CED

THE MAGAZINE OF BROADBAND TECHNOLOGY / OCTOBER 1990

The quest for high quality audio

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Preparing for an OSHA visit

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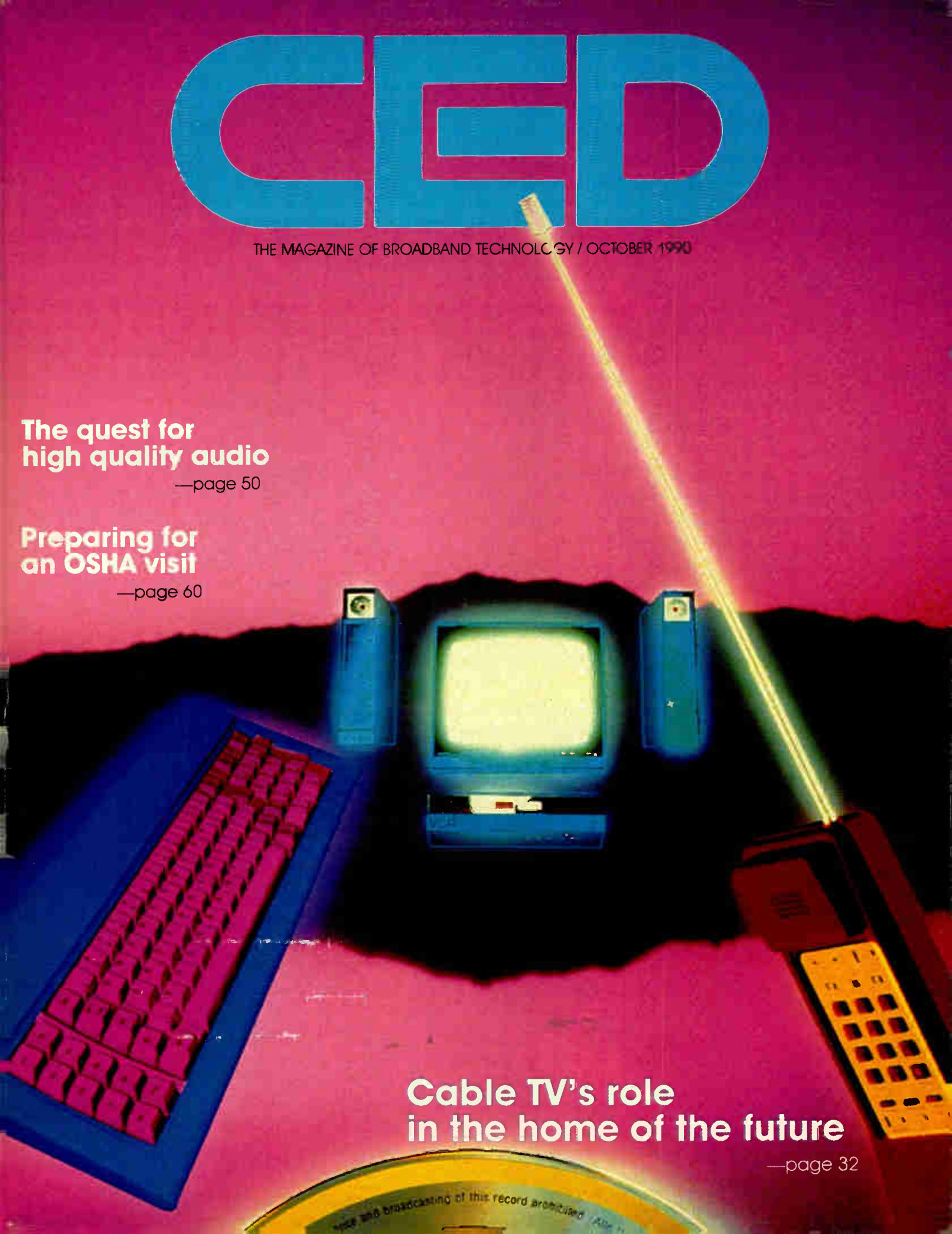

Cable TV's role in the home of the future

—page 32

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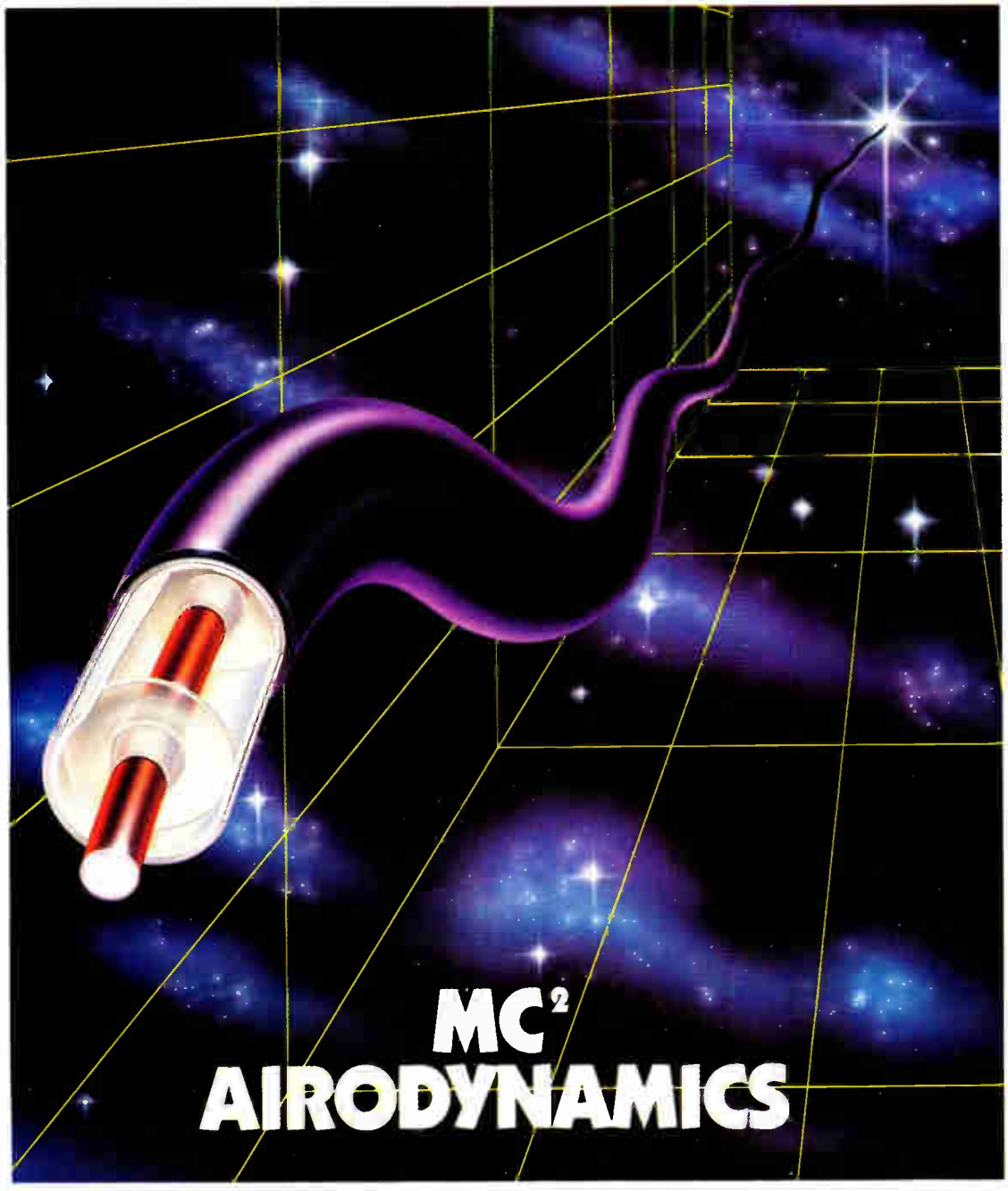

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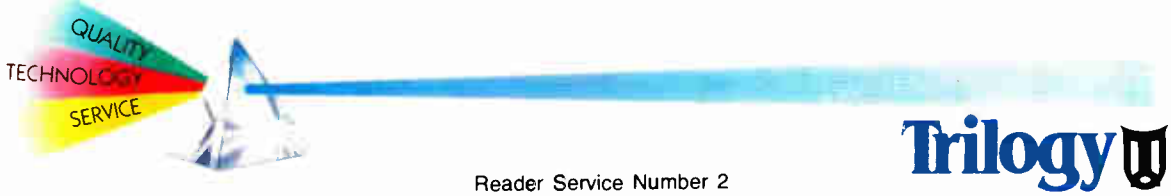

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October 1990 CED Volume 16, Number 11

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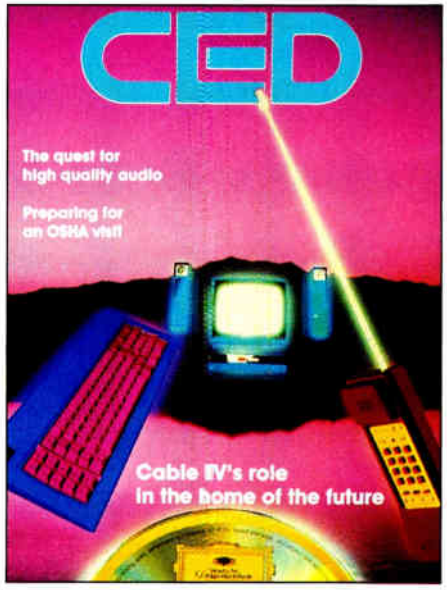

About the Cover:
Integration of all home communication media is the promise of the home of tomorrow. Photo by the Image Bank.

DEPARTMENTS

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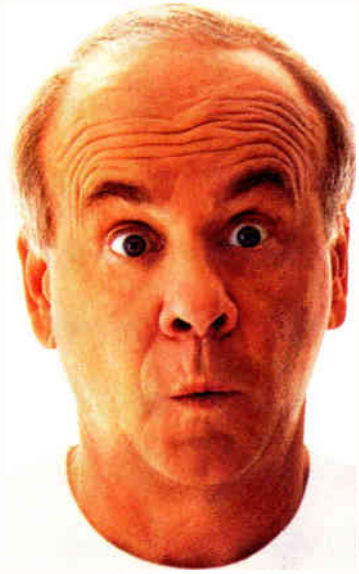

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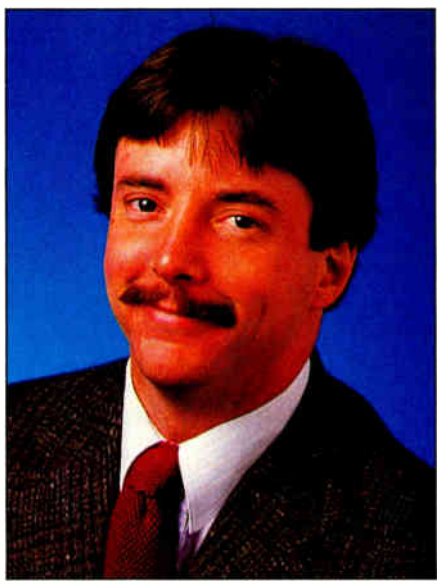
To get your free Titan fiber baseball cap, or for more information on Corning Titan fiber and its availability, write to Telecommunications Products Division, Corning Incorporated, MP-RO-03, Corning, NY., 14831, or call Loretta Maloney at (607) 974-7181.

Meeting more compliance criteria

Arguably, the best barometer of an industry's size or influence is the amount of attention it attracts on Capitol Hill. This is true even in the current political climate, which favors a free marketplace. Think about it: Is there anything near and dear to your heart that Congress hasn't held a hearing or passed legislation on in the past year or two? Even baseball expansion efforts hasn't escaped Congressional scrutiny.

