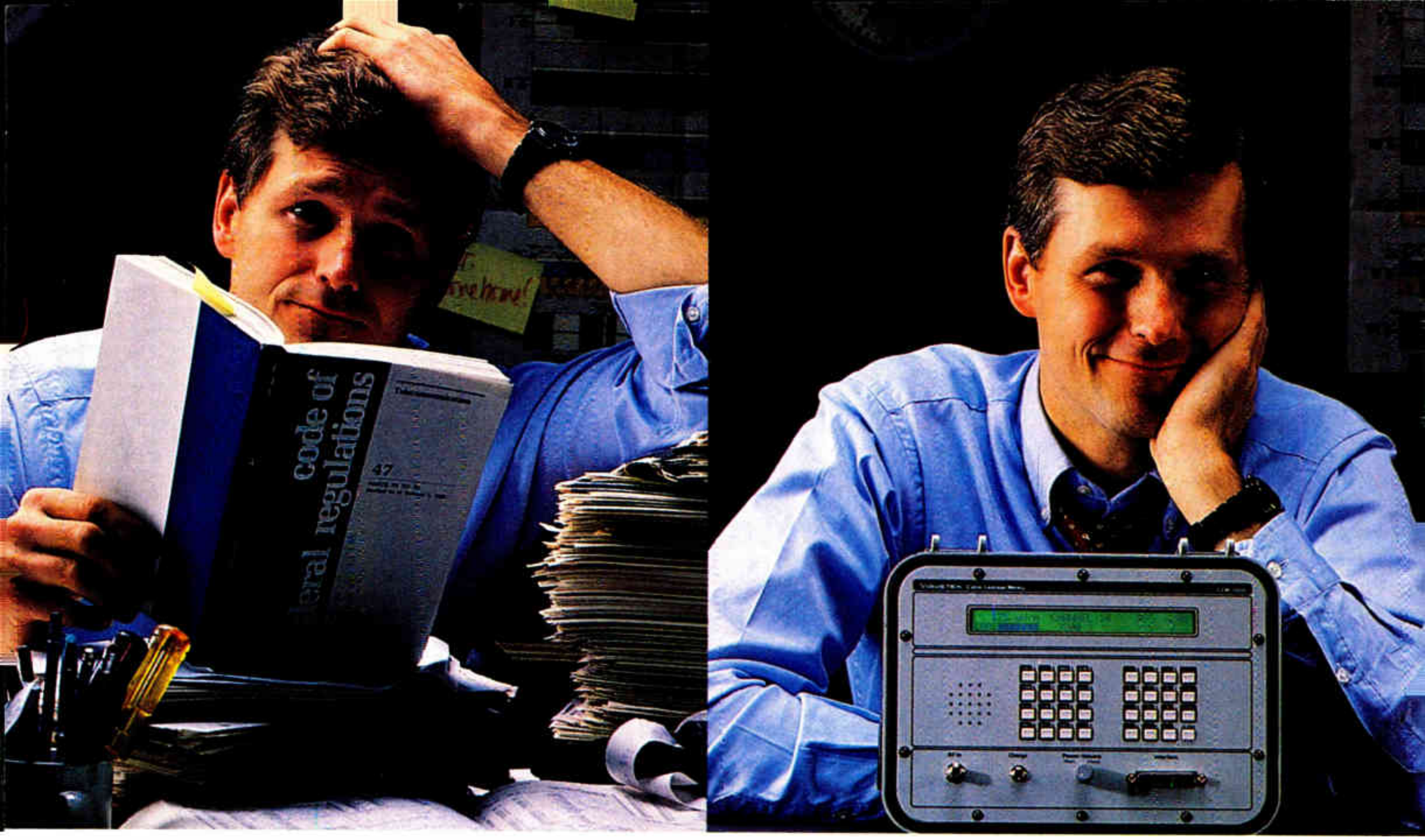

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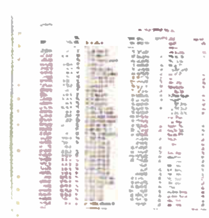

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Power supply

The PS 910 power supply, capable of delivering 900 watts of uninterrupted power, has been announced by C-COR. The 15 amp unit is said to minimize system operating costs with an operating efficiency of better than 90 percent at a load of 10 to 15 amps. The AC unit section can be disconnected from utility power and plugged into auxillary power with its attached power cord, and the electronics section can be removed and replaced in less than three minutes without disrupting power.

In addition, the product performs a standby mode 24-minute self test every 17 days, and if the test is unsuccessful it will return to AC operation and indicators will show the condition that caused failure. It is available as either pole or pedestal mount and an interface for optional remote status monitoring can be obtained from the company.

For additional information, contact C-COR Electronics, 60 Decibel Rd., State College, Pa. 16801, (814) 238-2461; or circle #138 on the reader service card.

Trap products

Pico Products announced its Perfect Trap (PT) product line including notch filters, decoding filters and tier traps. The line uses parallel capacitor circuitry, which, according to the company, makes it possible to achieve perfect temperature compensation in a trap and eliminate drifting and adjacent channel interference.

Both ends of the trap are welded for moisture proofing and RF shielding effectiveness. The PT line exceeds the 1990 FCC standards for cumulative leakage index.

For further details, contact Pico Products, CATV Division, 103 Commerce Blvd., Liverpool, N.Y. 13088, (315) 451-7700; or circle #139 on the reader service card.

Power supply, 1 GHz passives

Lindsay introduced its Power Shift power supply for CATV distribution systems that offers protection from the sheath currents caused by input voltage imbalances, transients and static electricity. It also introduced a family of line passives offering frequency response up to 1 GHz.

The Power Shift unit monitors the AC voltage on the cable, and when the input exceeds maximum safe operating voltages it shifts from a full-wave doubler mode to a positive half-wave mode. Thus, the product protects the regulator and increases the maximum safe operating voltage to 170 V RMS in a square wave system or 140 V RMS in a sine wave system. It is tolerant to three times the normal operating voltage. (Circle #141 on the reader service card for more information on the Power Shift.)

The 1 GHz passives also introduced by the company are capable of carrying up to 156 channels and are compatible with coaxial and fiber-optic systems. The passives allow the mother board to be replaced without disturbing the connectors and the corrosion resistant zinc chromate housing is hinged to allow the unit to be opened without shutting down the system. They can be installed in existing Lindsay passive housings and they also feature flexible power routing via removable buss bars, 15 amp power passing, low return loss and low insertion loss. (Circle #140 on the reader service card for further information on the 1 GHz passives.)

Contact Lindsay Specialty Products, 1248 Clairmont Rd., Suite 3D-231, Atlanta, Ga. 30030, (404) 633-1515, for more information.

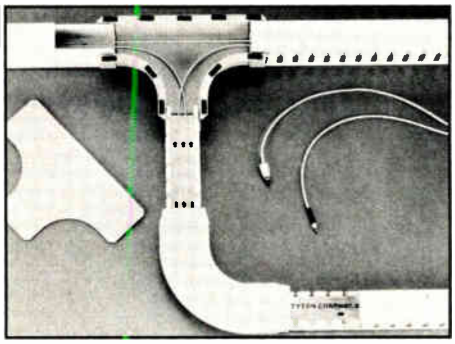
Connector

Raychem's new EZ Grip connector was designed specifically for use with Comm/Scope's Quantum Reach cable, and has been approved by that company's engineering department. According to the company, the aluminum connector contains a minimum number of parts to facilitate easy installation.

The product is environmentally sealed and has an operating range of 4 to 1,000 MHz, with a return loss of 30 dB or greater. It is available through Anixter Cable TV.

For more details, contact Anixter, 4711 Golf Rd., One Concourse Plaza, Skokie, Ill., 60076, (312) 677-2600; or circle #128 on the reader service card.

Fiber protector



Tyton announced the development of its Lightguide System for routing and protecting fiber-optic cables, patch cords and pigtails. Three sizes of protective channels and a variety of connectors are offered. According to the company, the system's 90 degree elbow and tee connectors provide an appropriate bending radius for the cable, ensuring smooth corner guiding and preventing significant dB signal loss.

The system can be mounted with an adhesive backing, laid on cable racks or mechanically mounted to equipment relay racks. Its protective channels come with snap-on and non-slip plastic covers.

For more details, contact Tyton Corp., P.O. Box 23055, 7930 N. Faulkner Rd., Milwaukee, WI 53223, (414) 355-1130; or circle #132 on the reader service card.

IRD option, downconverter

Standard Communications introduced its agile IRD (integrated receiver option) for the agile 40C/K and agile 32C/K headend satellite receivers and also introduced the ODC1A block downconverter.

The agile IRD was designed to integrate the VideoCipher commercial descrambler module into the operation of two of the company's CATV receivers without requiring modification and minimizing rack space at the headend. The unit takes up seven inches less rack space than most previous separate descrambler receiver designs according to the company. System reliability is said to be enhanced because the descrambler has its own RF shielding, individual power supply, full function indicators and maximum heat reduction. (Circle #136 on the reader service card for more information on the agile IRD.)

The self-contained ODC1A block downconverter was designed for upgrading and converting 270-700 MHz satellite CATV systems to 950-1,450 MHz frequencies. When used with an existing 270-770 MHz satellite polarity, the unit will upgrade that polarity to the new 950-1,450 MHz block conversion frequencies. According to the company, with this unit in place the existing 270-770 MHz receivers will operate better due to the improved carrier-to-noise ratio. (For more details on the ODC1A, circle #135 on the reader service card.)

Contact Standard Communications Corp., P.O. Box 92151, Los Angeles, Calif. 90009-2151, (213) 532-5300 for more information on these products.

Scheduling source

Pioneer announced plans to introduce its LaserDisc Universal System (PLUS) pay-per-view program scheduling source, which will be available for installation sometime during the first quarter this year.

The PLUS system allows cable operators to design and customize their own PPV channel. The PLUS controller consists of an IBM AT or compatible computer that connects to the autochanger's built-in RS232 interface port. According to the company, this autochanger is the key component to the system as it can contain up to 72 laser videodiscs, providing for approximately 145 hours of video. This component provides for quick random access within and between discs and any point on a single disc can be accessed within three seconds. Events can be scheduled virtually back-to-back since a maximum of only 25 seconds is required to access the beginning of any disc. (Circle #138 on the reader service card for more information on the PLUS system.)

Pioneer also announced its M2 addressable controller system based on IBM PC/AT-compatible hardware. The system manages up to 50,000 subscriber records, and functions include the ability to define up to 32 programming tiers, password protection for system security, flexible polling intervals and full system reporting and backup/restore capabilities. It is driven by IBM DOS or MS DOS V4.0 operating systems and is written in C language with the company's dBase compatible format. (Circle #137 on the reader service card for more details on the M2 controller.)

Contact Pioneer, 600 E. Crescent Ave., Upper Saddle River, N.J. 07458-1827, (201) 327-6400, for more information on these products.

SLM, switch

The SP 1700 digital signal level meter and the Interlink Model 7RS syndex/headend reconfiguration switch have been introduced by Trilithic. The signal level meter features 5-600 MHz frequency range, keyboard or spinknob digital tuning by channnel or frequency and electromechanical attenuators. Testing features include carrier-to-noise and 60 Hz and 120 Hz active carrier hum testing. It also includes multiple channel plans, user definable front panel presets and water resistant construction. (Circle #125 on the reader service card for additional information on the SP 1700.)

The Interlink Model 7RS syndex/headend reconfiguration switch is a modular design utilizing plug-in cards for flexibility. Functions available include A/B switching for baseband video, composite video with 4.5 MHz audio, intermediate frequency (IF), radio frequency (RF) to 650 MHz, 1,000 MHz or 950 to 1,450 MHz, SPDT contact closures, satellite receiver tuning and 12 bit A to D converter. RS232C, GPIB or manual front-panel control can perform the functions. (Circle #117 on the reader service card for more information on the Model 7RS.)

Contact Trilithic, 9202 E. 33rd St., Indianapolis, Ind. 46236, (317) 895-3600, for further details on these products.

Power supply

Power Guard introduced its Power Cast power supply that features the first high efficiency transformer encased in a noncorrosive all-aluminum cast housing, according to the firm. It offers the traditional mounting capabilities for poles and pedestals and in addition, it has strand mounting capabilities. According to the company, the strand mounting capability will help cable operators comply with increasingly stringent power supplies on poles and can provide an alternative to leasing pole space and setting of separate poles.

The unit's environmentally sealed housing protects the electronics from the elements and the transformer is thermally bonded to the cast housing providing maximum heat transfer. It is available in 5, 7, 10 and 15 amp models and is also offered as an annodized model for coastal environments.

For additional details, contact Power Guard, 801 Fox Trail, Opelika, AL 36801, (205) 742-0050; or circle #129 on the reader service card.

Repeater, transmitter

The AML-IBBR-124 is a repeater for use by CATV operators in the CARS band (12.7 to 13.2 GHz) introduced by Hughes. It is a broadband microwave amplifier that is used as a non-translating (on-frequency) repeater for retransmitting microwave signals to receive sites that do not have a direct line of sight to the originating transmit site. According to the company, the high power output of the unit can extend the reach of an overall microwave system, while establishing an intermediate point from which microwave paths to multiple receive sites can originate.

Because of its 57.5 dBm third-order intercept point, the unit is said to provide a high quality output at levels comparable to those found at one of the output ports of a channelized AML MTX-132 transmitter. Also, it incorporates a microwave local drop port following the ALC attenuator and low noise amplifier. With the built-in image noise reject filter, the local drop serves as low-noise front end for an optional phase-locked receiver. (Circle #116 on the reader service card for more details on the AML-IBBR-124.)

The new frequency agile transmitter developed by Hughes, the ASST-146, can be used to back up any transmitter in a STX-141 or SSTX-145 transmitter array and covers the 12.7 to 13.2 GHz CARS band. Retuning is not required when changing to a different channel. It is necessary to connect the unit to the bottom of an STX-141 or SSTX-145 circulator chain because a multiplexing unit is not included with it. If this is done, the normal circulator combining limitations will restrict the channels that can be carried in the configuration without attaching the unit to another string.

It can also be connected through an external harmonic filter directly to an unused input port of a magic tee in the output multiplex combing network of Hughes' STX-141 or an SSTX-145 transmitter, and then there are no channel restrictions. The unit is specified for an output of 1 watt with a nominal input of +40 dBmV. (For more information on the ASST-146, circle #115 on the reader service card.)

Contact Hughes Microwave Products Division, P.O. Box 2940, Torrance, Calif. 90509-2940, (213) 517-7665, for more information on these products.

FO products

Anixter announced the development of a new fiber-optic cable, the dual Laser Link system and a splicing system.

The fiber-optic cable—developed with AT&T—features a lower cost, lightweight sheath design that eliminates the armor but includes a high density polyethylene jacket (HDPE) with a 600 pound pulling strength. It is available with standard AT&T depressed clad core used in LXE cable (.40MIFL) in counts of 6, 12, 18 and 24. According to the company, it can also be configured with limited amounts of a new high performance pure silica core fiber that can improve loss performance by as much as 20 percent. (Circle #123 on the reader service card for more details on this fiber.)

Anixter also added the Sumitomo Type 35 fusion splicer to its fiber product line. It features the direct core monitoring (DCM) technique of core alignment and performs all the steps in aligning and fusing fibers automatically. The system has 16 standard programs for arc fusion parameters and the ability to be modified in the field. It is lightweight and comes in a self-contained package. (Circle #122 on the reader service card for more information on the Type 35.)

The Laser Link system is now available in a dual laser configuration that, according to the company, allows CATV operators to improve their system performance by 3 dB (C/N) or extend standard loss budget by as much as 30 percent in distance. Using two standard Laser Link transmitters and a single Laser Link receiver node site equipped with a new dual detector module, the system is capable of carrying 40, 60 or 80 channels of video and can be upgraded. The company recommends it as an alternative for operators who are currently deploying fiber but may need to upgrade in the future. (Circle #121 on the reader service card for more information on the Laser Link system.)

Contact Anixter Cable TV, 4711 Golf Rd., 1 Concourse Plaza, Skokie, Ill. 60076, (312) 677-2600, for further information on these products.

Backup switch

Scientific-Atlanta introduced its automatic laser backup switch as an optional feature of its 6450 optoelectronic transmitter. Developed by Corning, and packaged in modular form, it will be incorporated in the optoelectronic transmitter chassis. It is a four-port device that can be factory configured for fiber network testing and laser transister redundancy.

The switch facilitates applications involving the use of an optical time domain reflectometer (OTDR) to take measurements on a single fiber as the OTDR can be connected to the switch and switched to the fiber path otherwise occupied by the laser, without disconnecting the laser or breaking the fiber. Also, an optical power level meter connected to one of the switch's output ports can be used to measure the optical power of the laser.

For more details, contact Scientific-Atlanta, 1 Technology Pkwy., Box 105600, Atlanta, Ga. 30348, (404) 441-4000; or circle #132 on the reader service card.

When it comes time to increase channel capacity, available headend space may be the first problem.

Enter the agile 40C/K or 32C/K IRD.

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The descrambler module mainframe can only be used by specifically approved SCC receivers.
VideoCipher is a registered trademark of General Video Instruments.

Reader Service Number 69.

FO test set, receiver, software, leak detection

CaLan recently announced the development of several new products.

The Model 2000T fiber-optic loss test set measures cable loss or optical power at any point in a system. The set includes the 2000S transmitter (test source), which is a 1,300 nm laser source with a fixed ruggedized FC output connector. Also in the set is the 2000M fiber-optic power meter with a dynamic range sufficient to measure loss in excess of 50 dB. The power meter is calibrated at 850, 1,300 and 1,550 nm. (For more information on the test set, circle #112 on the reader service card.)

The CaLan Cub receiver Model 1775, designed to be used with the company's Model 1777 transmitter to produce high resolution sweep response, uses an electro luminescent display and hall effect input keys. In the analyzer mode a full spectrum view of both video and audio carriers is displayed, and the single channel function allows the user to zoom in on a single channel and perform carrier-to-noise tests. (For more details on the Model 1775, circle #111 on the reader service card.)

CaLan released Revision 3.1 software that allows the company's Model 1776 receiver to address additional memory available in the FS-80 memory option. The FS-80 allows storage of 80 sweep traces, 18 reference traces and setup tables. The Revision 3.1 also enables the use of the IF-13 module that provides 13 kHz resolution for the 1776-1 spectrum analyzer function. (For more information on the Revision 3.1 and the options, circle #110 on the reader service card.)

The ALAN (automatic leakage and navigation) is a mobile system for detecting and documenting leakage and consists of a vehicle measurement system and a desktop workstation. The system detects system leaks and records the measurement location as the vehicle is driven around the cable plant. (For more details on ALAN, circle #109 on the reader service card.)

Contact CaLan, R.R. 1, Box 86T, Route 739, Dingman's Plaza, Dingman's Ferry, Pa. 18328, (717) 828-2356, for details.

Converter, control system

Oak Communications introduced its new Sigma 2000 addressable converter and also its Sigma ACS control system.

The Sigma 2000 addressable converter was redesigned and 45 percent smaller and is fully compatible with all of the company's previous Sigma products. (Circle #127 on the reader service card for more details on the Sigma 2000.)

The Sigma ACS control system is PC-based and capable of scheduling an unlimited number of PPV events, and accepting monthly master scheduler information directly from a billing system or pay-per-view programmer. According to the company, the system can support small to very large systems using identical software. (Circle #126 on the reader service card for additional details on the Sigma ACS control system.)

Contact Oak Communications, 16516 Via Esprillo, San Diego, Calif. 92127, (619) 451-1500, for further information.

Catalog

Wegener announced the completion of its *Cable Television Products Catalog*. It contains a complete compilation of the company's CATV products.

For further information, contact Wegener Communications, Technology Park/Johns Creek, 11350 Technology Circle, Duluth, Ga. 30136, (404) 623-0096; or circle #134 on the reader service card.

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February 1990

Focus on powering

BACK TO BASICS

The training and educational supplement to Communications Technology magazine.

Contents

Formerly Installer/Technician

Giving your system the power to perform

By Jud Williams
Owner, Performance Technologies

When designing the layout for the AC power supply location in a cable system, the most important thing to know is Ohm's law. Without this knowledge the task of determining the correct location of the power supply is nearly impossible. Prior to reading this article, it may help to refer to "Hands On" (page 14).

Other considerations are knowledge of the characteristics of the cable that is being used, as well as the current drain of the various amplifiers being installed into the system. Another important thing to be aware of is the lower operation limits of the DC power supply within the amplifiers themselves. For instance, some power supply regulators will operate at a lower input voltage than others without going out of regulation. There also is an upper limit for the input voltage before it puts an undue strain on the isolation transformer in the DC power supply.

Just a note for clarification: We are using the words "power supply" to describe two different pieces of equipment. The main concern is the placement of the ferroresonant power supply and standby power supply. When referring to these power supplies we will call them *AC supplies*. The other power supply we will refer to is the one within the amplifiers. These we will refer to as *DC supplies*.

As we go through the process of determining the spacing of the amplifiers we will be concerned with the decreasing amount of power available due to the drops in voltage caused by cable resistance between these amplifiers. Another concern is the advised amount of current that can be drawn from the AC power supply.

To determine the characteristics of the cable, refer to the manufacturer's specification sheet. Under the heading "Electrical characteristics" you will find the maximum DC resistance. Under that you will find the resistance for the inner conductor and the resistance of the outer conductor. You also will find the *loop resistance*, which is the combined resistances of the inner and outer conductors. The resistance is stated as ohms per 1,000 feet (Ω/1,000 ft.) As an example, a ½-inch cable may have an inner conductor DC resistance of 1.28 Ω/1,000 ft. and an outer conductor (sheath) DC resistance of 0.4 Ω/1,000 ft. This results in a loop resistance of 1.68 Ω/1,000 ft. by adding the inner and outer resistances together.

The final bit of information we need is the power output of the AC power supplies to be used. Since 14 amperes, also known as 840 VA (volt/amperes), is a popular size of power supply we will use it in our examples. If a standby power supply is being used, it must have the same rating as the ferroresonant supply.

The cable system looks like a series of resistances with their associated current drains and voltage drops (Figure 1). Ohm's law is used to determine where to place the power supplies in a system. As mentioned before, the cable has resistance and the individual amplifiers draw a certain amount of current. Ohm's law states that voltage (E) is equal to current (I) times resistance (R) (E = I × R). Sometimes voltage is referred to as an *IR drop*.

> *"The (power) supply is located so the current into the system feeds it in both directions with half the power going each way."*

As a general rule, the placement of the AC power supply in the cable system is such that the system is balanced. This means that the supply is located so the current into the system feeds it in both directions with half of the power going each way. Of course, this can be tricky but with very careful calculations it can be done.

The amount of current drawn from the AC power supply should be somewhere around 80 to 85 percent. By leaving a bit of headroom there will be current capacity

Figure 1

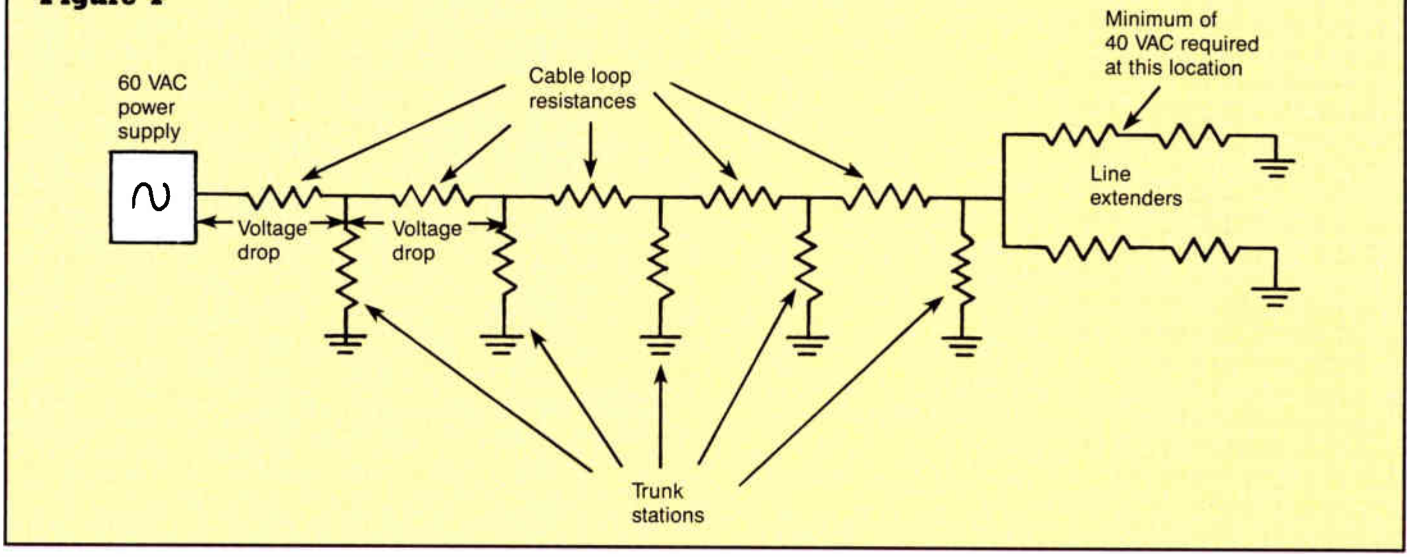
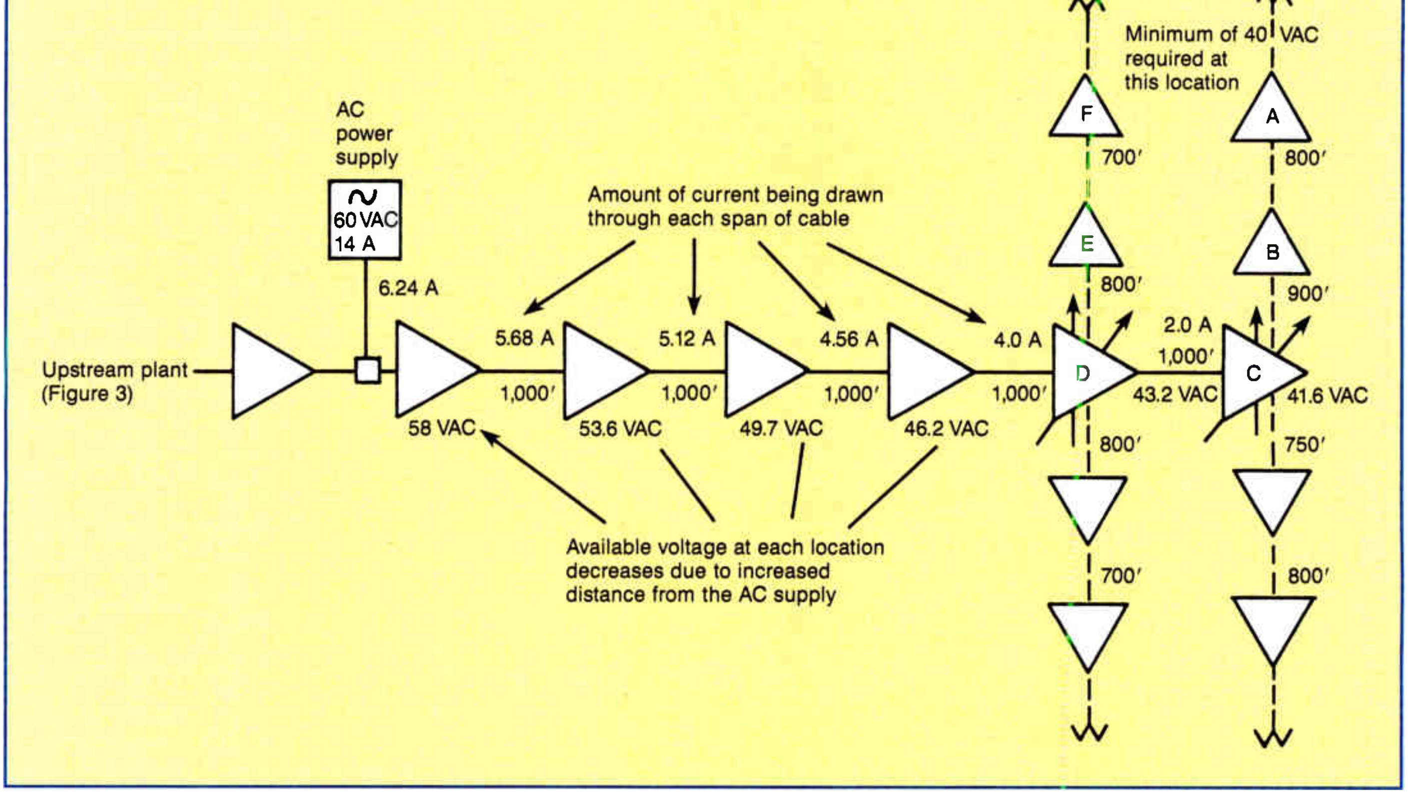


Figure 2



for any eventual additions to the system and the AC power supply will not have to be relocated. Also, it is not wise to allow more than about 6 A of current to flow through any amplifier. Of course, this applies mainly to the amplifiers closest to the AC supply.

In our scheme we will set up the AC supply in a balanced situation as previously recommended. As a result, when we power the downstream amplifiers we will utilize only about 45 percent of the capacity of the AC supply. When the current requirements for amplifiers going toward the headend are calculated, another 45 percent of the AC supply output will be used. In each case we will be working toward some middle point that will ultimately become the location for the AC supply under consideration.

The information needed to determine the location of the AC supply is indicated on the strand map. You must refer to it to know how the various amplifiers are spaced and where to start your calculations. Once you have located the downstream amplifier or line extender furthest from the point you are working from on the strand map, you will then decide the minimum AC voltage you wish to supply to the amplifier, making sure that its DC power supply will operate properly. Some amplifiers will operate on as low as 38 volts AC (VAC) while others may require as much as 43 VAC. We will use 40 VAC in our calculations.