If you buy that premise, it would help explain the new spate of legislation and regulation aimed at CATV. Cable television enjoyed a period of deregulation in the latter half of the 1980s. Rates were deregulated, technical standards were not in existence, even signal leakage rules didn't take affect until the calendar turned to 1990.



Perhaps July 1, the date of signal leakage compliance, was just a precursor to the bag of tricks that's been thrown at the industry lately. Congress held hearings, publicly blasted the industry for its rate hikes and monopolistic attitude, and decided it was time for some form of rate re-regulation because cable-TV is in existence in a plurality of American homes.

Now comes word that the 1990s will be known as the "decade of OSHA," according to an article written by Tom Brooksher of NCTI (see page 60). Consequently, cable operators will be hearing and reading more about the Occupational Safety and Health Administration, which has sweeping powers to ensure employers are providing a safe environment for people to work in.

It may come as no surprise to operators in the large urban areas, but small-system operators may be stunned to learn that OSHA requires employers to provide adequate safety training, maintain complete safety records and inform workers of hazardous materials.

OSHA has been given the power to ensure a safe work environment is provided by employers. Failure to comply with that broad guideline results in fines and, possibly, jail time. While it isn't difficult to maintain compliance with OSHA guidelines, it can be difficult to wind your way through the maze of regulations that apply to cable-television system operation. For example, how do you dispose of motor oil removed from service trucks? Did you know there are PCBs in power supplies? Is your electrical system in compliance with NEC guidelines? Are the ladders you use in good repair?

Operators who don't have OSHA compliance programs in place will benefit greatly from a two-day seminar, "OSHA Compliance for Cable Television Operators," a how-to program presented Oct. 22-23 in Denver by NCTI and co-sponsored by *CED*. For information about the seminar, call NCTI at (303) 761-8554.

Finally, in case you miss the NCTA call for technical papers (published on page 78), take note now of the deadline. Because the NCTA National Show is scheduled for March 1991, technical papers submitted for consideration must be delivered by *November 2*.

Roger J. Brown

Roger Brown
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Reader Service Number 6

High-tech remote control unit gains set-top suppliers' interest

A new device which combines the simplicity of a computer mouse with the convenience of a wireless remote control has been developed by a Vermont-based company and could be bundled with cable-television converter boxes by this time next year.

Dubbed "AirMouse" by Selectech Ltd., the inventing company, the device features only one button, yet can be used to perform a number of functions, including program selection, volume control, picture controls and performs other functions via a menu listed on the television screen.

According to William Ewer, VP of marketing for Selectech, AirMouse's simplicity will be embraced by cable subscribers who are confused or intimidated by a remote control filled with buttons. And Ewer predicts that a single-key remote will increase buy-rates for pay-per-view events because the buy can be made instantaneously.

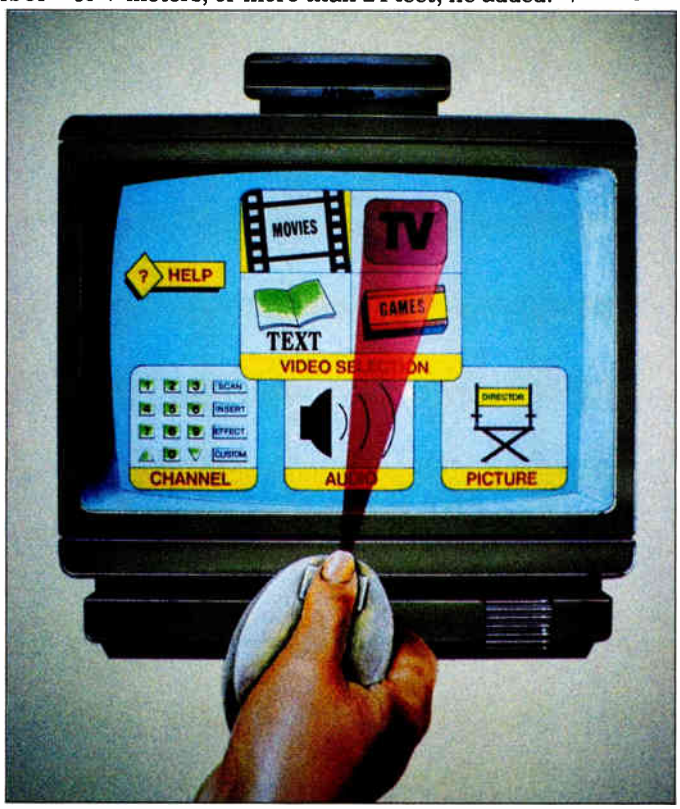
Built-in smarts?

Under its present configuration, AirMouse requires the use of a base station to generate the on-screen menu graphics and locate the AirMouse's location in the room. However, Ewer says his firm has had meaningful discussions with two of the three largest converter manufacturers and hopes to one day have the base station's intelligence built into those set-tops. According to Ewer, the circuitry needed to make Air-Mouse work would cost less than $5 per converter (a little more for a version which could learn the functions of other remotes). The AirMouse handheld remote would cost about $100, in quantity, he added.

Although AirMouse's operation is simple to the casual observer, it requires sophisticated electronics.

When the remote is picked up, a motion detector senses the movement and "wakes up" the AirMouse from the "sleep" mode it goes into when left untouched. It beams an infrared wake-up call to the base station (or converter) which, in turn, issues a locator beam throughout the room and determines exactly where the AirMouse is in relation to the television screen. A cursor then comes up on the screen.

The remote is powered by four AA batteries and pointing accuracy has been as good as ±0.4 percent in tests, said Ewer. It has a range of eight meters, or more than 24 feet, he added.



An artist's representation of how the AirMouse would work.

AirMouse could solve the problem of lost remotes by squeaking when a button on the converter is touched or, perhaps, when a person's hands are clapped together.

Selectech Ltd. is of course exploring other markets with AirMouse and has also talked with television receiver manufacturers to determine their interest. The device actually grew out of products designed for handicapped persons and underwent refinement beginning about a year ago. Ewer says this is just the first product developed by Selectech, which holds several patents related to the man/machine interface.

Maybe one day viewers will be able to make their programming choices by pointing their fingers, postulated Ewer during an interview.

For information, call Ewer at (714) 494-1400 or Jim Richards at (802) 860-7600.

VideoCipher in violation?

See if you can follow this one.

Satellite programmers who utilize VideoCipher encryption technology received letters last month informing them that they are in fact infringing upon a patent issued to Illinois-based Feature Film Services and therefore are subject to adhere to licensing agreements issued by FFS.

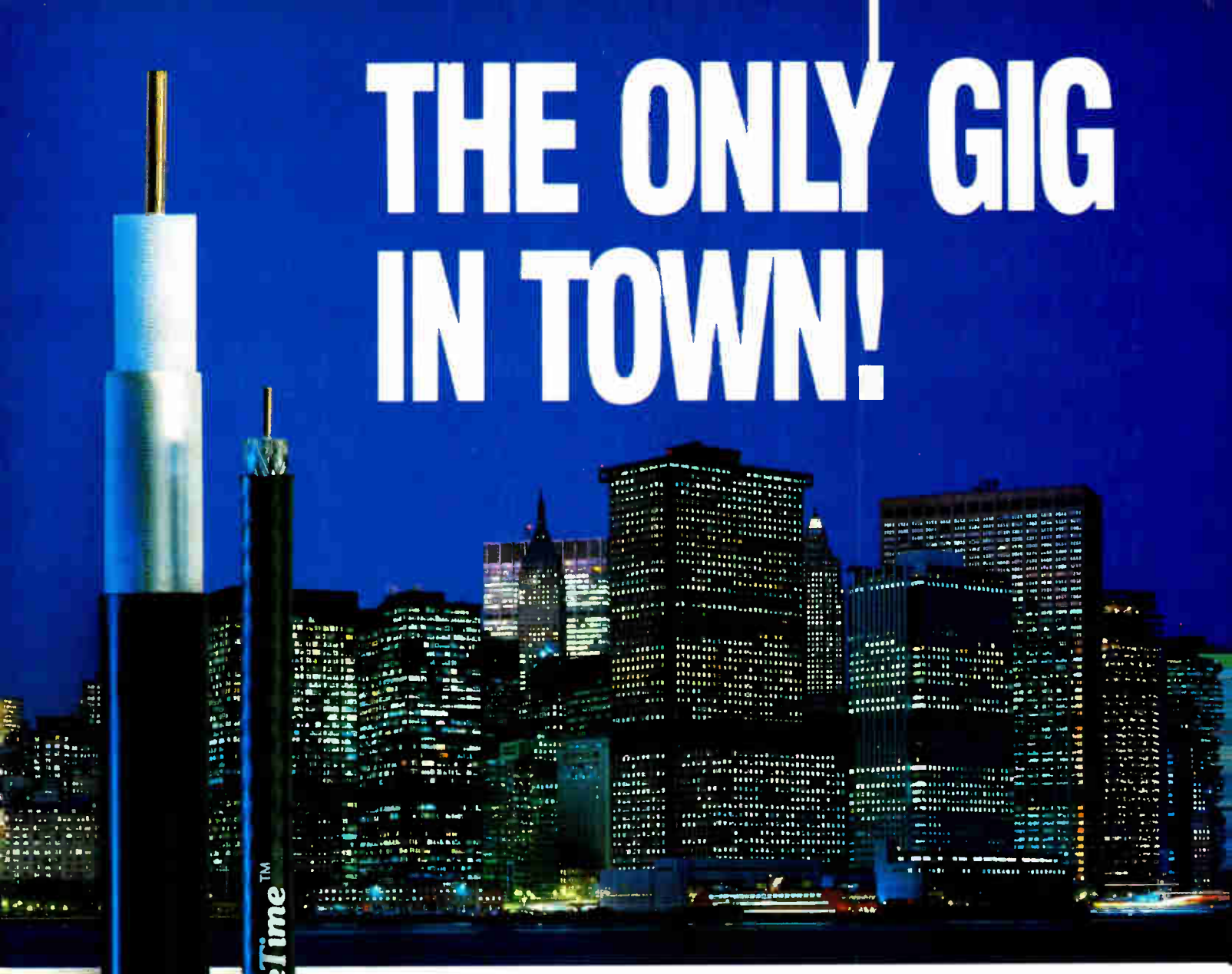
The letter was sent by attorney Gerald Hosier on behalf of FFS and reportedly requests that the programmers sign licenses. The license calls for FFS to receive a royalty rate of 0.8 percent of the programmer's revenue derived from encrypted programming.

The root of the issue centers on FFS' contention that the patent for encrypting satellite signals rightfully belongs to it, not General Instrument's VideoCipher Division. "It is not a whimsical letter by any means," said Hosier. "(My client) wants to obtain a reasonable share of the revenue generated by encryption" which Hosier conservatively estimated to be $250 million annually.

To date, Hosier has targeted the programmers only and has no intention of pursuing VideoCipher, despite claims by some of the programmers that the problem lies at GI's doorstep. "The value of the (VideoCipher encryption and descrambling) equipment is not the value of the invention," counters Hosier.

Programmers were reluctant to comment upon the letter until it was reviewed by legal counsel. However, Hosier said his conversations with programmers had been "cordial."

Broadcasters could, of course, cease using VideoCipher technology and avoid the licensing issue. However, that would



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Reader Service Number 7

force cable system operators to resort to trap-based systems and would likely revive the home-dish market.