Next we will begin to work backwards by determining the length of cable between the furthest amplifier and the next one upstream toward the intended location of the AC power supply. If the cable length referred to on our strand map (Figure 2) is 800 feet, the loop resistance of that section of cable will be 1.49 Ω. We arrived at this figure by referring to the manufacturer's specifications (1.68 Ω/1,000 ft.) and multiplying this by 0.8 (80 percent of 1,000 feet), which represents the section of cable length from the strand map.

In addition to knowing the lowest acceptable AC voltage required by the amplifier, we also need to know the amount of current the DC power supply will be drawing through the cable. This information may be obtained from the manufacturer's data. By referring to the line extender station specifications and locating the AC current requirements we see, for example, that 360 mA (milliamperes) of current is drawn with 60 VAC input for a particular model of line extender. The specification also states that it is for a forward only, rather than a two-way, system.

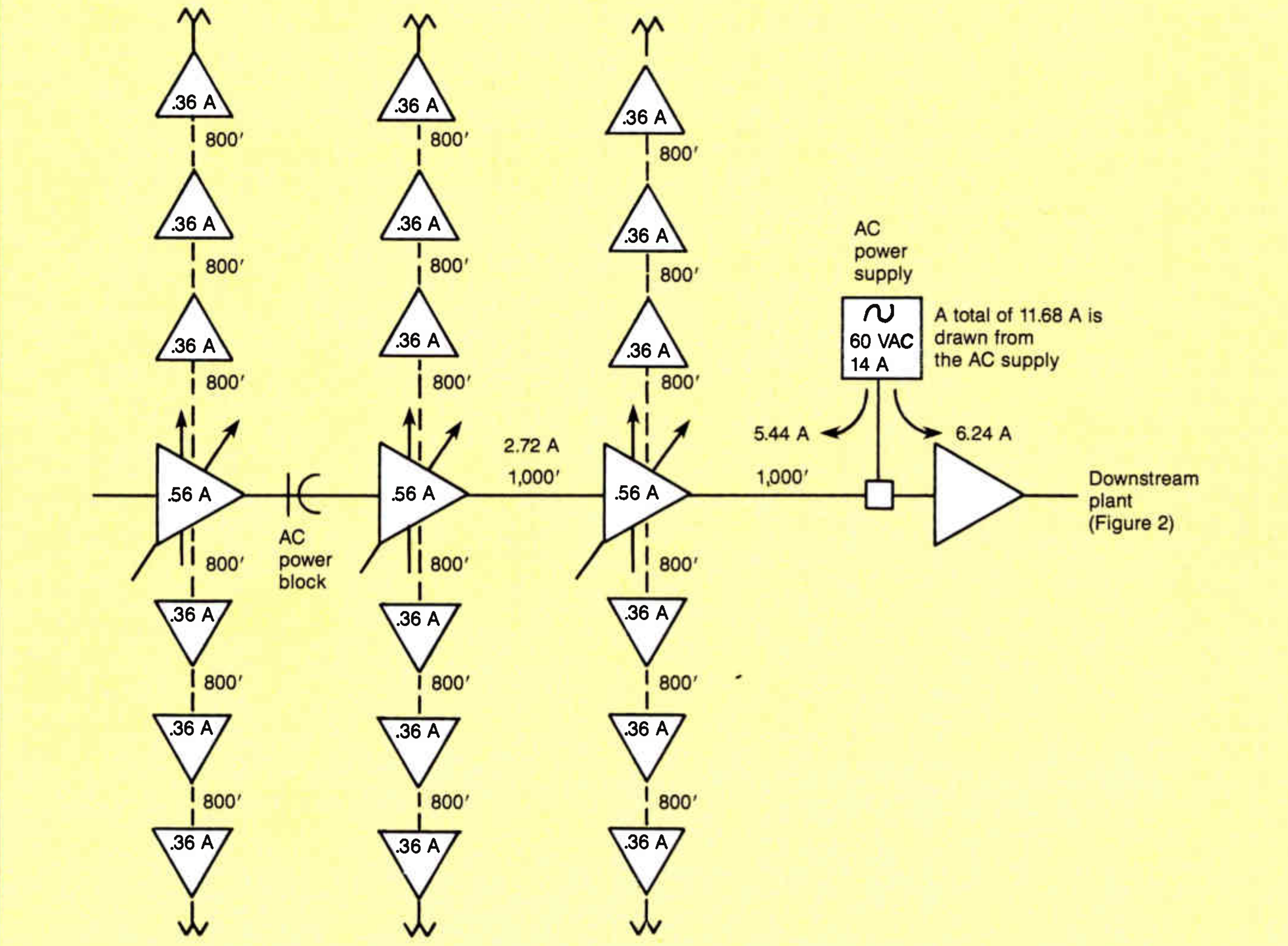
Making the calculations

We now have all the information we need to make our first calculation. We previously determined there is 1.49 Ω of cable loop resistance between the furthermost line extender, which we will denote as amp A (Figure 2), and the next one located upstream toward the bridger/trunk station, which we will designate as amp B. We also note that the current being drawn through the cable section going to amp A is 360 mA. Multiply the loop resistance by the AC current. The result will be a drop of 0.536 V for that stretch of cable: $E = I \times R$ or $0.36\ A \times 1.49\ \Omega = 0.5\ V$ (approximately).

Since we are using 40 VAC as our minimum input voltage required at amp A, we must have at least 40.5 V at amp B so amp A will not be "voltage starved." Note that each step of the way we will be nibbling away at the capacity of the AC power supply until we reach a point where we are drawing most of the power that is available.

We see by our strand map that the next upstream device is a bridger/trunk station we will designate as amp C. The cable span is 900 feet between amps B and C. Using a loop resistance figure of 1.68 Ω/1,000 ft. we calculate resistance for this section to be 1.5 Ω. Since there are two line extenders drawing current we must use the combined values of A and B in our calculations. Each line extender will be drawing 360 mA (0.36 A). Add these together for a total of 720 mA (0.72 A). By multi-

Figure 3



plying 1.5 Ω by 0.72 A we calculate a drop of 1.1 V (rounded off). The required output voltage at the bridger/trunk is 41.6 VAC. Keep in mind, we are working upstream toward the AC power supply location so that the voltage levels at each amplifier will increase.

Returning to our strand map we find there is another leg of line extenders coming into our bridger/trunk station. The cable lengths here are not as long as those in the previous calculations. The end line extender has a length of 800 feet and the cable span between it and the next line extender. The next section of cable going to the bridger trunk amp is 750 feet. Based on our previous calculations, we can conclude that there will be enough voltage for this branch since the cable is somewhat shorter in length than our previous example, resulting in less voltage drop. As an exercise, you may wish to do the necessary calculations for this leg.

Let us proceed to the next upstream trunk amp. Referring back to the manufacturer's specification sheet we locate the trunk amplifier station specification. It states that the AC current requirements for a complete station, which would include the necessary bridger module as well as the trunk and AGC modules, is 560 mA. This current applies to amp C in our example.

The cable between amp C and the next upstream trunk station (amp D) is now ¾ inch rather than the ½ inch used previously. The loop resistance for the ¾ inch cable is somewhat lower than the ½ inch; according to the manufacturer, it has a loop resistance of 0.76 Ω/1,000 ft.

Referring to our strand map again we see that the span between amp C and D is approximately 1,000 feet, so we will go with the 0.76 Ω number. Bear in mind that the current drain from the various amplifiers downstream is cumulative. In other words we must add them together when figuring the voltage drop for each successive cable span.

The total current for the four line extenders going out from the bridger/trunk station is 360 mA (0.36 A) multiplied by 4. Thus we have 1.44 A being drawn through amp C by these line extenders. Add to this the 560 mA of current that bridger/trunk (amp C) draws and we have a total of 2 A of current being drawn through the 1,000 foot span of cable between the two trunk stations (amps C and D). Multiplying the loop resistance of 0.78 times 2 A, we calculate a voltage drop of 1.56 V. We must add this voltage drop to 41.6 V (the level at amp C). So now the AC voltage required at amp D is 43.2 V. At this point we still have a margin of 16.8 V between here and the ultimate location of the AC supply. Note that we have consumed 2 A of the available current from the AC supply. Having allotted 6 A for this portion of the AC supply system, we see that we have 4 A left to work with. That figures out to 86 VA of power consumed so far, which is close to 10 percent of the available power from the AC supply.

An exercise

Now for an exercise in what you have

learned so far. The bridger/trunk amplifier, designated D, has two legs of line extenders connected to it. Using the information from the previous example, do the necessary calculations to determine if the voltage available at each line extender is higher than the required 40 V.

Follow this procedure to determine the voltage available at amp E:

1) Determine the loop resistance of the 800 feet of ½ inch cable running between bridger/trunk D and line extender E.

2) Determine the amount of current being drawn through this span of cable. (Remember, it is the sum of both line extenders E and F).

3) Multiply the current times the resistance.

4) Subtract this voltage drop from the 43.2 V we already know is available at bridger/trunk D. Is the voltage OK at line extender E?

Next calculate the voltage available for line extender F:

1) What is the loop resistance for the 700 feet of cable running between the two line extenders?

2) How much current is being drawn through the cable?

3) What is the voltage drop across this span of cable?

4) What is the voltage at line extender F?

Your calculations should have given you the following figures: 1) 1.176 Ω, 2) 0.36 A, 3) 0.423 VAC and 4) 41.8 VAC.

Now the process becomes a repeat of what we discussed up to this point. At each bridger/trunk station we must first consider the voltage needs of the line extenders branching off from that point as we described in our example. Then we must continue to add in all the accumulating current drains from all the downstream amplifiers as we calculate the voltage drop of each succeeding cable span between each trunk station. This is shown in Figure 2 where four more trunk stations are cascaded in the system.

As we approach the intended AC power supply location, note that the amount of current being drawn through each succeeding span of cable is increasing. Also, the calculated voltage of 58 V approaches the maximum 60 V available from the AC supply. This is certainly adequate to satisfy the needs of the amplifiers in our system; in fact, the extra 2 V will reflect back into the system as an extra margin of reserve capacity. We also are within our limits as far as current consumption is concerned since we are drawing 6.24 A. So you see, we have arrived at the optimum location for the AC supply.

Now we will move to the upstream side of the AC supply (Figure 3) and see how to calculate the voltage drops in determining where to place the AC block. As noted earlier, this part can be a bit tricky. Some trial calculations must be used to arrive at our results.

Our example for the downstream section had a fairly long trunk run before reaching the line extenders. This may be the case in a sparsely settled area. We will contrast that with a system in a more densely populated area in this example.

The first span of cable is 1,000 feet long consisting of ¾ inch cable with a loop resistance of 0.76 Ω. The first bridger/trunk station has six line extenders fed by it, three on each of two different legs. Remember that the line extenders each draw 0.36 A and the trunk station draws 0.56 A. The cable connecting the line extenders is ½ inch with a loop resistance of 1.68 Ω.

Since we are necessarily working in the direction away from the power supply, we are unable to go to the line extender furthest away from the AC supply and work our way back in as before. We must look at the closest trunk station and determine how much current is being drawn by all the line extenders associated with it and add that to the current drawn by the trunk: Multiply 0.36 A times six line extenders. This comes to 2.16 A, added to 0.56 A for the trunk, which equals 2.72 A total. This results in a voltage drop across 1,000 feet of 0.76 Ω cable of approximately 2.1 V.

Down the cable 1,000 feet we have a second bridger/trunk station, again feeding six line extenders in the same configuration as before. The total current drain is again 2.72 A. The voltage drop between the two trunks is 2.1 V.

Now return to the first trunk station and add the current that is being drawn by the second trunk station (2.72 A + 2.72 A = 5.44 A). This total current is now used to recalculate the voltage drop of the first 1,000-foot cable span going back to the AC supply. The voltage at the first trunk station changes to 55.9 V. (5.44 A × 0.76 Ω = 4.1 V; subtract 4.1 V from the AC supply output of 60 V.)

As you advance along the cable system, you must keep going back and changing the current through the paths leading back to the AC supply. Remember, all current drawn by each amplifier beyond any point in the cable system must pass through that point. Now we can check the voltage drops for the various line extenders to be assured that they are receiving the necessary amount of voltage.

(Continued on page 10)

What do you know about standby power?

The following series of questions was originally formulated as a quiz for a system's technical staff and for an SCTE chapter seminar. Test your knowledge by filling in the blanks.

By Mark Harrigan
Bay Area District Engineer, United Cable

1) The perfect waveform output from a ferroresonant-type CATV power supply is a ________________ wave.

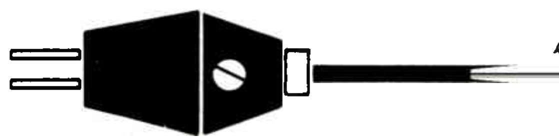
2) Battery voltage checks must be done under __________ to ensure accuracy.

3) The "12 volt" batteries that we use for standby power are in reality ________ volts each at room temperature.

4) A power supply that is loaded to 100 percent of its rated capacity will run hotter or cooler than if it is loaded to 80 percent of its capacity? ________________.

5) Most low-cost volt ohmmeters do not read true __________ voltages, and in reality read about ___________ percent _____________.

6) The two most critical factors governing battery life are __________________ and _____________________ ____________________________.



10) Briefly describe what will happen when a 12.5 volt battery is matched up with two 13.5 volt batteries. *Since the battery charger runs at a constant 40.5 volts the 12.5 volt cell will undercharge while the two 13.5 volt batteries will overcharge and eventually be damaged.*

11) The maximum recommended voltage differential between batteries is *0.5* volts.

12) The maximum recommended shelf life (before they are put into service) for batteries is *90* days.

13) Can a good voltage be detected in a bad battery under load? *No.* Under no load? *Yes.*

14) The recommended charging procedure for batteries requiring refresh charging, prior to installation: *Connect them in parallel to a 14.4 volt (maximum) battery charger to get equal charges on the batteries.*

15) Batteries can be explosive. What are some of the danger signs to look for? *Battery swelling, corrosion, uneven voltages and excessive heat.*

16) Describe what state the power supply should be in before load testing. *The door should be closed, and all visual and electrical checks completed and okayed.*

7) A battery's life will be reduced by approximately ________ percent if it is run 15°F above 77°F.

8) When using an external 15 amp breaker on the utility service to the power supply, it must be of a ________ type able to withstand very high initial current.

9) Whenever you are handling standby batteries or doing power supply maintenance, what safety equipment *must* you be wearing? ________, ________ and ________, ________.

10) Briefly describe what will happen when a 12.5 volt battery is matched up with two 13.5 volt batteries.

____

____

____

11) The maximum recommended voltage differential between batteries is ________ volts.

12) The maximum recommended shelf life (before they are put into service) for batteries is ________ days.

13) Can a good voltage be detected in a bad battery under load? ________. Under no load? ________.

14) The recommended charging procedure for batteries requiring refresh charging, prior to installation:

____

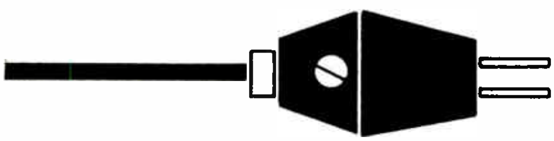
____

15) Batteries can be explosive. What are some of the danger signs to look for? ________, ________, ________ and ________.