Faroudja drops out of ATV test process

The Federal Communication Commission's testing of advanced television proponents may get underway and completed on time after all. Faroudja Research has decided not to participate in the advanced testing process, which was scheduled to begin this fall with Faroudja's SuperNTSC system. Instead, the Sunnyvale, Calif. company will take it's NTSC enhancement system directly to the marketplace.

In a prepared statement, Yves Faroudja, inventor of the system said, "Recent correspondence from the FCC, in response to developments in the SuperNTSC technology, lead us to believe that SuperNTSC is in full compliance with the current FCC regulations on color television trasmission. . . . Consequently, we can bring SuperNTSC to market." Faroudja added, that as a first step toward commercialization, a series of over-the-air public demonstrations will be held in major markets.

The SuperNTSC system relies on encoding at the signal origination point and decoding circuitry in the television receiver to enable viewers to see the full effects of line doubling and NTSC artifact reduction. However, even viewers of televisions without the decoding devices will see a marked improvement in NTSC broadcasts, according to Faroudja. He predicted the system would add $300 to the cost of TV receivers and broadcasters would have to invest about $10,000 at the transmission site.

The effect on the FCC Advisory Committee on Advanced Television Systems' ATV test schedule was not immediately known. However, Brian James, director of advanced TV testing for Cable Television Laboratories, predicted that the order of proponents scheduled to be tested would remain the same. James surmised that testing would not actually begin until early January 1991, because a system must be certified by Systems Subcommittee Working Party 1 at least 90 days before testing can commence.

In a related development, CableLabs has awarded the construction of the ATV test bed to Jerrold Communications. The Hatboro, Pa. company's Applied Media Lab will build the facility and deliver it to the Advanced Television Test Center in Alexandria, Va. by October 19, according to James. CableLabs earlier this year signed a $2.5 million pact with the ATTC in exchange for use of the facilities and lab and office space.

Beginning next year, CableLabs will conduct tests of the ATV proponents and how they fare with typical cable system signal impairments, including: random noise, intermodulation distortions, multipath and multiple microreflections, hum and low frequency noise, incidental carrier phase modulation and discrete frequency interference.

Jerrold announced that it will also donate a 20-kilometer fiber optic link to CableLabs for the duration of the testing phase, scheduled to be completed in early 1992.

Broad support needed for HDTV

If high definition television is to catch on in the American marketplace, all delivery media will have to take an active role, according to D. Joseph Donahue, senior vice president for technology and business development at Thomson Consumer Electronics. Donahue made the comments last month at the annual conference of the Association for Maximum Service Television in Washington, D.C.

"Considerable progress has been made by Thomson and other manufacturers toward development of widescreen picture tubes, TV receivers and VCRs," said Donahue. However, "the lesson to be learned from the slow start of color TV is that these emerging video technologies and products will win widespread consumer acceptace only if programming availability keeps pace with consumer electronics hardware," he cautioned.

Donahue recounted how color TV almost didn't succeed because hardware suppliers and programmers were following different timetables. He explained that while color TV was first introduced in 1954, it wasn't until 1965 that color TV receiver sales reached an "acceptable" level.

Donahue suggested that a possible scenario to follow would be to introduce widescrren enhanced definition receivers in 1993-94 followed by true HDTV receivers as soon as broadcast and cable programs are delivered in that format. But, Donahue added, that timetable "is subject to the pace of systems development, standards selection and program delivery."

In with a bang?

Everyone expected a bang, but the first cable system shutdown as a result of signal leakage compliance rules has taken place.

Details were sketchy as of press time, but apparently a West Coast cable system operator was forced to temporarily shut down some aeronautical-band channels after an FCC inspection determined the system was in violation of signal egress rules, which went into effect July 1. Apparently, the system was able to repair the leaks swiftly and was reportedly back up and running quickly.

The announcement may be just the tip of the iceberg, but industry observers privately wonder if the FCC will be able to make good on its promise to vigorously police the cable industry because of the severe budget constraints the federal government is experiencing. Time will tell.

Jottings

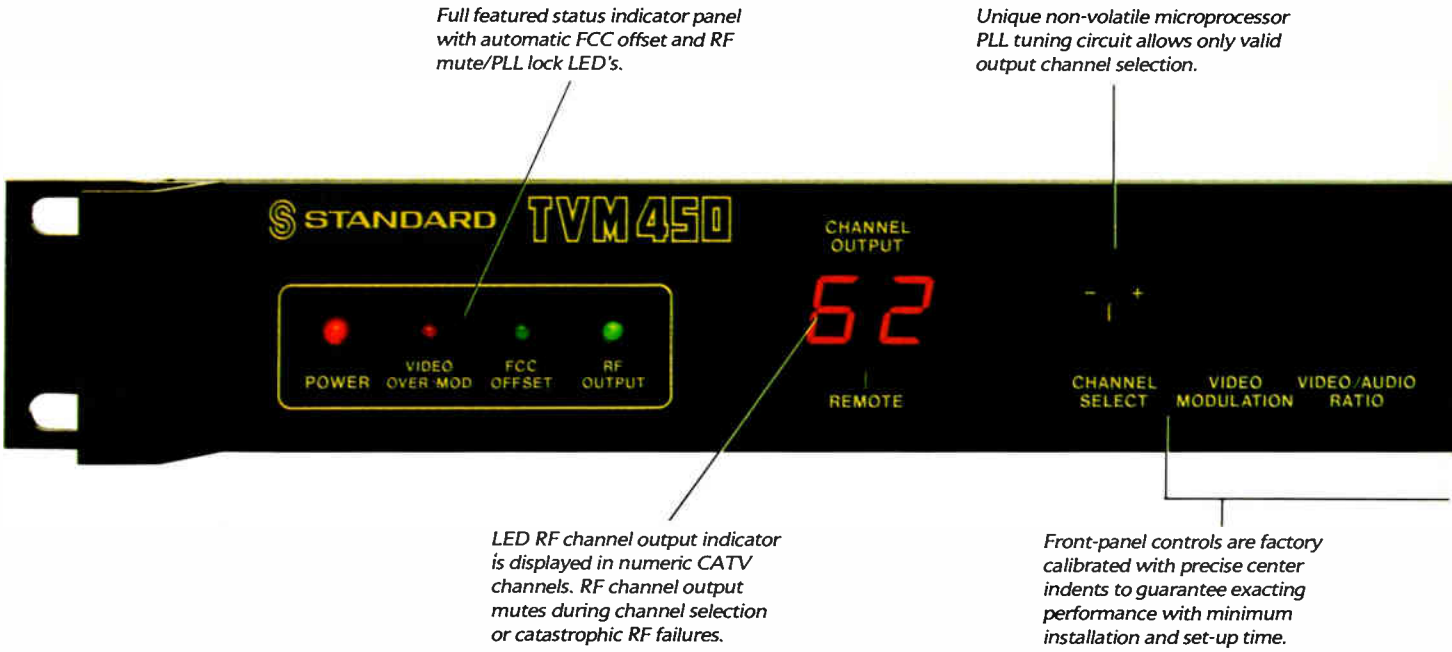
Some random notes from a variety of sources . . . **Larry Nelson** was named president of Comm/Scope. He was formerly executive VP . . . Don't forget to congratulate CableLabs' **Brian James**. He was slated to be married Sept. 21 to Genevieve Howse, formerly a CableLabs employee in Boulder, Colo. . . . By the way, Brian says he'll need several "expert observers" for about a week when the ATV tests get underway next year. Give him a call at (703) 739-3870 . . . And finally, from the Sept. 11, 1990 edition of *The Wall Street Journal*: "Faced with a problem, the House did what comes naturally: Voted to regulate it. The vote in the House yesterday was to 'reregulate' the price of basic cable TV service, after receiving complaints of price increases and poor service. The bill now will bring the FCC heavily into the cable business, which is likely to ensure an industry in which innovation becomes the lowest priority." ■

—Roger Brown

When is a modulator not a modulator?

Standard Communications

When it's a



No noise. No filters. No problems. No kidding.

Forget everything you've ever known about frequency agile modulators. You see, the TVM450 from Standard Communications is not a modulator. It's a revolution.

The TVM450 is the first 450 MHz frequency-agile modulator to challenge the RF performance of fixed channel modulators. The technically advanced PLL synthesized tuning process takes full advantage of Standard's High-Level Mixing (HLM). With six levels of filtering, and extremely stable RF circuitry, we can offer the industry out-of-band noise floor and spurious free performance previously available only with fixed frequency modulators.

The result?

Listen carefully. The final RF output signal meets all recommended NTC7 noise and spurious specifications for a 450 MHz CATV distribution system, and external bandpass filters are not required.

If you're thinking of rebuilding or upgrading your headend, this is one revolution you'll want to join.

On air. Off air. No error anywhere.

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

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

revolution.

Expansion slot allows options such as:
CSG60 integrated BTSC stereo generator module
OAP450 Off-Air I.F. processor module
CMA60 Monoral audio module
Internal space is provided for optional CRC450 RS232C remote control module

RF output purity, stability and video quality can be monitored with front panel video and RF output test ports.

FCC offsets are automatically selected via an internal microprocessor or custom programmed PROM. A rear panel switch is also provided for manual selection of required FCC offsets.

Left. Right. Mono. In Stereo.

The TVM450 Mono audio processing module features a 7-segment calibrated audio deviation meter, pre-calibrated front panel audio deviation control and an external BTSC input indicator.

With the unique integration of the GSG60 BTSC stereo encoder the TVM450 is the first agile modulator that puts stereo in its place.

Inside the Modulator!

This proven stereo unit will save you countless hours of tedious integration and set-up. The front-panel level controls are factory calibrated with precise center indents to guarantee exacting performance with minimum installation and set-up time.

For one unit, an entire headend or a complete network Standard's addressable Remote Alignment Control (RAC) option gives you multi-station access and status monitoring capability.

All of these powerful features are masterfully incorporated into one impressive piece of cabinetry. The front panel offers clear, precise control of all functions and direct reading of channel output.

When it's time to automate your headend, when it's time to rebuild or upgrade your headend there is no other choice.

The TVM450 is downright revolutionary.

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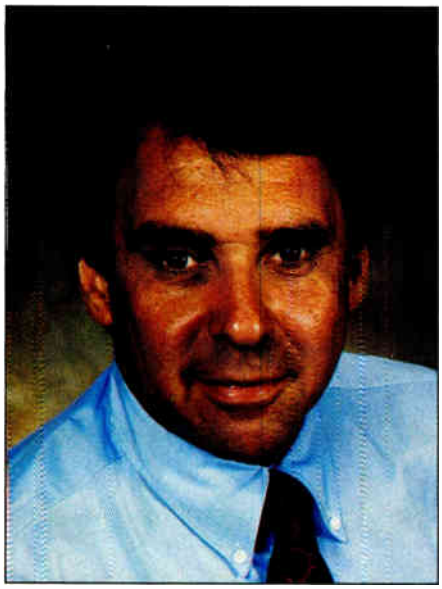

Dom Stasi

An eye for technology

Ever wonder whose hand flipped the switch that sent MTV to 1.1 million U.S. households? Wonder no longer. The hand belongs to Dom Stasi, who is currently president of Illinois-based Flight Trac Inc., a signal leakage flyover company. Stasi is a man who, in his 15 years in cable television, has developed an uncanny ability to stay on the crest of new technologies—from his involvement in the first satellite uplink of cable television programming, to the creation of MTV's first privately owned and operated uplink site, to his involvement with interactive home shopping, to his current flyover business.