16) Describe what state the power supply should be in before load testing.

____

____



Answers

1) The perfect waveform output from a ferroresonant-type CATV power supply is a *quasi-square* wave.

2) Battery voltage checks must be done under *load* to ensure accuracy.

3) The "12 volt" batteries that we use for standby power are in reality *13.5 to 13.8* volts each at room temperature.

4) A power supply that is loaded to 100 percent of its rated capacity will run hotter or cooler than if it is loaded to 80 percent of its capacity? *Cooler.*

5) Most low-cost volt ohmmeters do not read true *RMS* voltages, and in reality read about *10* percent *high.*

6) The two most critical factors governing battery life are *temperature* and maintaining *proper charge voltage* on each battery.

7) A battery's life will be reduced by approximately *50* percent if it is run 15°F above 77°F.

8) When using an external 15 amp breaker on the utility service to the power supply, it must be of a *high-magnetic or motor-start* type able to withstand very high initial current.

9) Whenever you are handling standby batteries or doing power supply maintenance, what safety equipment *must* you be wearing? *Safety goggles, gloves* and *protective clothing, or a face mask.*

Don't assault your battery

By Chuck Beckham
Marketing Manager, Voltex Batteries

Lead acid batteries came into being in 1859 as a result of the work of French physicist Gaston Plante. Yet today, more than 100 years later, they remain shrouded in mystery. We hear various theories and opinions concerning batteries, many of which are true and others completely false.

My objective is to bring forth some semblance of understanding of batteries particularly with regards to cable TV. It is estimated that 80 percent of the failures of standby power supplies are due to battery failure. This may in fact be true but the fault is not altogether that of the batteries themselves, but more often poor battery management, neglect and abuse.

Battery management involves the proper selection of batteries, proper ordering based on need and proper storage. Neglect involves the lack of a preventive maintenance program where the batteries are checked periodically to see they have the proper fluid level, output capacity, etc. Abuse results most often from incorrect charging and poor ventilation.

Battery selection

There are several different types of batteries, two of which are generally used in our industry. The first, used during the earlier days of standby power supplies, was the SLI, better known as the automotive battery. The Sears Die Hard is a popular example of this type of battery.

This type of battery was designed to be inexpensive and allow repeated cycling and recharging at a high rate following a short discharge while starting an engine. The one thing this type of battery will not tolerate is the deep discharge, such as when the car's headlights are accidentally left on.

The battery industry increasingly became aware that its automotive batteries were being used in standby power supplies in the cable and computer industries. Although they had been building long-lasting batteries for telephone use, there was a gap between these and the ones used in the automotive industry. As a result, there was an industrywide effort to build a battery that could be deep cycled to meet the needs of standby power supplies.

By use of special additives to the elements within the batteries and new construction techniques deep cycle batteries have evolved. Deep cycle batteries are designed to be discharged at a far slower rate and for a much longer duration than automotive batteries. They accept a charge at an equally slow rate.

There are several configurations of batteries in use today. First, there is the old reliable wet cell with removable vent caps. These are servicable batteries that allow replenishing of the acid level lost due to gassing.

Second is the recombination type of battery with its sealed maintenance-free construction. They are not servicable like the wet cell but contain vents so accumulated gas may escape when necessary. Internally, they are constructed somewhat differently than wet cells.

Third, there is a type of wet cell called the sealed flooded type. This means that it is the same as the old fashioned wet cell with venting but has no provisions for adding distilled water since there are no removable vent caps. This also is a maintenance-free battery.

The fourth and final type of battery is the gel cell. Instead of using sulfuric acid in the form of a liquid, it has the consistency of jelly and is designed not to leak or spill.

The important thing to know about all of these batteries is they are all lead acid batteries. They all have the same voltage output and require virtually the same charging techniques. All are affected by extremes in temperature. In other words, a lead acid battery is a lead acid battery no matter what form it is in.

Some like it hot, some like it cold

Environment is an ever present consideration in the selection of batteries. Certain types of batteries operate more effectively in temperature extremes than others. For example, early indications are that the new gel cell batteries have considerably lower output capacity at low (winter) temperatures. While they function well indoors, in the sort of controlled environment that a computer uninterruptible power supply (UPS) is located, the gel cell may be inadequate in the extreme weather of a New England winter.

Output capacity refers to the time the backup power supply will operate during standby. A manufacturer may claim that its standby power supply will operate for two hours during a power failure. However, when the temperature drops in winter, this may not necessarily be true. You may be lucky to get half the standby time you expect. Since the likelihood of needing the standby is greatly reduced during the cooler months as compared to the summer lightning season, the reduced capacity becomes less important. No matter what we do there are trade-offs.

The other extreme of temperature has a very damaging effect on batteries. When the hot weather strikes we run into the problem of overcharging the battery, causing overheating and excessive gassing. Batteries require less current to keep them at full charge when temperatures are high. When the battery is being charged with excessive current, the amount of gassing that takes place depends on the portion of current not absorbed by the battery. This also may result in excessive heat buildup, causing the plates to buckle or warp.

Gassing takes place in sealed as well as unsealed batteries. In the older type of wet cells with removable vent caps the fluid lost through gassing may be replenished while the sealed types of batteries continue to deteriorate. The only solution here is for the battery to be recharged by a temperature compensated charger that limits the current as temperature rises above 77° F.

In the desert Southwest, my feelings are that wet cells with removable vent caps are by far the most desirable for the extreme summer temperatures. These batteries must be regularly maintained so that the fluid level is always correct. If it is at all possible, the addition of a fan to the battery compartment would certainly add to the life of the batteries. This is a feature usually overlooked by the power supply manufacturers.

The maximum storage time for batteries is cut in half for each 10° C increase in temperature. Battery capacity is reduced by both high and low temperature extremes. The life of batteries is very dependent on temperature and how they are charged. They go hand in hand.

There have been numerous instances where batteries have exploded in a CATV power supply installation. This is caused mainly due to overcharging. The gassing taking place is the release of hydrogen and oxygen, which unite with explosive force.

If lead-calcium type batteries have been selected for use with your standby power supply, they do not require an equalizing charge as specified by several power supply manufacturers. For this reason,

"Battery management involves the proper selection of batteries, proper ordering based on need and proper storage."

these are often preferred over the lead-antimony types for standby applications.

Charge it, please

There are several types of battery chargers for use in the shop. They come with numerous names for any one type but can roughly be categorized as follows: One of the simplest is the unregulated type available at auto supply stores. The next is a type that regulates the maximum amount of voltage that may be applied to the battery. The battery charger usually used by battery jobbers and distributors is the constant current type. And finally, the least sophisticated is the trickle charger.

When using the unregulated charger one must keep close watch so as not to overcharge the battery, which would heat up excessively, resulting in permanent damage. Don't just hook it up, walk away and forget it! If the charger has an ammeter, note when the current has dropped off to about 0.25 to 0.5 ampere and turn it off. After disconnecting, let the battery sit for awhile, then check the open circuit voltage with a very accurate digital voltmeter. If the voltage is 12.68 volts (V), it is 100 percent charged. If the voltage is 12.24 V, it is only 50 percent charged. If the voltage is as low as 11.89 V it is totally discharged.

The voltage regulated charger will supply the greatest amount of its current at the beginning of the charging cycle and the current will gradually diminish as the battery reaches full charge. The battery is considered fully charged when the current drops to below 200 mA (milliamperes). This residual current can be considered a trickle charge. A voltage regulated charger is commonly used in the standby power supply itself and is often incorrectly set resulting in overcharging. A properly set charger will allow no more than 200 mA of current to flow into a fully charged battery.

The constant current supply is more of an industrial type of charger in that it is often used to brute force a battery to take on a charge that other types of chargers are incapable of. If large numbers of batteries are used by a system, it may be a wise investment to purchase this type of charger since many batteries brought in from the field may be rejuvenated and put back into service. Many batteries that have been deep cycled can be salvaged by this method.

The ordinary trickle charge is another type that should be watched closely to be sure that it doesn't cause excessive gassing and loss of fluid. Normally, the output current is low enough that it would not permanently damage the battery but it's best to keep an eye on it.

So-called "stand loss" is another enemy of the lead acid battery. Storing a battery for too long before installing it into the system can appreciably shorten its service life. It is recommended that a cable system keep a 90 day supply of batteries on hand. The storage temperature should be close to normal room temperature to keep them in prime condition.

If the batteries are kept for more than six months the open circuit voltage should be checked periodically to see that it has not dropped to below 50 percent of full charge. As mentioned previously, this would be 12.24 V on a digital voltmeter. If the voltage has dropped below this point, the battery should be boosted with a charger.

Preventive maintenance is a simple matter of checking the batteries in storage and in the field on a regularly scheduled basis. When in the field, make sure terminals aren't corroded, fluid levels aren't low and the batteries are fully charged. The use of a battery load tester is recommended particularly if it has a timer and may be attached to a digital voltmeter. Each time the batteries are checked the voltage levels established by the tester should be logged to establish a history for each battery. One power supply manufacturer wisely recommends that any battery that is more than 0.3 V different from the others in the bank should be replaced.

As a rule any water that is drinkable may be used to replenish the water lost through gassing. If the water seems to have high mineral content (indicated by stains on sinks, etc.) it is best to use distilled water, available at most supermarkets.

Batteries are costly items and they perform a very crucial function. They should be carefully looked after so their usefulness is not compromised by neglect and abuse. The best advice I can give is to have a comprehensive battery management program that includes proper periodic maintenance. ■

The author wishes to thank Jud Williams of Performance Technologies for his help in writing this article.

Power to perform

(Continued from page 5)

For simplification we will use 800 feet as the length of cable between line extenders. The section of cable going to the first line extender will be passing the currents from all three line extenders (0.36 A × 3 = 1.1 A). The loop resistance is 80 percent of 1.68 Ω or 1.34 Ω. Now multiply 1.34 Ω by 1.1 A, which equals a 1.5 V drop. The voltage at the trunk station is 55.9 V so we will be left with 54.4 V at the first line extender.

The current through the second span of 800 feet of cable connecting to the second line extender is the total of two line extenders. This equals 0.72 A with a resulting voltage drop of 0.96 V. The voltage at the second line extender is reduced to approximately 53.4 V. By observation we can assume that the voltage at the third line extender will be well within the required 40 V minimum. The line extenders on the other leg of the bridger will be the same as these since the spacing is identical.

Moving out to the next trunk station, we see that the AC voltage has dropped to 53.8 V. Again we are working with a line extender run identically to the previous one. As mentioned before, the combined current drawn by the three line extenders is 1.1 A. This results in a 1.5 V drop due to a loop resistance of 1.34 Ω. The voltage at this point is down to 52.3 V. The next line extender voltage will drop to about 51 V and the third will be about 50 V, so we have enough operating voltage for the amplifiers considered thus far.

It appears that we have enough voltage to reach out to another trunk/bridger and associated line extenders. For simplicity we will use the same configuration as before. The main thing to be aware of is to change the current in the main trunk cable to include the added amplifiers at the third trunk station.

We already know that the total current drawn by the trunk amplifier plus six line extenders is 2.72 A. This amount must be added to the amount of current passing through the first and second spans of cable running between the AC power supply and the trunk stations.

If we were to add another trunk station we would exceed the current available from the AC power supply by drawing a total of 8.16 A. Thus we have reached the point where we must place the AC block. It would go between the second and third trunk stations on the diagram. The trunk station upstream of the block must be powered by another power supply. ■

Installer's Tech Book

Converting dBmV to μV/m

By Ron Hranac
Senior Staff Engineer, Jones Intercable Inc.

Channel 35 or V (289.2625 MHz)

dBmV	µV/m	dBmV	µV/m	dBmV	µV/m	dBmV	µV/m
−60	6.07	−36	96.27	−10	1920.93	16	38327.58
−59	6.82	−35	108.02	− 9	2155.32	17	43004.26
−58	7.65	−34	121.20	− 8	2418.31	18	48251.57
−57	8.58	−33	135.99	− 7	2713.39	19	54139.15
−56	9.63	−32	152.58	− 6	3044.47	20	60745.13
−55	10.80	−31	171.20	− 5	3415.95	21	68157.15
−54	12.12	−30	192.09	− 4	3832.76	22	76473.58
−53	13.60	−29	215.53	− 3	4300.43	23	85804.77
−52.15	**15**	−28	241.83	− 2	4825.16	24	96274.54
−52	15.26	−27	271.34	− 1	5413.91	25	108021.81
−51	17.12	−26	304.45	0	6074.51	26	121202.46
−50	19.21	−25	341.59	1	6815.72	27	135991.40
−49	21.55	−24	383.28	2	7647.36	28	152584.86
−48	24.18	−23	430.04	3	8580.48	29	171203.02
−47	27.13	−22	482.52	4	9627.45	30	192092.95
−46	30.44	−21	541.39	5	10802.18	31	215531.84
−45	34.16	−20	607.45	6	12120.25	32	241830.70
−44	38.33	−19	681.57	7	13599.14	33	271338.51
−43	43.00	−18	764.74	8	15258.49	34	304446.81
−42	48.25	−17	858.05	9	17120.30	35	341594.94
−41.69	**50**	−16	962.75	10	19209.30	36	383275.83
−41	54.14	−15	1080.22	11	21553.18	37	430042.55
−40	60.75	−14	1212.02	12	24183.07	38	482515.68
−39	68.16	−13	1359.91	13	27133.85	39	541391.50
−38	76.47	−12	1525.85	14	30444.68	40	607451.25
−37	85.80	−11	1712.03	15	34159.49		

Channel 36 or W (295.2625 MHz)

dBmV	µV/m	dBmV	µV/m	dBmV	µV/m	dBmV	µV/m
−60	6.20	−36	98.27	−10	1960.77	16	39122.59
−59	6.96	−35	110.26	− 9	2200.02	17	43896.27
−58	7.81	−34	123.72	− 8	2468.47	18	49252.42
−57	8.76	−33	138.81	− 7	2769.67	19	55262.13
−56	9.83	−32	155.75	− 6	3107.62	20	62005.13
−55	11.03	−31	174.75	− 5	3486.80	21	69570.89
−54	12.37	−30	196.08	− 4	3912.26	22	78059.83
−53	13.88	−29	220.00	− 3	4389.63	23	87584.57
−52.33	**15**	−28	246.85	− 2	4925.24	24	98271.50
−52	15.57	−27	276.97	− 1	5526.21	25	110262.44
−51	17.48	−26	310.76	0	6200.51	26	123716.49
−50	19.61	−25	348.68	1	6957.09	27	138812.18
−49	22.00	−24	391.23	2	7805.98	28	155749.83
−48	24.68	−23	438.96	3	8758.46	29	174754.19
−47	27.70	−22	492.52	4	9827.15	30	196077.42
−46	31.08	−21	552.62	5	11026.24	31	220002.49
−45	34.87	−20	620.05	6	12371.65	32	246846.85
−44	39.12	−19	695.71	7	13881.22	33	276966.72
−43	43.90	−18	780.60	8	15574.98	34	310761.77
−42	49.25	−17	875.85	9	17475.42	35	348680.44
−41.87	**50**	−16	982.72	10	19607.74	36	391225.89
−41	55.26	−15	1102.62	11	22000.25	37	438962.67
−40	62.01	−14	1237.16	12	24684.68	38	492524.21
−39	69.57	−13	1388.12	13	27696.67	39	552621.26
−38	78.06	−12	1557.50	14	31076.18	40	620051.25
−37	87.58	−11	1747.54	15	34868.04		

Channel 37 or AA (301.2625 MHz)

dBmV	µV/m	dBmV	µV/m	dBmV	µV/m	dBmV	µV/m
−60	6.33	−36	100.27	−10	2000.62	16	39917.60
−59	7.10	−35	112.50	− 9	2244.73	17	44788.28
−58	7.96	−34	126.23	− 8	2518.63	18	50253.28
−57	8.94	−33	141.63	− 7	2825.95	19	56385.10
−56	10.03	−32	158.91	− 6	3170.77	20	63265.13
−55	11.25	−31	178.31	− 5	3557.66	21	70984.64
−54	12.62	−30	200.06	− 4	3991.76	22	79646.07
−53	14.16	−29	224.47	− 3	4478.83	23	89364.36
−52.50	**15**	−28	251.86	− 2	5025.33	24	100268.47
−52	15.89	−27	282.59	− 1	5638.51	25	112503.07
−51	17.83	−26	317.08	0	6326.51	26	126230.52
−50	20.01	−25	355.77	1	7098.46	27	141632.97
−49	22.45	−24	399.18	2	7964.61	28	158914.81
−48	25.19	−23	447.88	3	8936.44	29	178305.35
−47	28.26	−22	502.53	4	10026.85	30	200061.89
−46	31.71	−21	563.85	5	11250.31	31	224473.13
−45	35.58	−20	632.65	6	12623.05	32	251863.00
−44	39.92	−19	709.85	7	14163.30	33	282594.93
−43	44.79	−18	796.46	8	15891.48	34	317076.73
−42.04	**50**	−17	893.64	9	17830.53	35	355765.94
−42	50.25	−16	1002.68	10	20006.19	36	399175.95
−41	56.39	−15	1125.03	11	22447.31	37	447882.79
−40	63.27	−14	1262.31	12	25186.30	38	502532.75
−39	70.98	−13	1416.33	13	28259.49	39	563851.02
−38	79.65	−12	1589.15	14	31707.67	40	632651.25
−37	89.36	−11	1783.05	15	35576.59		

Channel 38 or BB (307.2625 MHz)

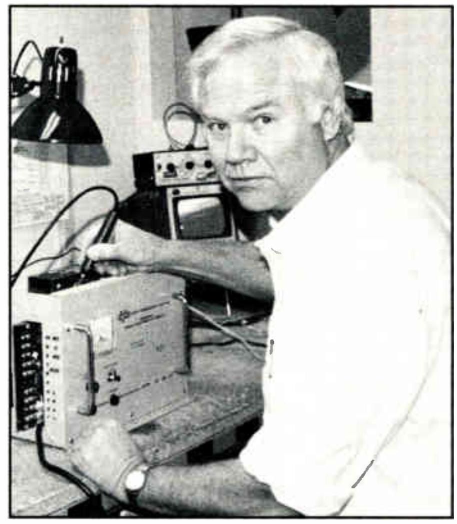
dBmV	µV/m	dBmV	µV/m	dBmV	µV/m	dBmV	µV/m
−60	6.45	−36	102.27	−10	2040.46	16	40712.60
−59	7.24	−35	114.74	− 9	2289.44	17	45680.29
−58	8.12	−34	128.74	− 8	2568.79	18	51254.13
−57	9.11	−33	144.45	− 7	2882.23	19	57508.08
−56	10.23	−32	162.08	− 6	3233.92	20	64525.13
−55	11.47	−31	181.86	− 5	3628.51	21	72398.38
−54	12.87	−30	204.05	− 4	4071.26	22	81232.32
−53	14.45	−29	228.94	− 3	4568.03	23	91144.16
−52.67	**15**	−28	256.88	− 2	5125.41	24	102265.43
−52	16.21	−27	288.22	− 1	5750.81	25	114743.70
−51	18.19	−26	323.39	0	6452.51	26	128744.55
−50	20.40	−25	362.85	1	7239.84	27	144453.76
−49	22.89	−24	407.13	2	8123.23	28	162079.79
−48	25.69	−23	456.80	3	9114.42	29	181856.51
−47	28.82	−22	512.54	4	10226.54	30	204046.36
−46	32.34	−21	575.08	5	11474.37	31	228943.78
−45	36.29	−20	645.25	6	12874.46	32	256879.15
−44	40.71	−19	723.98	7	14445.38	33	288223.15
−43	45.68	−18	812.32	8	16207.98	34	323391.69
−42.22	**50**	−17	911.44	9	18185.65	35	362851.44
−42	51.25	−16	1022.65	10	20404.64	36	407126.02
−41	57.51	−15	1147.44	11	22894.38	37	456802.90
−40	64.53	−14	1287.45	12	25687.91	38	512541.29
−39	72.40	−13	1444.54	13	28822.31	39	575080.78
−38	81.23	−12	1620.80	14	32339.17	40	645251.25
−37	91.14	−11	1818.57	15	36285.14		

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

Hands On

The essence of Ohm's law

By Jud Williams
Owner, Performance Technologies



A lot of folks do not know what the difference is between voltage and current or, for that matter, resistance. Then to further confuse things, there is the term "power." Let's look at some of these terms and work toward understanding them better. Then we can explore Ohm's law.

Voltage is the hardest of the previous terms to understand. We have developed misconceptions because it is misused so often. Voltage is merely stored energy and really does not do anything useful. About all we can do with voltage is measure it. The thing that does all the work is current. Current is well named because it describes what it really does. Look at the current in a river. It is basically the same concept. As current flows, it is capable of doing work like floating some object down the river or turning a water wheel.

Voltage does not do that; it just sits there as a potential. For instance, the water held back by a dam is just like the voltage in a battery. The voltage in the battery is not doing anything until something is hooked to the terminals that will allow current to flow. Then it is the current that does the work. That's simple, isn't it?

As for power, it relates to how much work the current is doing. Take a light bulb, for instance. They are always rated in wattage and we know that they get very hot. That heat is caused by the current flowing through the filament. The power is then related to the amount of heat that is generated. The hotter an object gets is generally related to the amount of power consumed.

So now we can presume that if a device were to have current passing through it, it would become warm to some degree—if not hot. If we were to increase the amount of current through a device, it would become hotter. How could we cause the current to increase through the device in question? Well, let's say that we begin using one battery and then add a second battery that would double the voltage. This additional battery causes an increase of current through the device we are working with. How does this happen?

Getting a bit technical

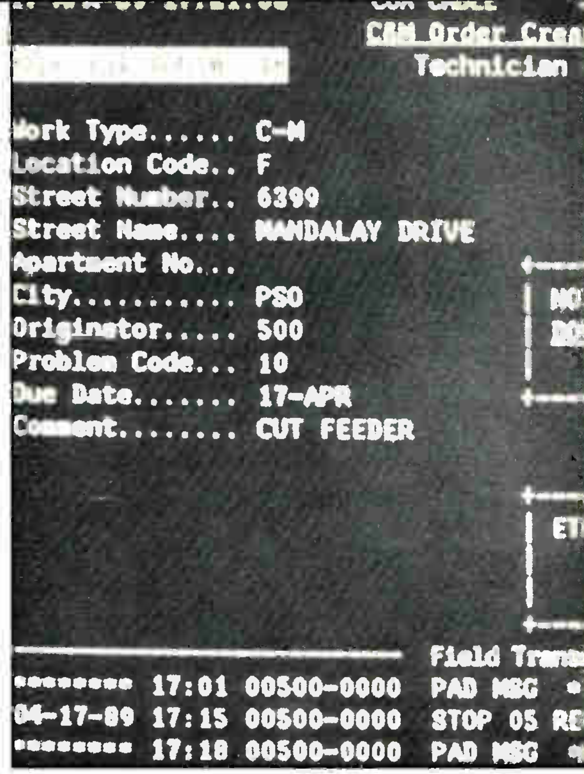
Let's explore Ohm's law and clear up some mysteries surrounding it. Take a resistor of some value such as 10 ohms and apply 12 V (volts) across the resistor. Knowing these two values, we can now calculate the amount of current that is flowing through the resistor.

"Heat is a result of the power consumed by the resistor."

Ohm's law states that current (amperes) is equal to the voltage divided by the value of the resistor. Divide 12 V by 10 ohms and we get 1.2 amps. Remember, previously we suggested that if we were to increase the voltage by adding another battery, additional current would flow. So let's add another 12 V and see what happens. Dividing 24 V by 10 ohms gives us 2.4 amps of current—twice as much as before. Do you think the resistor will get warmer as a result of this?

Remember that the heat is a result of the power consumed by the resistor. Ohm's law for power is current multiplied by voltage: $P = I \times E$. ("PIE" is an easy way to remember the formula.) If the current with 12 V (one battery) is 1.2 amps, we would calculate the power to be 14.4 watts. Now let's again increase the voltage by adding a second battery, which we have already discovered increases the current flow. Multiplying 24 volts times 2.4 amps gives us 57.6 watts. That is four times the wattage increase for just twice the voltage increase. Now you know why some devices get so hot so quickly. ■

The service tech completes a work order and sends a message via the C-ARDS terminal to dispatch.



The construction and maintenance (C&M) screen allows dis of the billing system.

Computer-aided radio dispatch

By John Tidyman
President, J.H. Tidyman Associates

At Cox Cable in Cleveland, everything prior to last spring is considered B.C. or *before* C-ARDS (an acronym for the Computer-Aided Radio Dispatch System created by the Technical Products Division of CNG Energy Co. and developed by Systems Data Inc.). Dispatchers and service techs at Cox shared customer service problems common to cable systems across the country. These included a busy radio frequency that cost technicians and dispatchers valuable time every day, manual account processing with substantial paperwork, the lack of timely information about a tech's location and route progress—and customer satisfaction that was less than desirable. However, for Cox Cable's 32 radio-equipped service trucks serving 52,000 subscribers, these problems began to be solved following the implementation of C-ARDS.

This technology, already in use by other utilities, is an on-line, real-time communications system consisting of three primary components: dispatch console (with accompanying computer software), radio base station controller and vehicle-mounted mobile data terminals (MDTs). It works with an existing two-way radio dispatch.

Schedule for the day

Each Cox Cable service tech begins the day by entering a command into the MDT. This information is transmitted over the two-way radio to a computer, which sends back the tech's complete schedule for the day on the MDT display. A service order is selected; progress is communicated when the tech presses special keys labeled "next," "arrive" and "complete." These statuses are automatically time-stamped by the MDT and sent to the dispatcher.

When the order is completed, the terminal prompts for "fix" and "solution" codes as well as additional comments; it also validates the codes. Customer accounts are updated instantly rather than at the end of the day by a dispatch clerk entering data collected on paper or received over the radio.

En route to a subscriber, the Cox service tech commands the dispatch system to call ahead and find out if the sub is home. A recorded message is played when the sub answers the phone. Then the computer notifies the tech with a message on the MDT that the sub is waiting; the tech proceeds. If no one picks up the phone or the call is intercepted by an answering machine, the tech is notified and does not make a trip.

Other features of C-ARDS include:

1) a service tech request to the dispatcher to turn on (or off) an addressable converter.
2) the ability of the tech to make an on-line inquiry to the billing system for service history on an account. On the MDT appear dates and results of service requests for the last three visits to the sub.
3) access of up-to-the-minute credit history. Field collectors can request current balances as well as 30-, 60- and 90-day credit information that is instantly available to the MDT from the billing systems.

"Standby time waiting for new orders, additional information and job clearance is eliminated."

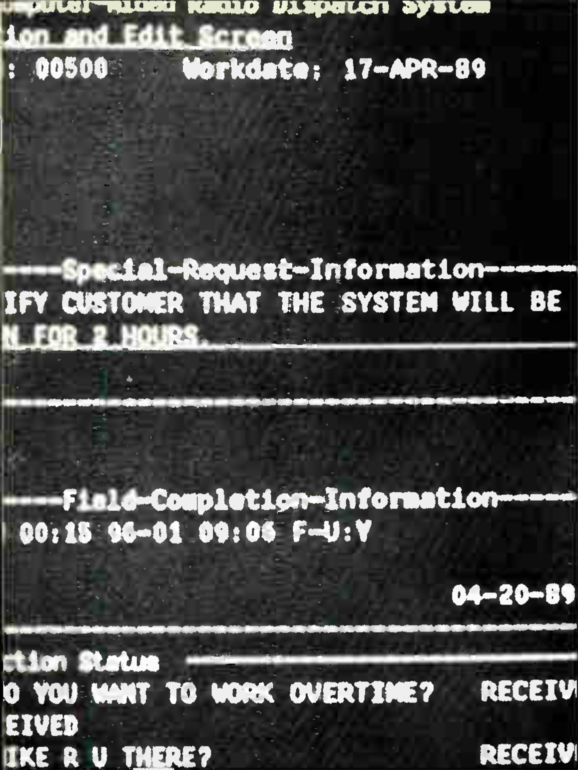
When the tech is beyond radio reception, C-ARDS stores all "completion," "fix" and "solution" codes. The MDT then automatically sends the stored data when the next transmission is acknowledged as the vehicle re-enters reception range.

System description

C-ARDS components include the dispatch console, a Digital Equipment Corp. Micro-PDP-11/52 with 4 megabyte (MB) memory, 400 kilobyte (kB) mini floppy disk and 30 MB Winchester hard disk. Operating system software is MicroRSX. The dispatch terminal is a color CRT; a second CRT is used for C-ARDS maintenance as well as monitoring all incoming and outgoing messages. A printer is used to generate an audit trail of events and for management reports.

Dispatch software programs are menu-driven and allow the dispatcher to communicate with MDTs for adding, deleting or moving orders and to monitor the progress of the service fleet. All programs are written in Fortran (except for the high-speed interface programs, written in MACRO assembler). MDT microprocessor software is written in MACRO assembler and resides in erasable-programmable read-only memory (EPROM).

When and if growth demands, up to 75 MDTs can be operated from the dispatch computer. Specifically, the MDT is a back-lit LCD-type screen, measuring 4½ by 10¾ inches; it can display 160 characters per page (four lines at 40 characters per line). Its alphanumeric keyboard has 59 keys (full ASCII) with 11 special function keys. Capacities include a DEC 16 bit T-11 processor and memory of 16 kB expandable to



patchers and techs to create an order independent

The dispatcher at the Cox Cable office receives the message from the tech and transmits a new work order.

32 kB. Its control program is 16K EPROM, with transmission modulation at 1,200 bits per second FSK (frequency shift key).

The MDT has an internal lithium battery for backing up the RAM chip. Cable connectors are nine-pin miniature for radio interface and MS series twist-lock for power supply from the vehicle battery. Operating voltage is 10 to 14.7 VDC and operating current is 1.4 amperes when the back light is on. Storage temperature ranges are −40 to 90°C, with operating temperatures at −20 to 70°C.