Stasi's cable career began in 1975, after a short stint as an engineering instructor at the State University of New York. "After I got my engineering degree at SUNY, I stayed on as an engineer and instructor. But I started to realize that I was just teaching people to do what I wanted to be doing. My heart wasn't in it; there was no passion. So, in 1975, I left."

At the time, a new entity was emerging on the streets of New York—called Home Box Office. HBO was seeking an engineer; Stasi was seeking a challenge. The union was an important one to Stasi, who rapidly became involved in the development of cable's first satellite uplink. "HBO was building a network in the northeastern United States, with cities connected by microwave hops," says Stasi. "A city like Boston was, say, 13 hops down the line. A failure in any one of those hops would take HBO off the air. Boston was not so bad, but how would we get to Los Angeles or Chicago?" Stasi wondered.

"There was something on the horizon at that time called satellite technology. And somehow, these enormously creative engineers I was working with managed to go out and convince the operators that satellite technology was in their best interest."

Stasi stayed with HBO until 1980, working his way up the proverbial ladder to the role of director of engineering. But times were changing and again, Stasi was itching to blaze new paths. "I dearly loved HBO, but it had become a corporation," says Stasi.

Biggest engineering challenge

In early 1980, Stasi moved on to Warner-Amex, where he headed up the search for a new uplink facility for a new channel—Music Television. "When I first heard the idea of 24-hour music videos, I laughed my head off. I thought it was the nuttiest thing I had ever heard," Stasi remembers. But soon he was scouting out facilities and designing the uplink while simulaneously operating the Buffalo, N.Y.-based uplink of The Movie Channel.

As the VP of engineering for Warner-Amex, Stasi was faced with a monumental decision: either find a new, wholly owned uplink site for the fledgling MTV, or take the safe road and uplink the channel at the rented Buffalo, N.Y., facility. Stasi opted for the riskier route, setting his sites on Long Island.

"Everybody had a million reasons why it wasn't going to work," Stasi remembers. "This period of time had to be my greatest engineering challenge: designing the MTV uplink and putting in place the solutions to the enormous problem of interference on Long Island," Stasi continues. "Because when you want to put a new signal up in the air, it's not allowed to interfere with anyone—not in reality, not on paper, not in postulation."

Stasi achieved this by working with an engineer for Compucon, the Dallas-based company that handles satellite frequency coordination. "I found a spot that I liked on Long Island. I took the maps to Texas, and for a solid week we sat at these machines working out theories of refraction, diffraction and beam averaging," Stasi explains. "We made the building part of the antenna system, and moved it in hundreds of different positions. Finally, the computer finally spit out one that would work."

With paper-proof in hand, Stasi was then faced with the task of convincing corporate officials, the FCC and the New York telephone companies that his idea, although risky, was a winner. And he did. At midnight on August 1, 1981, MTV was launched, with Stasi and his bedraggled colleagues looking on, weary but pleased, after working 36 straight hours to meet the deadline.

Risk pays off

Ironically, the move to a wholly-owned uplink site turned out to be a hidden blessing. "Up until the launch date of the Long Island uplink, we had been bicycling the pre-recorded V.J. tapes by airplane from New York City to the Buffalo uplink site," says Stasi. "Coincidentally, the launch day for the Long Island uplink site was the same day the air traffic controllers went on strike. So had we opted for the safe route (Buffalo), we would've been in deep trouble," Stasi recounts. "I guess sometimes, the safe road isn't always the safest road."

In 1986, Stasi left Warner-Amex to head up the engineering efforts of the ill-fated Teleaction, a Chicago-based interactive shopping network. Stasi stayed with Teleaction until it folded in 1989. From there, he moved on to form his own flyover organization.

A pilot himself since 1965, for Stasi the move was a natural progression. "Signal leakage is a big issue right now, and with my love for flying, it was the right thing for me to do," Stasi says. Flight Trac operates throughout the United States with American Television and Communications heading up the client list. Future plans include expansion to other hub cities across the U.S. "to better serve the operators," Stasi comments.

Stasi isn't sure what his next move will be. "I want to make Flight Trac more successful first. This is a whole different thing for me. And at my age, this is a real exciting thing to be doing—it's entreprenurial. It's a challenge to make a company emerge and succeed. So for now, this is my future," Stasi laughs, "but I never seem to stay in one place for more than five years—so check with me after I've lived my requisite 5 years in Chicago!" ■

—Leslie Miller

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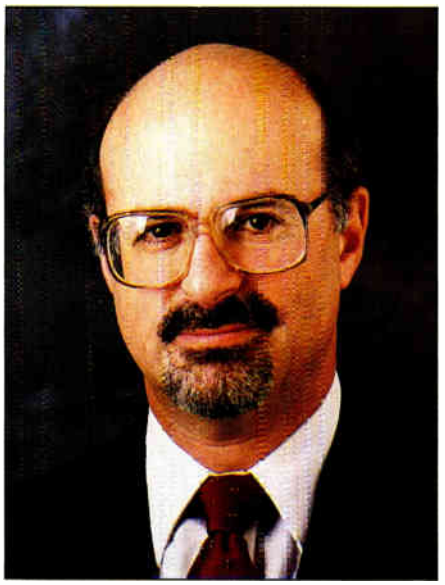

Digital video compression and HDTV

There are now seven proponent formats being considered for the U.S. standard for terrestrial broadcasting of advanced television. One of them, the DigiCipher™ system proposed by General Instrument Corporation, is an all-digital compression and transmission format; the others are either partly or totally analog.

GI submitted its DigiCipher HDTV format just before the June 30, 1990 deadline. But digital video compression will probably be applied to NTSC signals well before the HDTV market develops. There are several companies working on NTSC digital compression.

Of course, not everyone is in favor of new technical approaches such as digital *compression*. I can conceive of some "policy" questions that might be raised in attempts to slow down the implementation of digital video compression. For example, will TV broadcasters be placed at an "unfair" disadvantage compared to cable operators and satellite broadcasters, who may choose to employ digital video compression for NTSC channels?

Another "fairness" question: Is it "fair" that only one HDTV format is all-digital, or should we wait a year or two and give others a chance to develop competing all-digital formats?

By Jeffrey Krauss, Independent Telecommunications Policy Consultant and President of Telecommunications and Technology Policy of Rockville, Md.

Not really a new concept

Digital video compression has been under development for the last decade. In the early 1980s, video teleconferencing terminals operated at 3 Mbps. Later, the data rate came down to 1.5 Mbps. The current state-of-the-art for teleconferencing is 768 kbps. These are not broadcast quality, but they are all-digital.

It should therefore be no surprise that Compression Labs, an industry leader in teleconferencing technology, has developed the video coding algorithm that will be used by SkyPix Corp. SkyPix plans to deliver 80 NTSC video channels over 10 satellite transponders, starting next year.

The first market for digital video compression is likely to be satellite-delivered NTSC programming, not HDTV. HDTV broadcasting probably won't start until 1995, but SkyPix plans to start satellite broadcasting of digitally-compressed NTSC video in 1991.

General Instrument also has an NTSC version of DigiCipher under development, capable of carrying up to 10 NTSC channels in a satellite transponder, or up to four NTSC signals in a 6 MHz TV broadcast or cable channel. Other companies with digital NTSC video compression development underway may include Comsat, Scientific-Atlanta, Sarnoff Labs and Global Entertainment Systems.

Cable and satellite operators are likely to be the first to employ digital video compression. Unlike broadcasters, they are not required to comply with NTSC signal format regulations. The decoding could be built into the cable or satellite converter/descrambler/receiver.

Fairness issues

Although it is technically feasible for a TV broadcaster to use digital video compression, it is much less likely that a broadcaster would want to replace his single channel NTSC programming with a digital multichannel service. It would turn the service into pay television, a business that most TV broadcasters are not familiar with. Moreover, a specific FCC rule waiver would be needed, as well as decoding equipment for home subscribers.

Not everyone favors the concept of an all-digital HDTV system. You can expect that some will try to use the existence of the DigiCipher digital format as a ploy to delay the HDTV standards process. They will say that other proponents should be given time to modify their proposals and to develop all-digital formats.

Who will make these arguments? They will come from two sources. Competing proponents, who are now committed to analog or hybrid analog/digital formats, would like more time. While they might not have the time to produce an all-digital format to be tested by 1991, maybe they can produce digital systems if testing is delayed until 1992 or 1993.

Some may say that it isn't fair to consider only a single all-digital HDTV format. But of course the U.S. free enterprise system, which is based on research, development and marketing of new or improved products, is not a "fair" system. Anyone having the "unfair" advantage of being first with a new product, or designing the best product, has an "unfair" chance of being successful. Sorry, but that's simply the way our system works.

The quiet detractors

Arguments in favor of delay will come from another source, as well. There have been entities in the broadcast and cable television industries who have been quietly opposed to HDTV. They ask, "Why force us to spend more money on transmitters and improved transmission plant when it won't increase our profits?" Then they said, "Let's wait until an all-digital format becomes feasible," never expecting that it would be feasible this soon. Now, confronted with the near-term feasibility of a digital format, they will try other delaying tactics, such as, "Wait for more digital formats so we can compare them."

These transparent delaying tactics, whether from competing proponents or from short-sighted broadcasters and cable operators who favor their own profits over improvements in television technical quality, should be firmly rejected by the FCC and the industry.

The FCC has set a course toward choosing a standard for HDTV. The FCC decision should be based on picture quality, equipment costs and effective spectrum usage, not on whether the format is digital or analog. "Fairness" arguments are merely distractions that will lead to delays. The FCC should stay the course. ■

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Reader Service Number 13

Classic technological mistakes

"Experience is the name everyone gives to their mistakes." —Oscar Wilde

Two such "experiences" hundreds of years ago seem to have echoes in modern times. What can we learn from these classic "experiences?" Surely we must not reject technological progress. But must experiences like the capsize of the *Vasa* or the fate of the Franklin expedition be accepted as the "price of progress?"

The Vasa

Nearly 400 years ago, in 1625, King Gustavus II Adolphus of Sweden signed a contract with Henrik Hybertsson to build the most powerful, expensive and magnificently ornamented naval vessel ever built in Sweden. The *Vasa*, named for the King's ancestral family, was to carry more cannon than any before, weighing more than 80 tons on two gun decks. She measured 226 feet overall, including her huge prow and bowsprit.

On Sunday, August 10, 1628, 100 crew members, many with wives and children, were on board for her maiden voyage. This was to be a great ceremonial occasion, with the bands playing, flags flying and Admiral Erik Jonsson aboard. Slowly and serenely, *Vasa* set off on what was confidently expected to be a glorious career.

Twenty minutes later the light breeze freshened slightly, and before horror-stricken onlookers, *Vasa* began to heel. Water gushed in through the lower gun ports and she slowly went to the bottom under sail, with pennants flying. Some 50 people are said to have followed *Vasa* into the deep.

Just 12 hours later, Captain Hansson stood, as a prisoner, before a Court of Inquiry seeking to learn the cause of the disaster and punish those responsible. "You can cut me into a thousand pieces if all the guns were not secured," he testified. "And before God Almighty I swear that no one on board was intoxicated." The Chief Boatswain testified that he had placed and secured as much rock ballast as could be accommodated in the space available below the lower gun deck.

Hansson placed the blame on the ship's design. She was top-heavy with her huge, nearly 200-foot masts and the enormous complement of 64 heavy bronze guns ordered by the King. The shipmaster revealed that to test the stability of the vessel, 30 men had run back and forth across the upper deck while she was moored at the quay. After three runs, the test was stopped for fear she would capsize on the spot. The Admiral, who had witnessed the test, commented: "If only His Majesty were at home!" But the King was in Prussia on a land grabbing mission. Four years later, he was killed in battle in Poland.