Observation period

In a four-week observation of the pilot installation for Cox Cable in Cleveland, savings measured in minutes were compiled and analyzed for service techs, dispatchers, supervisors and managers. What follows are some of the findings:

1) Information required to complete a service call is stored in the MDT and completion information entered into the terminals without any conversation with the dispatcher. Hence, standby time waiting for new orders, additional information and job clearance is eliminated. The actual time that the radio frequency is used is reduced. Before implementation, the average time necessary to stand by, receive data and pass completion information was four minutes per stop. The average time spent writing customer account and completion information was one minute per stop. After implementation, the total savings per person per day is expected to be 60 minutes.

2) The system also eliminates standby time waiting for dispatcher recognition and completion of calling ahead to the subscriber. The phone-ahead feature completes the function in 20 seconds, compared to 100 seconds required by voice. With an average number of 12 stops per day, 20 minutes per person per day are saved.

3) The average standby time for dispatcher recognition, in order to pass on information or a message, is 30 seconds and repeated about six times per day. By using the MDT to send a message, three minutes in standby time are saved. The employee need not be in the vehicle to receive the information, so messages are not missed.

4) There is less travel time and fewer wasted trips resulting from effective use of the phone-ahead feature, which notifies the tech when the sub is not home. In some cases, a sub who was going to leave did remain after receiving the call and hearing the recorded message. During the pilot study, the sub was not home on the first-call attempt 21 percent of the time; a conservative estimate of times that the wasted trip is avoided is 40 percent.

The average trip lasts 10 minutes. The phone-ahead feature saved 1.08 trips per day on average, or 11 minutes per person per day. Due to more accountability for location and status, improved scheduling and better workload planning, an estimated improvement in productivity per person per day saved an additional five minutes.

Total service tech savings totalled 97 minutes per day; for 20 techs, 1,940 minutes per day.

5) For the dispatcher, the savings measured in minutes are more dramatic. With C-ARDS, the average time necessary to communicate data for a service call and completion information is 30 seconds. It is done without any voice conversation between dispatcher and tech. For an average of 240 stops per day, 120 minutes are saved per day.

6) Use of the phone-ahead feature means the dispatcher no longer has to make the calls. With an average number of 240 stops per day, an additional 240 minutes are saved per day.

7) Because a dispatcher can now send a message to an MDT whether the tech is in the vehicle or not, average standby time of 30 seconds is eliminated. With an average of 20 such messages per day, 10 minutes are saved. Also, the dispatcher no longer has to update the billing system with completion information for each work order. C-ARDS automatically passes through the billing system interface the completion information and account comments received from the field. By eliminating the need for manual data entry, this saves another 90 minutes per day.

8) An estimated 10 minutes per day are saved due to improved productivity, a result of reduced stress and better working atmosphere without voice traffic. Dispatchers know the location and status of each service tech. All incoming messages are printed and therefore unlikely to be missed.

9) For supervisors, 30 minutes are saved because accounting and productivity programs will monitor employee effectiveness and compute commissions. This reduces the time the service supervisors spend performing these procedures. Also, the supervisor's MDT shows the location and status of each employee, allowing supervisors to perform their job more efficiently.

10) Savings for managers are difficult to compute in minutes. However, with more timely and accurate reports on employees and division performance, the ability to make informed personnel and operations decisions is enhanced.

Higher level of service

This complete mobile digital communications system has helped Cox Cable of Cleveland provide a higher level of service to its subscribers, which can equate to a higher level of subscriber satisfaction throughout its service territory.

Call for Nominations for Fellow Grade of the SCTE

By Walter S. Ciciora, Ph.D.
American Television & Communications

The Society of Cable Television Engineer's board of directors has approved a new set of bylaws. These were included in *The Interval* published in December 1989. In those bylaws, a new grade of membership was created, the grade of Fellow.

A Fellow of the Society is an individual who has made outstanding contributions to the broadband communications industry in a technical manner. Of particular note is that the total number of active (non-retired) Fellows is limited to only 1 percent of the membership. At the present time, that means no more than 60 individuals may be Fellows. This is a small group indeed!

The SCTE bylaws state that the Fellow Membership Committee may recommend individuals who have been nominated for the grade of Fellow to the SCTE board of directors. Only the board can elevate Senior members to the grade of Fellow. The board can only do this during a schedule meeting with a roll-call vote. The board is not obligated to elevate a member to Fellow grade. This is not a right. This is a special privilege "granted only at the pleasure of the Society" as represented by the board.

The Fellow grade cannot be applied for by an individual. The individual must be nominated by an active member of the society. The nomination form is quite difficult and requires dedicated effort. It is not something done casually. Since the number of Fellows is very limited, the Fellow Member Committee or the board may be in the position of selecting between seemingly equally qualified candidates. Therefore, it is important that the nominator and those submitting endorsements provide as much optional information as possible to support their candidates. It is not advisable to merely fill in the minimum amount of information. Details that would break a tie are important.

A requirement for Fellow grade (and now for Senior member grade) is participation and a specified degree of completion of the BCT/E exams. The Fellow Committee recognizes that certain highly qualified individuals may not have had the time to accomplish this. In such cases, the nomination process should proceed to the point of near completion. If the only remaining condition for Fellow grade is the tests, the candidate will be advised of the near completion of requirements. This will hopefully motivate the candidate to take the tests. The bylaws make no provision for waiving this requirement. It is expected that the BCT/E tests will always remain a part of the Fellow grade.

Those who have not applied for the grade of Senior member are encouraged to do so. Only Senior members are eligible to be considered for Fellow grade. The SCTE Fellow Committee also recognizes other related professional organizations and encourages participation in them. Included here are the Institute of Electrical and Electronic Engineers (IEEE) and the Society of Motion Picture and Television Engineers (SMPTE). Many SCTE members also are well-qualified to be Senior members of the IEEE but have not applied. They are encouraged to do so.

The nomination form must be supported by at least three endorsements from a list of highly qualified individuals. The SCTE advises that the following is a list, believed to be complete, of individuals who can endorse Fellow nominations:

Alex Best	(404) 843-5500	Lawrence Dolan	(317) 788-5965	Hubert Schlafly	(203) 661-6719
Frank Bias	(315) 635-6376	James Emerson	(813) 378-1104	Abe Sonnenschein	(213) 517-6233
Robert Bilodeau	(201) 665-0094	Sydney Fluck		James Stilwell	(215) 885-6350
James Chiddix	(303) 799-5600	Kenneth Gunter		Israel Switzer	(416) 964-6411
Ronald Cotten	(303) 695-0608	Richard Hickman	(404) 394-8837	Archer Taylor	(202) 835-7800
Henry Diambra		William Karnes	(214) 422-7981	Robert Tenten	(212) 598-7339
Robert V.C. Dickenson	(215) 619-0100	Harold Null		Joseph Van Loan	(415) 591-6020
		Thomas Polis	(215) 696-1800		

Additional individuals would also qualify for the list of those eligible to endorse nominations except that they are presently members of the Fellows Committee, the board of directors or the SCTE staff.

The nominator of a candidate is responsible for finding three qualified individuals willing to endorse the candidate. The nominator should facilitate the job of the individuals requested to endorse. They should be supplied with a filled out "Nomination Form," a copy of the relevant sections of the SCTE bylaws (see below) and the "Endorsement Form" with the appropriate sections filled out by the nominator.

The Fellow Committee would like to have the first group of members elevated to the grade of Fellow at Cable-Tec Expo '90. For this to be accomplished, complete nomination and endorsement forms must be received by the Fellow Member Committee by May 1, 1990, so that they may be acted upon by the May 19, 1990, SCTE board of directors meeting.

Following are the relevant parts of the current SCTE bylaws. From Article III, Section 2, Item f:

Fellow Member—Fellowship is granted only at the pleasure of the Society. It is intended that this be conferred on those few Senior Members who have made outstanding contributions to the broadband communications industry. In that light, there should be no expectation that any certain number of members will be elevated in any given year. In order to avoid dilution of the recognition due a Fellow Member, the total number of active Fellows will be limited to no more than one percent of the total membership in the Society. Retired Fellow Members will not be included in counting active Fellows for the purpose of setting the ceiling on Fellowships.

Candidates may be nominated by any current member of the Society. The nominator is responsible for filling out a form identifying the candidate's outstanding achievements and qualifications. He is also responsible for obtaining the endorsements outlined below.

The requirements for attaining Fellow status, although less specific, are intended to be considerably more stringent than those for Senior membership.

Seniority—As a minimum, successful candidates should have acquired twelve years of electronics experience, including seven years of broadband communications experience and five years of membership of any grade in the Society.

Professionalism—Supporting endorsements are required from at least three persons who can attest to the candidate's qualifications and who are qualified to serve on the Fellow Member Committee, but who are not currently members of that committee, the SCTE Board of Directors or headquarters staff.

Technical Competence—Candidates should be fully accredited by the Society of Cable Television Engineers. The Fellow Member Committee may, however, consider other evidence of broad technical knowledge of the industry to be equivalent to not more than two subject certification areas. Every candidate must be certified in Category VII.

Industry Contributions—The primary criteria for judging Fellow candidates will be outstanding technical contributions to the industry. Possi-

ble areas of contribution include:

- *Developing or directing the development of significant new products.*
- *Developing innovative technology to improve the efficiency, quality or reliability of broadband systems.*
- *Developing technology that opens new markets for broadband system operators.*
- *Developing programs that have a major positive influence on the technical competence level of industry personnel.*

Each candidate will be rated by the Fellow Member Committee as: Extraordinarily Qualified, Highly Qualified, Qualified, Qualified with Minor Reservations or Not Yet Qualified. The Board of Directors may choose to elevate to Fellow Membership any candidate(s) receiving one of the three highest recommendations from the Committee.

The Board may act upon recommended candidates with a roll-call vote at any of its scheduled meetings. If any member of the Board or the Fellow Committee is nominated, the member will abstain from participating in any decisions regarding himself.

From Article VIII, Section 4:

Fellow Member Committee: The Fellow Member Committee shall be composed of six current Fellow Members, except that until the General Membership Meeting in 1995, members may also include existing Senior Members who are also Fellows of the IEEE or SMPTE, SCTE Member of the Year recipients or NCTA Vanguard Award recipients in Science and Technology. Members will be asked to serve a two-year term and be limited to no more than three consecutive terms. Appointments will be staggered and the Board of Directors will replace half the committee members each year that the first meeting of the Board after the election of new Board members. The Board will also attempt to select members so as to achieve a geographically diverse committee, and shall select three each from the eastern and western regions.

The duty of the Fellow Membership Committee is to review nominees for the Fellow Member grade, to grade them in accordance with the Fellow Member guidelines, and report those evaluations to the Board of Directors.

Also, for ready reference, from Article III, Section 2, Item b:

Senior Member—is the highest professional grade for which application may be made. It is open to members who have demonstrated technical competence, partipated actively in Society and industry affairs, attained a degree of seniority and maintained a high standard of professionalism. Specific requirements are:

Seniority—A minimum of ten years electronic experience, five years of cable television or broadband communications experience and five years of Active or Charter membership in the Society. No candidate shall be considered whose Active or Charter membership has lapsed at any time during a period of three years prior to application. Industry and CATV experience may be established by submission of a verifiable resume.

Professionalism—Supporting nominations from at least three existing Senior or Fellow Members must be secured and submitted.

Industry Affairs—Candidates must submit evidence of qualification under at least three from among the following list:

- *National SCTE officer or director for at least one term.*
- *Chapter SCTE officer or director for at least one term.*
- *Active contributor to an SCTE committee.*
- *Technical presentations related to CATV presented at three national or regional technical panels.*
- *Technical presentations related to CATV presented at ten Chapter meetings.*
- *Three CATV-related papers published in national technical journals.*
- *Membership in the NCTA Engineering Committee for one year.*
- *Membership in a technical subcommittee of EIA, SMPTE, IEEE or other organization dealing with CATV-related issues for one year.*

Technical Competence—As a minimum, candidates must be registered participants in the BCT/E Certification Program. Certification must have been obtained in at least four Engineering or five Technician subject matter areas, at least one of which must be Category VII: Engineering Management and Professionalism. Any of the following may be substituted for one of the subject area certifications, except for Category VII:

- *Significant involvement in development of a new cable television technical product or procedure.*
- *Holder of at least one cable-related patent.*
- *Holder of Senior or Fellow membership grade in a related technical organization.*
- *Holder of FCC General Radiotelephone license.*

Applications will be reviewed by the Senior Member Committee which will recommend to the Board of Directors those candidates that they deem to have met the qualifications. Upgrades to Senior Member status will be granted upon confirmation by the Board.

Time is short. Now is the time to recognize a special SCTE member. Now is the time to nominate. All the tools you need are included here!

SCTE

SOCIETY OF CABLE TELEVISION ENGINEERS
669 Exton Commons
Exton, PA 19341
(215) 363-6888
FAX: (215) 363-5898

FELLOW GRADE NOMINATION FORM

Note: The current Society bylaws apply to this nomination. In particular, see Article III, Section 2.

If additional space is required, attach sheets with numbered pages. Indicate total number of attached pages. Indicate which section number of the form is being addressed by the attached information.

It is critically important that *all* information be filled in accurately and in the correct parts of the form. Incomplete or erroneously filled out forms will be sent back to the nominator without committee action.

Required Information

General Information:

1) Name of Candidate: ______________________________
Last First Middle

2) Occupation
Position: ______________________________

Organization: ______________________________

3) Business Address: ______________________________
Street

City State ZIP

Phone Number FAX Number

4) Home Address: ______________________________
Street

City State ZIP

Phone Number

5) Birth Date: ______________

6) Proposed Citation for Fellow Grade Certificate (not more than 30 words): ______________________________

7) Nominator's Name: ______________________________
Last First Middle

8) Nominator's Signature: ______________________________

9) Date: ______________

10) Nominator's SCTE Membership Grade and Number (must be a member): ______________________________

11) Nominator's Address: ______________________________
Street

City State ZIP

Phone Number FAX Number

Seniority of Candidate Requirement:

12) Current SCTE Membership Grade and Number (must be Senior member): ______________________________

13) Date of first SCTE Membership (must be a member for at least five years): ______________________________

Date and nature of first electronics experience (must have 12 years of electronics experience): ______________________________

Date and nature of first broadband communications experience (must have seven years of broadband communications experience):

Professionalism of Candidate Requirement:

14) Supporting endorsements from at least three persons who can attest to the candidate's qualifications and who are qualified to serve on the Fellow Member Committee, but who are not currently members of that committee, the SCTE board of directors or headquarters staff. See Section 4 of Article VIII of the current SCTE bylaws to determine who may submit endorsements. The requirements on those who can submit endorsements are rather strict. Non-qualifying endorsements will not be considered.