> Risks must be evaluated carefully, but cannot be entirely eliminated from progressive enterprise.

The ship builder, Hybertsson, could not be called to testify about the design and construction of the *Vasa*, because he had died the year before she was completed! The design of *Vasa*, with her high poop, tall masts and many guns, was visibly similar to many other warships of the period. That they were unstable was a recongized fact, but *Vasa* did not look top-heavy by comparison.

The Admiral had the power to prevent the Vasa's departure after the frightening stability test. But with the King waiting impatiently in Prussia, the Admiral's reluctance to reject the completed vessel, after investing three years of manpower and expense, is understandable. Seventeenth century shipbuilders were incapable of making construction drawings and performing the mathematical calculations needed to predict stability without tank tests or computers. We shall never know whether the shipbuilder knew about the similar capsize of the *Mary Rose* outside Portsmouth, England, nearly a century before, in 1545, with 700 persons on board.

Vasa was lifted from the cold waters of Stockholm harbor on April 24, 1961, remarkably well preserved after 333 years in the deep, with ballast, gun carriages, and sails properly secured—just as the crew had testified. Her hull and statuary were sprayed with polyethylene glycol for 18 years to prevent the old wood from disintegrating. She now rests in a special permanent museum in Stockholm, almost completely restored as she had been in 1628.

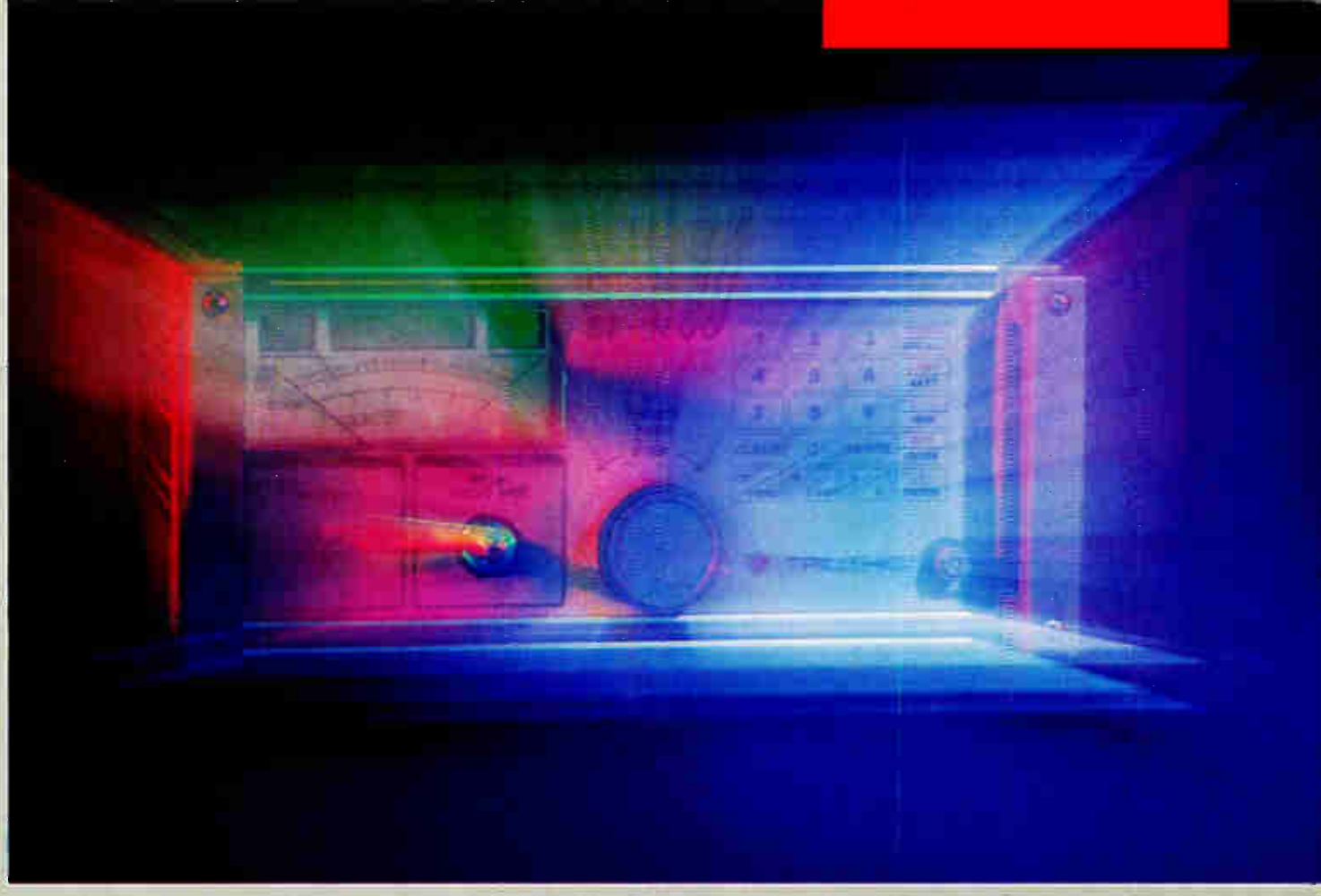
The Franklin expedition

On the 19th of May, 1845, HMS *Erebus*, under the command of Sir John Franklin, and HMS *Terror*, under the command of Captain Francis Crozier, sailed down the Thames from London, with royal instructions to sail from Baffin Bay through the Bering Straits to complete the heretofore impenetrable Northwest Passage.

Optimism ran high. Franklin, Crozier and Commander James Fitzjames, second in Command of *Erebus*, were experienced seamen and explorers, in both arctic and antarctic exploration. In a revolutionary stop, the vessels were equipped with screw propellers driven by 25 horsepower steam locomotives. Enormous quantities of provisions were loaded aboard, including nearly 35 tons of tinned meat, soup and vegetables.

Franklin was never heard from after leaving the escort vessel in Baffin Bay in July, 1845. On August 27, 1850, a sailor from one of many expeditions searching for Franklin, found three graves on windswept Beechey Island, just off the southwest corner of Devon Island on Lancaster Sound. Inscriptions carefully carved on mahogany headboards revealed that the three sailors had died during the Franklin party's first winter; two in January

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



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TRILITHIC

Reader Service Number 14

1846 and a third in April.

In May 1859, another search expedition found a note left in a cairn on King William Island by an officer of *Erebus*, reporting that as of May 1847, all was well with the Franklin party. However, in the margin of the note was a tragic report, dated almost a year later, that the two ships had been abandoned in April 1848 after being beset in ice for two winters. The note reported that in all, nine officers and 15 men of the 129-man crew had died, including Sir John Franklin.

Some bones and artifacts from the Franklin party were found. But, it was not until 1984 that a serious attempt was made to exhume the three bodies on Beechey Island, thought to be well preserved, even after 138 years in the permafrost deep freeze. Dr. Owen Beattie, an associate professor of anthropology at the University of Alberta in Edmonton, experienced in forensic investigations, was accompanied by a pathologist, Dr. Roger Amy, to conduct scientific autopsies with the hope of being able to determine the cause of death of the three Franklin sailors. Permission for the work was sought and granted by the Canadian Territorial government, and the British Admiralty was notified and kept informed.

Although the autopsy revealed concrete evidence of tuberculosis and emphysema, probably existing before the fatal voyage, there was no evidence of scurvy in the three men who died on Beechey Island. Extensive and highly sophisticated analysis of bones, soft-tissue and hair revealed concentrations of lead 20 to 30 times higher than normal. Especially significant was the high lead content found in the hair samples taken from the bodies of men who died eight to 12 months after departure from England, since those hair samples had obviously been grown during the voyage.

The preserved food, packed in "tin cans" for the first time, made Franklin's assault on the Northwest seem destined for success. However, the seams in the cylindrical cans had been soldered, both inside and out, with 90 percent lead solder. While lead poisoning may not have been the primary cause of the deaths of the 129 members of the Franklin party, it seems certain to have weakened them and left them abnormally vulnerable to pneumonia, tuberculosis and later to scurvy. It is also probable that the effect of lead on the mind could have had significant impact on the decision-making processes. Only clear minds in control of situations can hope to make correct decisions.

The contract for tinned preserved food was given to Stephen Goldner on April 1, 1845, less than two months before the departure. It seems likely that quality control could have suffered as a result of the crash program required to deliver 8,000 tins of preserved food, using untested innovative technology. Even before the expedition had sailed, Commander Fitzjames expressed concern that the Admiralty would buy meat from an unknown supplier simply because he had quoted a lower price.

Beware!

Beware of the lowest bidder!

Beware of betting the ranch on unproven technology.

Beware of crash programs, and impatient orders from the King.

Beware of too heavy reliances on "the way it has always been done."

Be wary, yes, but be not transfixed by fear of failure. Risks must be evaluated carefully, but cannot be entirely eliminated from progressive enterprise. ■

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Reader Service Number 16

NCTA NOTES

Re-reg and audio dominate engineering talk

Cable sound quality and industry re-regulation were the two hot topics discussed by the NCTA Engineering Committee at its August meeting, held at Dolby Labs in San Francisco.

NCTA VP of Science and Technology Wendell Bailey kicked off the meeting by summarizing House and Senate bills aimed at re-regulating CATV. He noted key modifications to the 1984 Cable Act that the bills propose, including: new definitions of basic cable, mandated access to cable programming, "bad actor" provisions, new must-carry provisions and FCC implemented and enforced technical standards. Bailey fielded numerous questions and suggested committee members outline real-world effects of some points of the proposed bills, e.g. how systems and consumers could suffer from mandatory on-channel must-carry.

Another bill would require all television sets (13-inch or larger) to have the capability of closed captioning reception, Bailey noted. The costs for the consumer electronics industry and subsequently the cable industry (to maintain consumer friendliness) were seen to be prohibitive.

Finally, Bailey mentioned the late-July FCC adoption of a Report to Congress on the state of cable television and status of the video marketplace six years after the Cable Act's passage. The Commission in essence concluded that the Cable Act's objectives are being fulfilled. Legislative recommendations did not include telco cable entry.

Sounds good to me

In a memorandum to the full committee, Ned Mountain, chairman of the sound quality subcommittee, covered his committee's attempts to measure cable system audio level variations. Data from devices for audio level analysis and control of gross audio level problems were presented and conclusions discussed. Longstanding debates over roots of the problem were revived, which led Bailey to ask Mountain to suggest specific solutions and put them to a full committee vote at the October meeting.

Joe Lemaire, who heads the in-home wiring subcommittee working group on external standards, reviewed a summary of comments on the preliminary draft of the EIA's Consumer Electronics Bus CX specification for in-home wiring. Committee members suggested minor changes to the 13 points in Lemaire's summary.

The general sense was that NCTA and EIA should continue to work together amicably so that cable's input on wiring specs can be put to good use. The subcommittee was instructed to put together one more set of comments and send them to EIA.

VideoCipher blues resolved

Norman Weinhouse declared the issue of VideoCipher II service and support resolved. A copy of VideoCipher's customer newsletter ("Commercial Service Bulletin" on clamp streaking) was included in the meeting handouts. During group discussion, it was noted that operators need to request the special modification that fixes the clamp streak problem when seeking other VC II descrambler repairs or upgrades. Weinhouse also said that manufacturers are responding to industry needs for ATIS equipment. The subcommittee's next focus was seen to be a return to seeking a solution to the varying audio levels of satellite programmers.

Bert Henscheid and Dick Shimp, co-chairs of the standards subcommittee, reported that they are presently in the data acquisition mode to determine what new Recommended Practices are needed. The two men are looking into cascade performance, cross modulation, signal leakage and fiber optic measurements. Part of the search is in technical papers and with CableLabs and manufacturers. Although a third edition of the *Recommended Practices* manual is not in the immediate future, possible supplements to the second edition in the form of "application notes" and/or new measurement methods are possible. Bailey suggested that the chairmen look into acquiring and adding more fiber optics graphic symbols by approaching either EIA or Corning Inc.

The next meeting of the NCTA Engineering Committee is scheduled to take place Oct. 10-11 in Washington, D.C. ■

By Katherine Rutkowski, Director, Technical Services, NCTA

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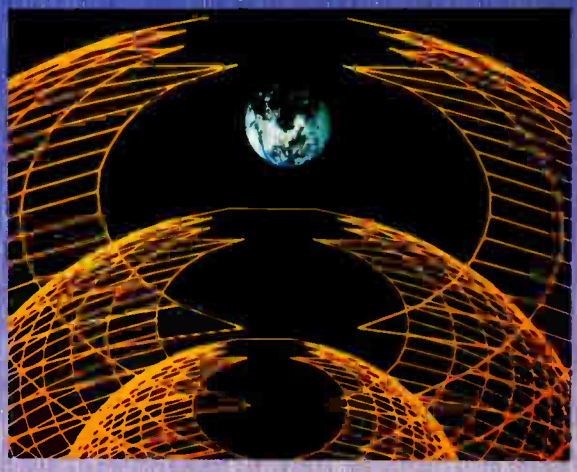

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'Digital mania'

I enjoyed reading Walt Ciciora's article entitled "Digital mania" in the August issue of CED (page 116). I do, however, have a few concerns which I would like to address.

The general message in Mr. Ciciora's article aappears to be that digital technology produces inferior pictures relative to analog transmission and is subject to intolerable "digital artifacts."

While this limitation may be true of digital systems that use some type of compression algorithm, it is most certainly not the case in digital systems that use full linear encoding. Uncompressed, linear PCM (pulse code modulation) systems provide the highest signal quality and have been used in dedicated links, private networks and broadcast studio applications for over 10 years.

Both full linear bandwidth and compression systems digitize all the information that is present in a video signal. However, bandwidth compression, as the name implies, uses a mathematical formula to discard redundant information. This process of discarding information can result in digital motion artifacts described by Mr. Ciciora.

I would also like to comment on Mr. Ciciora's concern regarding "quantizing noise." This quantizing effect is present in all digital systems, occurring when the input signal is at a critical level where the A/D converter cannot decide whether to go to the next higher codeword level or the next lower level. Under static input test signal conditions, the A/D converter will "toggle" up and down. This toggling creates a peak-to-peak error which corresponds to one Least Significant Bit level.

To further clarify this issue, a digital transmission system using an 8-bit coding scheme is able to resolve to one part in 256 (0.39 percent) of a 1 volt p-p signal or 3.9 mV. Therefore, the A/D converter is accurate to $\pm 1/2$ of 0.39 percent or 0.195 percent (1.95 mV). Today, most digital systems using 8-bit coding will guarantee RS250 B medium haul specs (60 dB signal-to-noise) over a specified optical loss budget.

During a presentation on April 10, 1973 at a SMPTE Technical Conference in Chicago, A.A. Goldberg discussed a series of subjective tests which were used to determine the importance of various parameters when digitally encoding a video signal. His conclusion was that television pictures encoded with 8-, 7- or 6-bit codewords exhibited no subjective impairment over direct pictures. It was only when pictures were encoded using 5-bit resolution that noise became sufficiently noticeable to impair the picture.

Nyquist has shown us that if we sample at a rate which is twice the highest frequency, we can use the collected and quantized samples to recover a waveform which is *indistinguishable* from the original. Evidently, the broadcasters agree. The de facto standard for digital equipment used in broadcast applications is full linear, 8-bit coding.

Most experts agree and studies have proven that picture quality is not a limitation of full bandwidth encoded digital systems. The majority of digital systems using full linear bandwidth encoding produce a picture that is far superior to any other competing analog system. If cable operators are truly concerned about delivering the best quality signal deep into their system, they need only consider one alternative—an all-digital fiber transmission system.

Robert W. Harris
Fiber Optic Staff Engineer
C-Cor Electronics

Mr. Ciciora responds:

I have received two letters from manufacturers of digital video systems for transport of signals within the cable plant. One even coined a new term: "digital bashing." Both were very concerned that readers would confuse the applications of aggressively compressed video for delivery to the home with the use of uncompressed digital video for plant transport.

I've re-read the "Digital mania" piece and the article which follows it. It should be fairly clear that these articles only consider to-the-home delivery of aggressively compressed signals, not uncompressed or 2-to-1 compressed applications for transport. If any other readers were confused by this, let me make it perfectly clear. I am not discussing uncompressed digital signals for transport within the plant.

The letters raise a few interesting points. Strictly speaking, the Nyquist Theorem does not apply to quantized (or digital) signals. Only in the case of noiseless, linear, *analog* systems does Nyquist provide for *errorless* reconstruction. As a practical matter, quantizing noise for most systems falls below other system distortions. However, in cases where a signal is repeatedly converted back and forth from a digital representation to its analog form, errors will accumulate. This is especially true of low saturation chroma signals. Significant phase errors can be introduced by the quantizing process.

Quantizing noise is not an uncertain toggling when a voltage falls near a quantizing level. Quantizing noise is the error between the actual analog value of the signal and its quantized representation. Again, while it is a small quantity in systems using at least eight bits, repeated reprocessing of the signal can be a problem.

A practical consequence of quantizing in near-noiseless systems is a phenomena called contouring. This occurs when chroma or luminance values change gradually over distance, such as in the sky or facial regions of a picture.

As the signal values cross quantizing boundaries, a noticeable step in color or brightness may occur, giving a "paint-by-numbers" appearance. This is a serious problem with six bits, a real problem with seven bits and not uncommon in eight-bit systems which are very clean. In fact, some approaches deliberately introduce noise into the analog signal before quantizing to break up the contours. This practice is called "dithering."

I am pleased with Mr. Harris's exuberance in his second-from-the-last paragraph. However, good engineering practice requires an open mind and a willingness to evaluate all approaches, even old ones. While I am a digital enthusiast, I am also an analog realist—especially when it comes to interfacing to the 200 million NTSC analog receivers which provide the cable industry with nearly all of its revenue.

Digital techniques have a well-earned place in the point-to-point transport of signals in the cable plant. I believe they will also have a place in compressed signals for special applications such as near video-on-demand. But high quality analog signals will be required for the existing population of NTSC receivers for the foreseeable future.

CED *welcomes your comments. Send all correspondence to* CED Magazine, *600 S. Cherry St., Suite 400, Denver, CO 80222, Attn: Roger Brown.*

Home automation and cable television

Part I—The technology

Remember kindergarten when kids pantomimed and sang, "I'm a little teapot, short and stout?" Well, the technology exists today for the teapot itself to talk to its colleagues throughout the house. Thermostats can communicate with television sets, the hot water heater can talk to the computer, and the refrigerator, if it needs to, can have a dialogue with the garage door opener because today, thanks to advanced in-home communications networks, they are on speaking terms. In fact, the whole house could have a panel discussion.

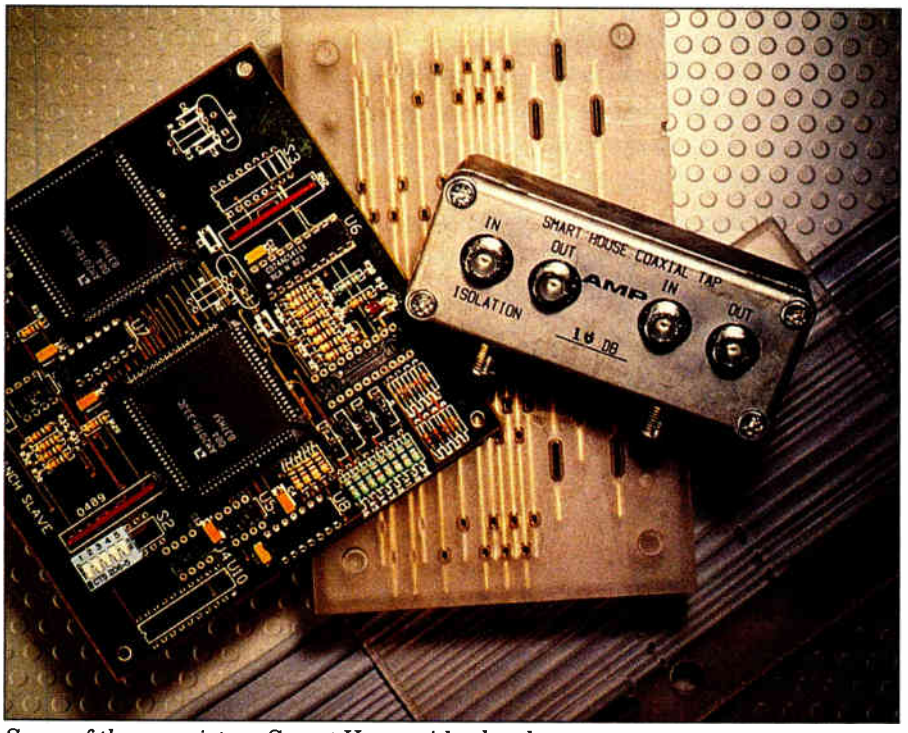
A private commercial effort, Smart House, L.P., has been developing extensive plans for designs and products for home automation and in-home networking, and marshalling together various companies to design products and advise them on how best to integrate home automation with outside service utilities.

And the Electronic Industries Association's (EIA) Consumer Electronics Bus (CEBus) Committee has been hard at work developing standards for networking and communications between in-home devices and appliances.

One would assume that inter- and intra-industry coordination on such a similar topic should be the key in this effort but this remains problematic. While Smart House people see themselves as entrepreneurial, others see them as proprietary and insensitive to the needs of related industries. With Smart House going its own way, there may arise significant incompatibilities between devices designed for the Smart House environment and those designed to meet CEBus standards.

And where does cable television fit into all of this? To both Smart House and CEBus, the cable industry is just another outside service utility not unlike gas and electric. In fact, it seems the CATV signal is viewed as a video entertainment source on the level of the VCR and camcorder while the telephone is considered a primary in-home control keypad, a gateway to outside communications and transactional services, and perhaps most importantly as likely to be the fiber optics pipeline into and out of the home of the future.

In this two-part article, we will take a look inside the automated home. In Part I, we will examine the technology involved and the in-home communications schemes proposed. Part II will consider the market and target market strategies for these approaches and products, and discuss the implications for cable television from the point of view of services, advanced applications, business, and regulatory matters.



Some of the proprietary Smart House video hardware.

By George Sell, Contributing Editor

Smart strategies

Smart House was launched by the National Association of Home Builders in the mid-1980s. It's a limited partnership and consortium of manufacturers and utilities that have come together to develop an integrated business approach to the planning, design, manufacturing, networking and control of in-home devices and the various utilities that service residences. As such, it is a private company and takes a proprietary approach to its planning and activities.

The sun revolves around Smart House and not the other way around. Products, devices and outside services must conform to Smart House configurations. Companies that want to participate in Smart House designing and planning must buy their way into the consortium.

Smart House has an Advisory Council of non-manufacturing organizations of which the National Cable Television Association is a member. Larry Nelson, president of Comm/Scope, chairs the NCTA Engineering Committee's subcommittee on in-home wiring.