Supporting Endorsements from:

#1) Name: ______________________________
Last First Middle

____
Street

____
City State ZIP

____
Phone Number FAX Number

Qualification to endorse:
- ☐ SCTE Fellow
- Until 1995:
  - ☐ IEEE Fellow
  - ☐ SMPTE Fellow
  - ☐ SCTE Member of the Year, year? ______________
  - ☐ NCTA Vanguard Award recipient in Science and Technology, year? ______________

#2) Name: ______________________________
Last First Middle

____
Street

____
City State ZIP

____
Phone Number FAX Number

Qualification to endorse:
- ☐ SCTE Fellow
- Until 1995:
  - ☐ IEEE Fellow
  - ☐ SMPTE Fellow
  - ☐ SCTE Member of the Year, year? ______________
  - ☐ NCTA Vanguard Award recipient in Science and Technology, year? ______________

#3) Name: ______________________________
Last First Middle

____
Street

____
City State ZIP

____
Phone Number FAX Number

Qualification to endorse:
- ☐ SCTE Fellow
- Until 1995:
  - ☐ IEEE Fellow
  - ☐ SMPTE Fellow
  - ☐ SCTE Member of the Year, year? ______________
  - ☐ NCTA Vanguard Award recipient in Science and Technology, year? ______________

15) Professional History (present position first):

Dates (years)	Organization	Position and Responsibilities

Technical Competence Requirement:

The primary indication of Technical Competence is the passing of all seven categories of the BCT/E test at the Engineer level. Evidence of broad technical knowledge of the industry may be submitted for consideration to be equivalent to not more than two subject certification areas. Every candidate must be certified in Category VII. The SCTE staff will verify the level of completion of the categories.

16) Evidence of Broad Technical Knowledge: ______________________________

____

Industry Contributions of Candidate Requirement:

The primary criteria for judging Fellow candidates will be outstanding technical contributions to the industry. The primary contribution should be the one mentioned in the citation. Explain why the contribution(s) is (are) significant and why it indicates individual performance substantially better than that of the average SCTE Senior member.

17) Describe in detail the outstanding technical contribution mentioned in the citation: ______________________________

____

____

____

____

____

18) Describe other outstanding technical contributions: ______________________________

____

____

19) Education:

Institution	Location	Degree	Year

20) Evidence of Technical Accomplishment: List the three most important items of tangible and verifiable evidence of technical accomplishments. Describe in detail. Follow this by a list of additional areas of accomplishment with less detailed descriptions.

____

____

____

____

____

21) SCTE Activities, Awards, Offices Held, Committee Memberships: ______________________________

____

____

22) Non-SCTE Professional Activities, Awards, Professional Society Memberships, Major Professional Committee Memberships, Professional Engineer's License, etc.: ______________________________

____

____

To Be Filled Out By SCTE Staff Only

Please verify:

The candidate's membership grade: ______________________________

The candidate has been in that grade since: ______________________________

The candidate has been a member since: ______________________________

☐ Candidate is fully accredited
- or ☐ candidate has passed test Category VII
- or ☐ candidate has passed a total of at least six categories
- or ☐ candidate has passed a total of at least five categories
- or ☐ candidate is deficient in test categories

At least three of the names proposed to give endorsements are from those qualified to endorse: yes ☐ no ☐

Industry affairs items relating to the SCTE are correct: yes ☐ no ☐

Those that are incorrect or cannot be confirmed should be identified and submitted to Fellow Member Committee:

____

____

____

Signature of SCTE staff member: ______________________________

Date: ______________________________

To Be Filled Out by the Fellow Member Committee Only

This candidate has been voted by at least a simple majority of the Fellow Member Committee to be qualified as indicated below:

- ☐ Extraordinarily Qualified
- ☐ Highly Qualified
- ☐ Qualified
- ☐ Qualified with Minor Reservations
- ☐ Not Yet Qualified

The Fellow Committee believes this candidate should be notified of deficiencies in the area of accreditation and considers the candidate to be otherwise:

- ☐ Extraordinarily Qualified
- ☐ Highly Qualified
- ☐ Qualified
- ☐ Qualified with Minor Reservations
- ☐ Not Yet Qualified

To fulfill the requirements for Fellow grade this candidate must:

- ☐ Pass Category VII
- ☐ Pass seven categories
- ☐ Pass a total of six categories (including Category VII), evidence of broad technical knowledge is accepted
- ☐ Pass a total of five categories (including Category VII), evidence of broad technical knowledge is accepted

The Fellow Committee recommends that the SCTE board approve this nomination contingent on fulfilling the testing requirements listed above. This contingent approval should expire in two years. yes ☐ no ☐

Respectfully submitted to the board of the SCTE.

Signature of the Fellow Committee Chairman: ______________________________

Date: ______________________

To Be Filled Out by the SCTE Board Only

The candidate's elevation to Fellow grade is:
- ☐ Approved
- ☐ Disapproved
- ☐ Approved contingent on removal of testing deficiencies

Signature of the president of the SCTE board: ______________________________

SCTE

SOCIETY OF CABLE TELEVISION ENGINEERS
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FELLOW GRADE ENDORSEMENT FORM

Note: The current Society bylaws apply to this nomination. In particular, see Article III, Section 2. The nominator of the candidate should supply you with a copy of these bylaws.

The nominator of the candidate should supply you with a copy of the "Nomination Form" completely filled out. If you believe there are errors or significant omissions on the form, please advise the nominator so that only correct and complete forms are submitted to the SCTE Fellow Membership Committee.

The SCTE Fellow Membership Committee thanks you for your efforts and cooperation in this important Society matter.

To Be Filled Out by the Nominator

1) Name of Candidate: ______________________________
Last First Middle

2) Nominator's Name: ______________________________
Last First Middle

3) Date: ______________________

4) Nominator's Address: ______________________________
Street

______________________ ________ ________
City State ZIP

______________________ ______________________
Phone Number FAX Number

5) Supporting Endorsements from:

Name: ______________________________
Last First Middle

Address: ______________________________
Street

______________________ ________ ________
City State ZIP

______________________ ______________________
Phone Number FAX Number

Qualification to endorse:
- ☐ SCTE Fellow

Until 1995:
- ☐ IEEE Fellow
- ☐ SMPTE Fellow
- ☐ SCTE Member of the Year, year? ______________________
- ☐ NCTA Vanguard Award recipient in Science and Technology, year? ______________

→

To Be Filled Out by the Person Submitting the Endorsement

6) Date when you first knew the candidate: ______________________________

7) Professional relationship to the candidate: ______________________________

8) Do you attest to the qualifications listed on the Nomination Form? yes ☐ no ☐

If you disagree, with which specific items do you disagree? ______________________________

____

9) Do you know the candidate to be of sufficient professional standing and strong character to qualify to be a Fellow of the Society and to bring honor to the profession? ______________________________

10) Are you aware of any reasons why the candidate should not be considered? ______________________________

11) In your own words, describe why the candidate is qualified: ______________________________

____

12) Is the proposed citation appropriate? ______________________________

13) In your opinion is the candidate:

- ☐ Extraordinarily Qualified
- ☐ Highly Qualified
- ☐ Qualified
- ☐ Qualified with Minor Reservations
- ☐ Not Yet Qualified

14) Signature of Person Submitting the Endorsement: ______________________________

Date: ______________________________

SCTE

Bylaws made easy

By Jack Trower
President, Society of Cable Television Engineers

One of the challenges of the board of directors of the Society of Cable Television Engineers is how to balance the rules of government with the desires of the members. As many of you who have had dealings with a bureaucracy know, this can be a very frustrating problem. It is also a problem that no matter how you plan to solve it, leaves someone dissatisfied with the solution. Such may be the case concerning bylaws for the chapter/meeting groups.

In 1987 due to the growth of the Society and the increased number of chapter/meeting groups being formed, it was decided by the board of directors to establish the Continuing Chapter Development Committee to continue the high purpose and integrity of the original Chapter Development Committee. The result was the "Guide to SCTE Chapter Development," 1988 revision. This guide was published in the March 1988 issue of *The Interval*. As some of you may remember there were some items in the guide that not everyone agreed with, so the Society's board, at its June 1988 meeting, made changes that resulted in the current "Guide to SCTE Chapter Development," second 1988 revision, which was published in the September 1988 issue of *The Interval*. These were incorporated through reference in the Society bylaws and approved by the membership in October 1989.

One of the requirements in the guide was for SCTE suggested bylaws that could be used as is or modified where needed by the chapter. These bylaws were to be submitted to the Society board for approval, as required by the Society bylaws. Members of the Chattahoochee Chapter and the Continuing Chapter Development Committee worked on a set of bylaws that could be used for this purpose but they were never approved by the board.

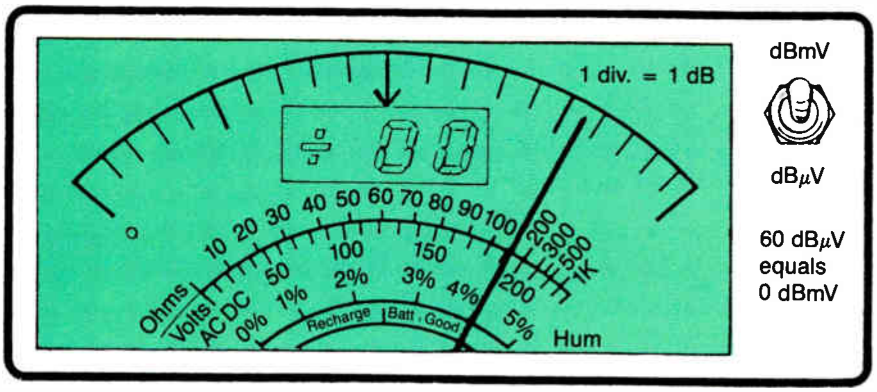
During a review of the Society bylaws, after my election as president of the SCTE, I noted it was required that all chapter bylaws be approved by the board. A further check revealed that, with the possible exception of one chapter, none of our chapter or meeting groups have bylaws that have been approved by the SCTE board of directors. To correct this problem I asked the SCTE national staff to review the chapter and meeting group bylaws that they had, make recommendation to the board for approval where appropriate and show what changes would be needed where approval could not be recommended. This proved to be an impossible task as the bylaws they had for review consisted of either nothing or documents containing many, many pages.

The board then asked the staff to take the recommended bylaws that had been previously submitted and to arrange them so every chapter or meeting group could insert required language and modify the bylaws as appropriate for their situation. The results of the national staff's efforts were reviewed at the board meeting in Anaheim, Calif., and with minor changes approved.

These recommended bylaws will let any group submit bylaws to suit their group with a minimum of effort. Of course, there will be some difference of opinion and these differences will be handled on a case-by-case basis. We have mailed these suggested bylaws to all the chapters and meeting groups and request that these documents be submitted as soon as possible so that a vote by the board can be made for approval.

Finally, I would remind the membership that an election package has been sent to each member authorized to vote in the Society. There are six regional director seats and one at-large director seat being contested in this election. All of the candidates seem to be well-qualified and desire to serve the Society. This is one way that the membership can say who they want to represent them on the Society board of directors. I encourage everyone to voice your opinion by voting.

Figure 1: Analog meter portion of signal level meter



Absolute vs. relative

By Joe E. Sadel
Vice President, Western Regional Sales
Sadelco Inc.

The concepts of absolute and relative specifications are of fundamental importance in the proper usage of electronic instruments. Along with absolute and relative specifications, you also find instruments that by their definition and through their usage are either absolute reading instruments or relative reading instruments. For instance, in optical encoder technology there are the absolute reading encoder and the relative reading encoder.

Absolute instruments

Likewise, in TV communications instruments there are absolute reading instruments such as signal level meters (SLMs), voltmeters and frequency counters. A pictorial representation of the analog meter portion of a typical SLM is shown in Figure 1. The dBmV reading of this SLM is an absolute quantity. Thus, an SLM is an absolute reading instrument.

When you review the factory specification of an SLM the accuracy specifications are given in decibels (dBmVs of course). These are absolute accuracy specifications with what may be considered one true value and the specified ± dB value that is the allowed deviation from the true value.

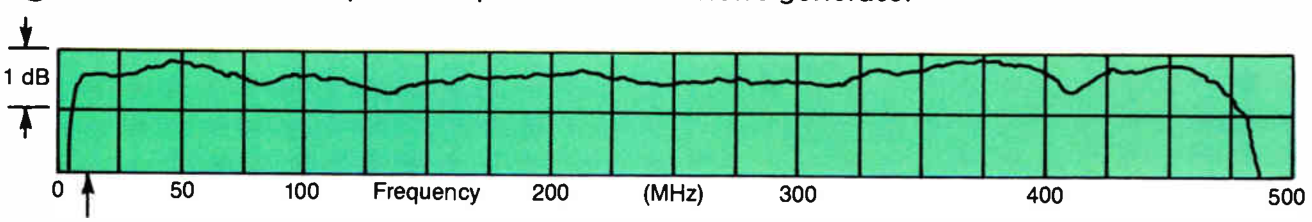
Relative instruments

Figure 2 shows a representation of the wideband output characteristic (response) of a precision white noise generator. (White noise may be defined as a signal that has the same amplitude per unit bandwidth throughout its spectrum. In Figure 2 the noise spectrum covers 4.5 to 450 MHz.) A white noise generator is a relative reading instrument used in broadband TV communication systems testing and in sweeping devices like traps and amplifiers. A white noise generator typically emits a precision ±0.25 dB flat white noise signal. The white noise is typically displayed on a spectrum analyzer, a signal level meter or an X, Y recorder.

"The concepts of absolute and relative specifications are of fundamental importance."

The wideband flatness specification of ±0.25 dB mentioned before is a relative specification of the white noise emitted from the generator. Figure 2 represents this value as the total algebraic deviation from a point relatively chosen halfway between the peak and trough of the white noise response shown.

Figure 2: Wideband response of precision white noise generator



BIRO CO-CHANNEL LOCATOR MAP ||||

Off-air Ch. 13

By Steven I. Biro
President, Biro Engineering

This is the 12th in a series of maps with technical and program parameter listings for off-air Channels 2-69, designed to be used when the cable system experiences co-channel interference. With this information, the headend technician can pinpoint the closest (i.e., the most probable) offenders, determine their directions and start the verification process with the rotor-mounted search antenna. Based on the tabulated technical information, the search can be concentrated on the most powerful stations or those that have the highest transmitting antenna towers.

The computer program for the maps was developed and data for the listings was collected by the staff of Biro Engineering, Princeton, N.J. The information is accurate as of Sept. 1, 1988.