"Part of that responsibility is to interact with other entities that are active in that environment including

the EIA, Smart House and others who may become involved in it. As part of this NCTA subcommittee effort we are attending the EIA meetings," says Nelson.

How smart is Smart House?

Smart House is oriented toward the home construction industry. After all, it's the home builders who are the parents of Smart House. Therefore, its planning effort is directed to in-home wiring and networking for new home construction. The wiring and cabling designs facilitate, in the first place, the building trades.

The basic concept, according to Ken Geremia of Smart House, "is a new wiring and plumbing system for homes to handle distribution of energy and communications and provide the basis for total home automation."

Smart House is looking to have up to three manufacturing members as sources for each product or component of the Smart House configuration. Currently most elements have only one or two.

Consortium members

Broadband Networks Inc. and C-Cor Electronics Inc., two State College, Pa. companies, are designing the coax headends which will amplify signals along the Smart House coaxial subsystem. A coaxial entertainment adaptor to enable conventional equipment to access the Smart House coaxial network system is being designed by Pioneer Electronics USA Inc. of Long Beach, Calif.

Two member companies are designing and manufacturing what Smart House calls their "hybrid cable." Canada Wire and Cable of Toronto has a hybrid cable that combines power and control communications conductors and a separate one which combines telephone and coaxial (audio/video) services.

Amp Inc. of Harrisburg, Pa. proposed a multi-wire conductor cable that would carry all of the services. AMP also designed a "cable tap," a termination device that would use prongs to pierce the hybrid cable insulation and make contact with the wires and coax. This was done to eliminate the need for the stripping and wrapping of wires. Apparently that entire design concept has been scrapped due to interference problems it created.

Amp is also designing switch/sensor outlets and housings, control panels and programmable wall switches. Since common proprietry receptacles is a design goal of Smart House, Amp sought ways in which the coaxial cable could be accommodated in a single face plate with other wires and outlets. However, they are currently back at the drawing boards with this too and it looks as if the coax will be terminated in some fashion with an F-connector.

AT&T is creating what's called the telephone gateway, an interface between a Smart House and the public telephone network. It also provides remote access to the Smart House and will be used within the home to control various household appliances.

Smart House's smart outlets will provide power, a coaxial connection, a telephone jack, and control signals for smart appliances. According to Smart House product literature, the most basic control devices are the wall switch and telephone. These will be programmed to control specified functions and later may be reprogrammed. A telephone keypad will be used to program pre-selected house modes or control individual functions such as lights, security and entertainment systems, etc.

"We don't really care if somebody wants to use a D2B (European) system or a CEBus system or other protocols. The idea is that we could be the network for that," Geremia of Smart House asserts.

"Because of the way the system is developed and the kinds of needs that were brought to the table for design, the Smart House system can handle that messaging far more efficiently and reliably than some of the other proposals. Whether somebody chooses to take advantage of that or ride with something that they have already begun with is really immaterial to us."

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But that's a matter of initial programming. "But think about the problem with that after a version of the Smart House central controller has been implemented and is in place in a home and something gets designed for CEBus later on. It might not be compatible because the software isn't aware of it or isn't aware of how it works."

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Another difference between Smart House and CEBus in terms of communications is that Smart House features wires installed in the house strictly for communications between devices. But with CEBus, a variety of media used to connect appliances can be used for communications. For example, a VCR and a TV set would not have to communicate over the Smart House communication line. They could talk to each other over the coax they are plugged into.

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Smart House and CATV

A communications cable contains two coax and four twisted pairs. From the service drop, this cable runs to distribution interface units (DIUs) for splitting to outlets, employing a star topology. The coax cables, upstream and downstream, in the communications cable array will carry CATV signals, audio signals, in-house generated video from VCRs and cameras, as well as high speed data information.

The DIU is a junction box containing splitters and combiners for telephone wiring and coaxial cables, and possibly optical fiber. Each of up to eight DIUs will be fed by individual cables from the service drop and then each DIU can have up to four runs of communications cables to outlets. Simple multiplication will tell you that within a Smart House, the CATV signal could be split up to 40 times just getting from the drop to wall outlets. This, of course, doesn't mention what the subscriber might do with cable and splitters after that. And this same coax will be carrying all those other in-home generated video and audio signals as well.

The coaxial headend, acting as a combiner and amplifier of all video, audio and high speed data from a variety of sources, will be designed to be transparent to all consumer electronics connected to it as well as to either set-top or off-premise converters. There will be no special processing to reduce distortion. Internal communications, however, between smart devices and appliances will be distributed on a separate communications conductor.

Smart House essentially provides an in-home wiring and cabling platform for CATV. "All it really provides is an infrastructure and wiring mechanism that makes it easier for the consumer to have these services delivered to all locations within the house," explains Mamid Heidary, C-Cor's representative to Smart House.

CEBus standards

CEBus (Consumer Electronics Bus) is a proposed set of in-home network communications standards being developed by the EIA. Unlike Smart House, CEBus is not a plan for wiring and cabling, product design or marketing of any home automation systems. CEBus deals only with communications networking within the home. But beyond setting standards for in-home communications, CEBus has taken into consideration known technologies and specified them for standardized use.

According to Jud Hoffman of Panasonic (USA) Inc., chairman of the EIA's CEBus Committee, "The CEBus standard defines three major parameters that we feel are required for a complete standard. First, there is a set of physical level or signalling standards for five media. Those are the power line, infrared light, low power radio, twisted pair and coaxial cable. The sixth media is in the organization stage now and is fiber optics.

"The second key parameter it defines is a method of automatically transferring control channel signals between those media. And the third key parameter it provides is a common application language (CAL) or command language for all products that we use on this network."

CEBus itself is the total set of standards. CEBus follows the ISO standard of a seven-layer hierarchy. The bottom layer is the physical layer, and that layer will be defined by a different CEBus standard for each communications medium.

Communication over the power line will be standardized in the PLBus specifications. All valid CEBus commands using infrared will be standardized in the SRBus. RFBus will specify the use and communications over radio frequencies and will deal mainly with home security. The TPBus will layout the standards for use of the twisted pair telephone lines in the home. CXBus, the set of standards of most interest to CATV, will specify standards for communications via coaxial cable. CXBus communications could include any of the in-home signals because there are bridges between the various buses in CEBus. In the event that home automation will communicate over optical fiber, the FOBus standards will apply.

"I have had a lot of meetings with the CXBus working group. We've decided that we are going to make some fairly radical changes. These have yet to be implemented. The standard is really not released at this point," O'Brien cautions, explaining that it will be officially released as an interim standard in June 1991, "and as such any copies of it that are out are really only supposed to be for the working group and other interested parties."

CXBus likely will consist of two coaxial cables for up- and downstream communication. Device communications over coax will use the downstream cable. Active taps are specified for access to the signal. Ouputs from devices are passively combined on the upstream cable and fed into the CXBus "node zero," where it is mixed with incoming CATV signals and/or off-air broadcast. Node zero will drive the downstream cable and also provide the bridge to the TPBus.

CEBus AND CATV

Even though the CEBus Committee and subcommittees are not required to accept comments on the standards until they reach the interim standard stage, one of the CXBus subcommittee members sent a draft to about 50 cable industry parties to elicit responses.

"One of the major concerns," Nelson reports, "was that the architecture essentially was a bus architecture. The majority feeling of the CATV industry is that bus architecture is very difficult to manage, particularly from a CLI standpoint—from the standpoint of the relationship to the CATV system and internal communications system and frequency allocations. One of our recommendations was to consider changing the architecture to accommodate those concerns to more like a traditional home-run type of architecture."

However, that would require a fundamental alteration in the direction the EIA is going with the CEBus standards, according to Nelson.

According to O'Brien, the bulk of the cable industry comments deal with outdated information contained in the draft. In fact, much of the criticism was due to incorrect terminology used. "I would consider (the CLI concerns) valid and serious. Cable system owners are, of course, going to be responsible if a drop cable is connected to a CXBus internal to a house. If there is leakage, the cable operator is going to be in trouble."

"The cable industry certainly is not a unified body in its thoughts about in-home wiring," Nelson stresses. "Some cable operators publicly say they have an interest in removing themselves from responsibility inside the home. And some have a diametrically opposed attitude in that they want to continue full responsibility inside the home—including protecting their revenues. Then there is confusion brought on by the CLI rules."

CEBus and Smart House

To add to the confusion, there is the possible incompatibilities that may arise between CEBus standards and Smart House specifications.

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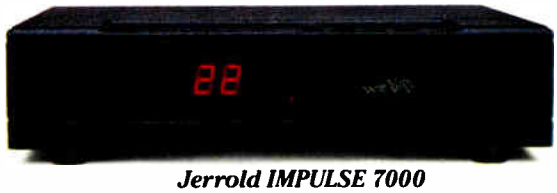

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Let the Wavetek 1882A sweep you in

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

A clear path home.

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

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

No interference.

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

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

1000 MHz to grow on.

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

See the light.

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

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

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

Elegant but easy.

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

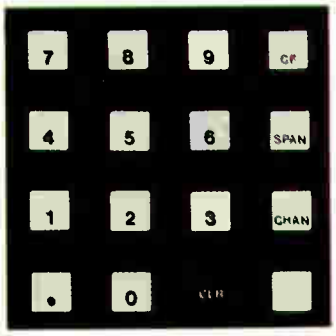
It takes only a few minutes to store your HEADEND,

to the future. Without interference.

FIRST AMP, or FIBER NODE reference – a fraction of the time other instruments require.

Then simply connect to your test point, press "3", "1", FUNCTION, and you are sweeping.

Because the 1882A is so easy to learn and use, your sweep techs will be more efficient and effective.



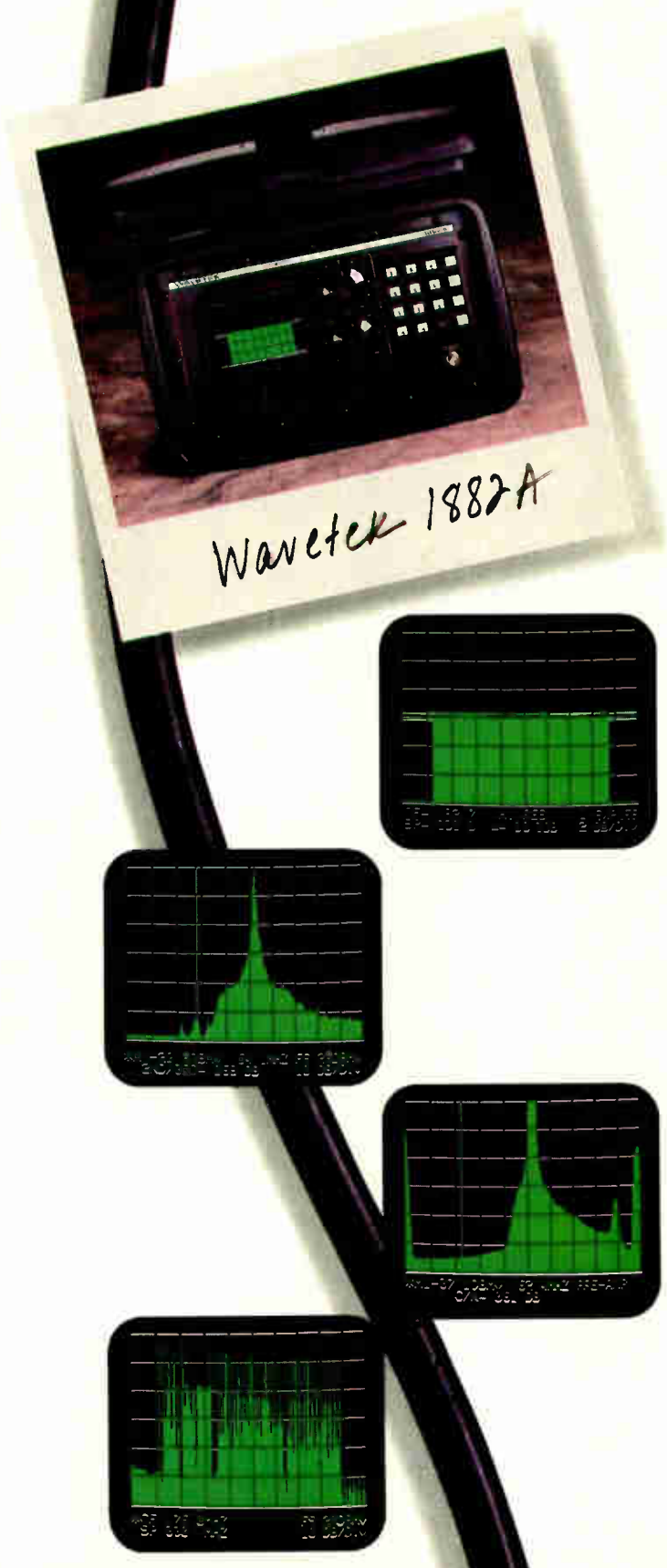
Fill in the blanks.