Key to listing

Call letters: Ch. 13 station identification

City: Station location or the area served by the station

Network affiliation:

A/C	CBS and ABC programming	CBC	Canadian Broadcasting Corp.
C/N	CBS and NBC programming	CTV	Canadian Television Network
A/N	ABC and NBC programming	RRQ	Reseau Radio Quebec
ACN	ABC, CBS and NBC programming	TVA	Canadian Independent Programming
ED	Educational station (PBS)	SRC	Societe Radio-Canada
IND	Independent station	SP	Spanish language programming

Power: The effective visual radiated output power (in kilowatts)

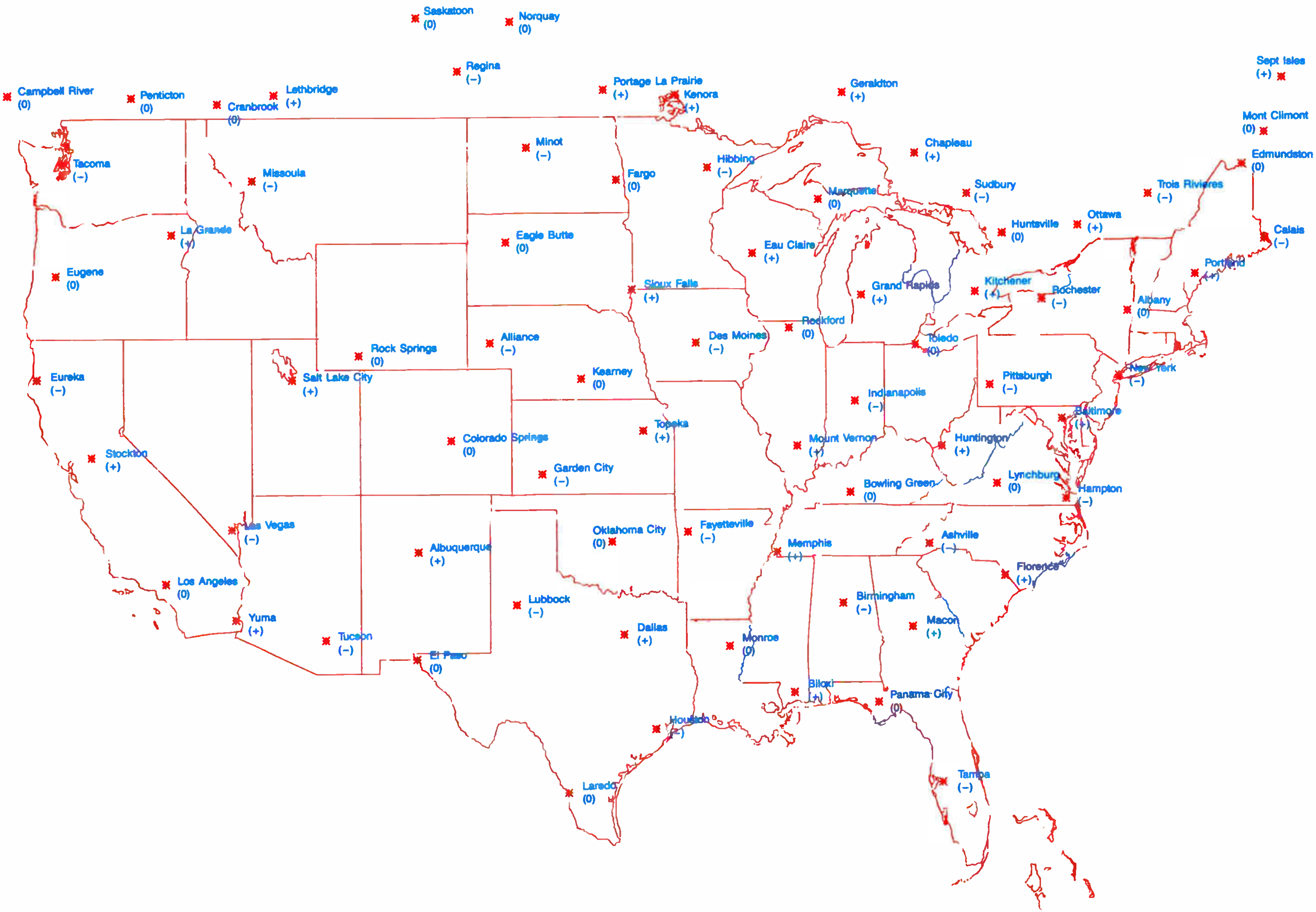
Offset: The offset frequency of the station

0	No offset
–	–10 kHz offset
+	+10 kHz offset

HAAT: Transmitting antenna height above average terrain (in feet)

Call letters	City	Network affiliation	Power	Offset	HAAT
WVTM	Birmingham, Ala.	NBC	316	–	1360
KIMO	Anchorage, Alaska	ABC	39	–	87
KTNL	Sitka, Alaska	CBS	1	0	15
KOLD	Tucson, Ariz.	CBS	110	–	3610
KYEL	Yuma, Ariz.	NBC	316	+	1560
KAFT	Fayetteville, Ark.	ED	316	–	1680
KEET	Eureka, Calif.	ED	181	–	1690
KCOP	Los Angeles	IND	162	0	2953
KOVR	Stockton, Calif.	ABC	316	+	1960
KRDO	Colorado Springs, Colo.	ABC	282	0	2140
WMBB	Panama City, Fla.	ABC	316	0	1403
WTVT	Tampa, Fla.	CBS	316	–	1416
WMAZ	Macon, Ga.	CBS	316	+	785
KHVO	Hilo, Hawaii	ABC	5	0	1
KHNL	Honolulu	IND	316	–	22
WCEE	Mount Vernon, Ill.	IND	316	+	989
WREX	Rockford, Ill.	ABC	316	0	710
WTHR	Indianapolis	NBC	316	–	980
WHO	Des Moines	NBC	316	–	1970
KUPK	Garden City, Kan.	ABC	225	–	870
WIBW	Topeka, Kan.	CBS	316	+	1380
WBKO	Bowling Green, Ky.	ABC	316	0	740
KLTM	Monroe, La.	ED	316	0	1780
WMED	Calais, Maine	ED	79	–	430
WGME	Portland, Maine	CBS	316	+	1610

Call letters	City	Network affiliation	Power	Offset	HAAT
WJZ	Baltimore	ABC	316	+	990
WZZM	Grand Rapids, Mich.	ABC	316	+	1000
WNMU	Marquette, Mich.	ED	316	0	1090
WIRT	Hibbing, Minn.	ABC	125	–	666
WLOX	Biloxi, Miss.	ABC	316	+	1340
KECI	Missoula, Mont.	A/N	300	–	2000
KTNE	Alliance, Neb.	ED	316	–	1553
KHGI	Kearney, Neb.	ABC	316	0	1110
KTNV	Las Vegas	ABC	316	–	2000
KGGM	Albuquerque, N.M.	CBS	89	+	4180
WNYT	Albany, N.Y.	NBC	178	0	1180
WNET	New York	ED	59	–	1637
WOKR	Rochester, N.Y.	ABC	316	–	500
WLOS	Ashville, N.C.	ABC	178	–	2804
KFME	Fargo, N.D.	ED	245	0	1130
KXMC	Minot N.D.	CBS	316	–	1120
WTVG	Toledo, Ohio	NBC	316	0	1000
KETA	Oklahoma City	ED	316	0	1450
KVAL	Eugene, Ore.	CBS	316	0	1476
KTVR	La Grande, Ore.	ED	13	+	2603
WQED	Pittsburgh	ED	316	–	690
WBTW	Florence, S.C.	CBS	316	+	1950
KPSD	Eagle Butte, S.D.	ED	316	0	1700
KSFY	Sioux Falls, S.D.	ABC	316	+	2000
WHBQ	Memphis, Tenn.	ABC	316	+	1013
KERA	Dallas	ED	316	+	1540
KCOS	El Paso, Texas	ED	224	0	820
KTRK	Houston	ABC	316	–	1930
KVTV	Laredo, Texas	CBS	88	0	920
KLBK	Lubbock, Texas	CBS	316	–	880
KSTU	Salt Lake City	IND	112	+	3670
WVEC	Hampton, Va.	ABC	316	–	980
WSET	Lynchburg, Va.	ABC	302	0	2040
KCPQ	Tacoma, Wash.	IND	316	–	2000
WOWK	Huntington, W. Va.	CBS	141	+	1275
WEAU	Eau Claire, Wis.	NBC	316	+	1990
KGWR	Rock Springs, Wyo.	CBS	209	0	1720
CITV	Edmonton, Alberta	IND	325	0	1115
CFCN	Lethbridge, Alberta	CTV	139	+	593
CHEK	Campbell River, British Columbia	CBC	3	0	1500
CBUT	Cranbrook, British Columbia	CBC	1	0	3400
CHBC	Penticton, British Columbia	CTV	1	0	2700
CHMI	Portage La Prairie, Manitoba	CTV	325	+	1075
CBCT	Charlottetown, Maritime Provinces	CBC	113	+	918
CJBR	Edmundston, Maritime Provinces	CBC	36	0	856
CBHF	Halifax, Maritime Provinces	CBC	4	0	900
CBHF	Sydney, Maritime Provinces	CBC	5		515
CBNL	Labrador City, Newfoundland	CBC	11		5
CBYT	Portland, Newfoundland	CBC	2	–	378
CBNT	Port Rexton, Newfoundland	CBC	16		696
CBNA	Ramea, Newfoundland	CBC	2	–	221
CBLF	Chapleau, Ontario	CBC	3	+	125
CBLA	Geraldton, Ontario	CBC	43	+	598
CICA	Huntsville, Ontario	ED	32	0	600
CIBN	Kenora, Ontario	CTV	1	+	285
CKCO	Kitchener, Ontario	CTV	325	+	1015
CJOH	Ottawa, Ontario	CTV	325	+	1150
CBLF	Sudbury, Ontario	CBC	17	–	478
CHAU	Gaspe, Quebec	TVA	157	–	242
CBGA	Mont Climont, Quebec	SRC	2	0	660
CHAU	Perce, Quebec	CBC	58	–	1315
CBST	Sept Iles, Quebec	SRC	20	+	489
CKTM	Trois Rivieres, Quebec	SRC	325	–	1323
CKOS	Norquay, Saskatchewan	CBC	25	0	374
CBKF	Regina, Saskatchewan	CBC	319	–	589
CBKF	Saskatoon, Saskatchewan	CBC	298	0	697
WPRV	Fajardo, Puerto Rico	SP	170	+	2825



Saskatoon (0)
Norquay (0)
Regina (–)
Campbell River (0)
Penticton (0)
Cranbrook (0)
Lethbridge (+)
Portage La Prairie (+)
Kenora (+)
Geraldton (+)
Sept Isles (+)
Mont Climont (0)
Edmundston (0)
Tacoma (–)
Missoula (–)
Minot (–)
Fargo (0)
Hibbing (–)
Chapleau (+)
Sudbury (–)
Trois Rivieres (–)
Marquette (0)
Huntsville (0)
Ottawa (+)
Calais (–)
La Grande (+)
Eagle Butte (0)
Eau Claire (+)
Portland (+)
Eugene (0)
Sioux Falls (+)
Grand Rapids (+)
Kitchener (+)
Rochester (–)
Albany (0)
Rockford (0)
Des Moines (–)
Toledo (0)
Rock Springs (0)
Alliance (–)
Eureka (–)
Salt Lake City (+)
Kearney (0)
Pittsburgh (–)
New York (–)
Indianapolis (–)
Baltimore (+)
Colorado Springs (0)
Topeka (+)
Mount Vernon (+)
Huntington (+)
Stockton (+)
Garden City (–)
Lynchburg (0)
Bowling Green (0)
Hampton (–)
Las Vegas (–)
Oklahoma City (0)
Fayetteville (–)
Memphis (+)
Ashville (–)
Albuquerque (+)
Florence (+)
Los Angeles (0)
Lubbock (–)
Birmingham (–)
Yuma (+)
Tucson (–)
Dallas (+)
Macon (+)
El Paso (0)
Monroe (0)
Biloxi (+)
Panama City (0)
Houston (–)
Laredo (0)
Tampa (–)

One or two lines?

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

There are many people in the cable industry that balk at the proposition of a single wire to the home providing both video and phone service. They are right, of course. But let's look at it from some other points of view.

The National Association of Regulatory Utility Commissioners (NARUC) advocates one wire (in this context, a glass fiber is called a "wire"). Why shouldn't it? If video on the second wire is free of PUC regulation, one wire is surely in NARUC's vested interest.

The National League of Cities (NLC) ought to be rather ambivalent on this issue. If the one wire combines video and POTS (plain old telephone service), NLC could end up with no regulatory authority. However, "one wire" sounds goods to its political constituency because it promises to bring cable TV rates under control; that is to say "down."

The United States Telephone Association (USTA), undoubtedly after careful study, has reached the unbiased conclusion that one wire would best serve the public interest. When pushed, it might even suggest who ought to be given responsibility for that one wire. Who better could be entrusted to rescue the public from the monopolistic grasp of the cable TV industry than the friendly, public spirited telephone monopoly supported by its cost plus guaranteed profit financing?

The plain, unvarnished, technological fact that is slowly being recognized is that two quite different services are involved. On the one hand, the primary service of cable TV is the distribution of video entertainment and informational programming from a headend to residential households. On the other hand, the primary service of the telephone industry is providing random access to duplex communication facilities capable of simultaneously transmitting and receiving voice (or data) between all possible pairs of commercial or residential terminals.

The technical facilities for these two different services are intrinsically incompatible. Cable TV networks are mostly two-way capable, thanks to the 1972 Federal Communications Commission Rules; but the tree-and-branch configuration is an inefficient, clumsy way to provide any but the most primitive forms of interactive communications. Telephone networks could be used to transmit a common set of messages (or programs) one way to all subscribers; but what a costly waste of capability that would represent.

Cable TV tree-and-branch networks are the most efficient and economical way to distribute a large package of video programs simultaneously to all subscribers. The telephone network is the most flexible and efficient way to provide point-to-point duplex service.

The question, then, is whether it is technically and economically feasible to try to provide both types of service on the same "wire?" In my opinion it is not, at least in the present TV environment.

It may be possible, as some seem to believe, that packet switching technology could be used with tree-and-branch or bus configurations to provide conventional voice and data services. However, the penalty would probably be extra cost and manpower to maintain sophisticated equipment decentralized to the consumer premises instead of being concentrated in the central exchange.

And, of course, video could be distributed on dedicated telephone subscriber loops by locating the channel selection and other control functions at more or less centralized switching centers. As we know well from experience with several failed off-premises experiments, the penalty is high cost and loss of operational flexibility.

There are many ways to combine POTS and CATV in the same duct: on separate fibers in the same multifiber cable, in the same controlled environment vaults (CEV) and in the same pedestals or cabinets. They can even be combined by wavelength division multiplexing (WDM) on the same optical fiber over portions of the distribution route. But for optimum efficiency and cost-effectiveness, the two services must necessarily follow functionally separate and different transmission paths.

It would be foolhardy to use the words *impossible* or *never* with respect to technology forecasting. I do suggest, however, that as long as video display terminals are designed primarily for reception of analog video signals broadcast by terrestrial transmitters, the one-wire dream is not likely to materialize.

It seems to me the idea of distributing video and POTS on a single wire implies a new type display terminal, probably digital, designed primarily for wired distribution. Digital over-the-air broadcasting is probably not possible because of the excessive spectrum required. Personal computers are, in effect, digital display devices that could easily evolve into TV displays, bypassing the conventional TV receiver industry.

However, this line of reasoning simply overlooks the political and economic power of the broadcasting industry. Is it conceivable that broadcasting might actually be transformed into a program provider for wired distribution? Converting the display industry from off-air reception to computer-based displays may not be so hard to imagine.

For the foreseeable future, which becomes increasingly indistinct after the first 10 to 20 years, there are likely to be at least two "wires" providing different kinds of communication services to residential households.

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