Before the Headend is turned on or when your frequency spectrum is not fully utilized, you still want to sweep your system. A special "blanking filter" available for Wavetek sweep generators will allow you to sweep unused spectrum and used spectrum at the same time.

Since you're generating a sweep signal only in the spectrum with no video or sound carriers, there is no chance of interference. You also sweep at sound carrier level so system loading is negligible.

Find the faults.

When you use a sweep generator with your 1882A, you can set up one of the channel plans for a small span and 100 KHz resolution. This will allow you to see standing waves reflected from almost any point in the span. No other non-interfering sweep system provides you with this type of resolution for fault finding.



Bring back the hard facts.

Sometimes you want to record a site problem for later analysis. With the 1882A you can store the sweep or analyzer results in memory, or print a hard copy with the P-1 printer option.

When you reach the end of the line.

Before your move on to the next trunk or line, make those end of the line measurements that ensure a quality picture for your subscribers.

The 1882A can measure C/N, second and third order distortion, X-mod and HUM – as easily as using the sweep. Just a few simple keystrokes, and you've finished a job well done.

Get the picture?

The 1882A will improve your profit picture by easily and effectively helping you deliver the best picture quality to your subscribers. No other instrument will work so hard to keep your system performing within its design parameters, now and well into the future.

And for all it does, the 1882A is the lowest priced complete system sweep available.

The Wavetek 1882A may be the single most important capital equipment investment you make.

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

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

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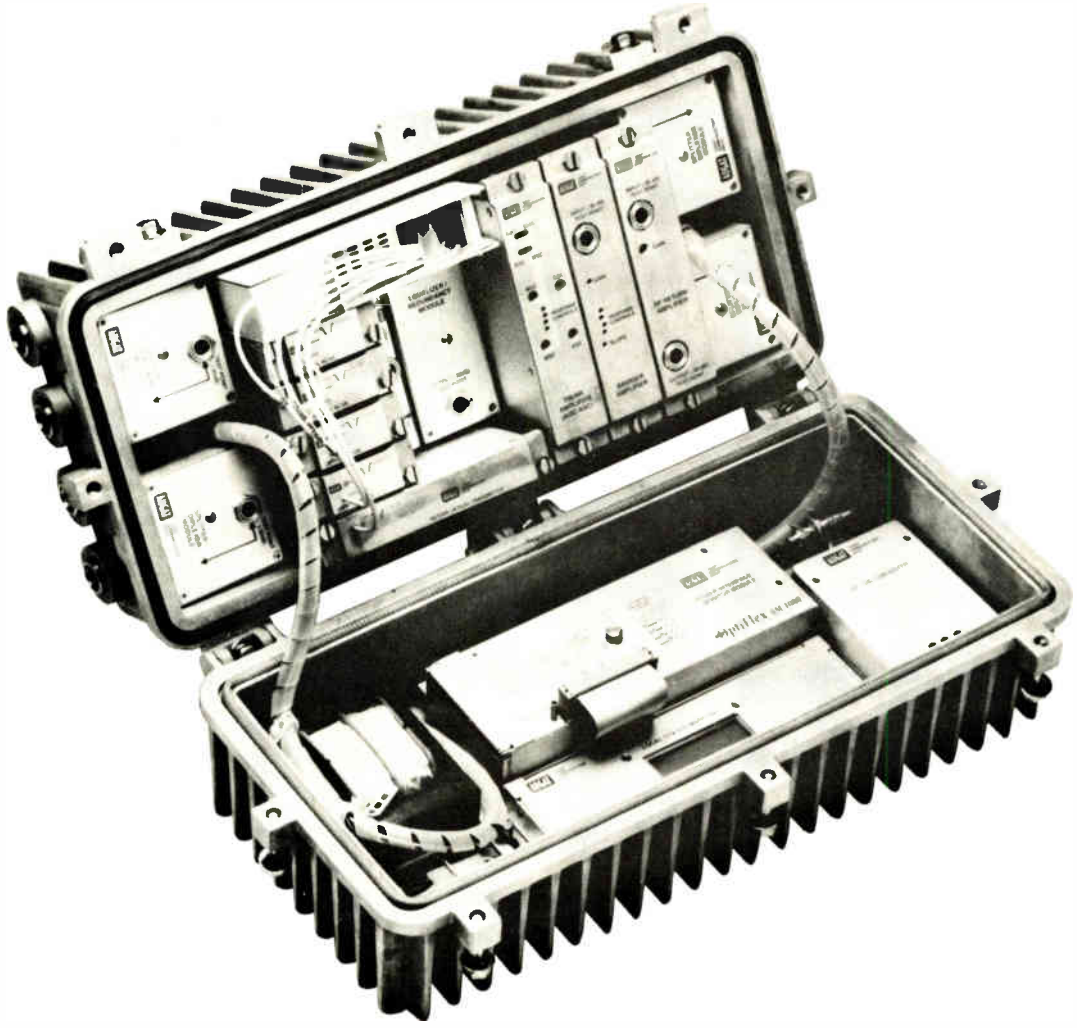

AUGAT

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Squeezing more margin from an optical link

The importance of suitable optical margin (measured in decibels or dB) cannot be overstated for decisions regarding purchases of fiber optic equipment. It becomes even more essential when implementing a CATV system that needs to endure for some time.

At first, optical margin may seem to be a simple decision. Upon closer examination, the customer will find that manufacturers use a variety of ways to specify optical margin. One term which surfaces for CATV fiber optic transmitters is "minimum average" output power. This is used for Intensity Modulated (typically called amplitude modulated, or AM) products.

In AM systems the laser is driven in accordance with the input signal. The customer will vary the input level in order to match his system. When this is done, the output power of the laser changes accordingly. Then, as the energy level in the live signal changes, so will the optical level unless a good AGC circuit is employed. It is important to understand what reference is used for the AGC circuit and the resulting effects on the CATV signal. Because of this, systems are typically installed using static video and audio test signals.

A starting point

A good point to bring up at standards meetings is the need to reference all systems to an agreed upon electrical injection level. Until then, what the manufacturers do is use an average input level, usually optimized for their particular system. This level may or may not match the customer's level. As a result, it is reasonable to expect that output power may not exactly match the data sheet for the customer's particular system.

The next specification to look at is receive power level. Once again for AM systems this is generally a nebulous number. The electrical carrier-to-noise ratio (CNR) will vary directly with the optical CNR. Quite a few manufacturers publish a matrix of receive power levels and the accompanying CNR, composite second order (CSO), and composite triple beat (CTB) figures. This creates a bit of back-and-forth engineering when attempting to achieve a certain performance level for a link.

The difference between the launch power and the receive power is termed the optical dynamic range or optical link margin. The goal is for this to be as large as possible but, in real life, it is some value less than desired. For AM systems using Fabry-Perot (FP) type lasers, it is a maximum of 8 dB. For systems with Distributed Feedback (DFB) lasers, it is typically 10 dB. For systems with Nd-YAG lasers it is a maximum of 15 dB. These numbers are referenced to CNR specifications in the 50 dB to 53 dB region.

Although YAG lasers will perform better than DFB lasers, the cost for YAG products is appreciably more. These optical figures depend *heavily* on the channel capacity and performance that is desired. Cost, of course, also becomes a consideration.

Future considerations

This brings up the central issue, which is system performance. Performance needs to be considered for today's requirements and for tomorrow. Video formats such as Super-VHS and HDTV may be questionable but what is not questionable is that new video formats will surface in the near future and these formats will require additional bandwidth and better signal quality.

By Mike Galli, Consultant for Palm Teknologies

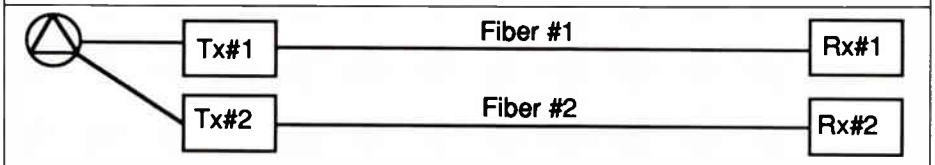
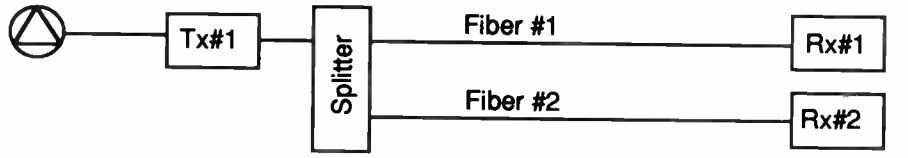


Figure 1



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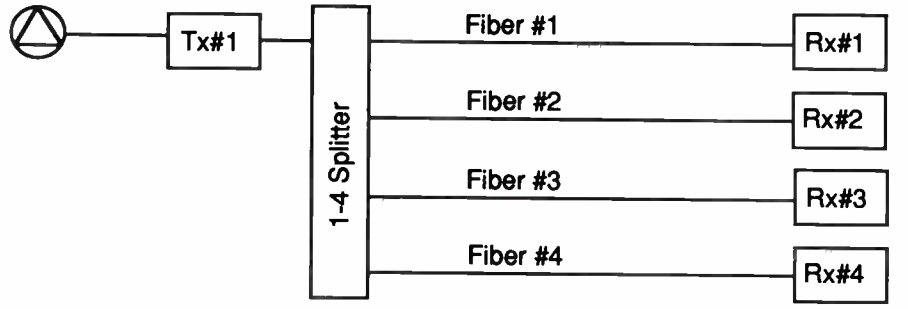

Figure 3

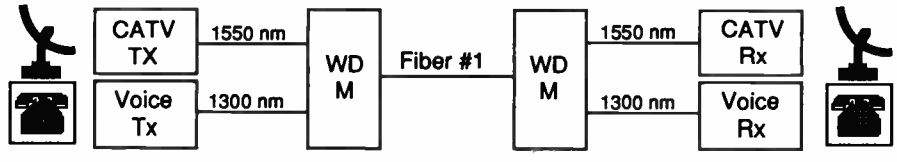

Figure 4

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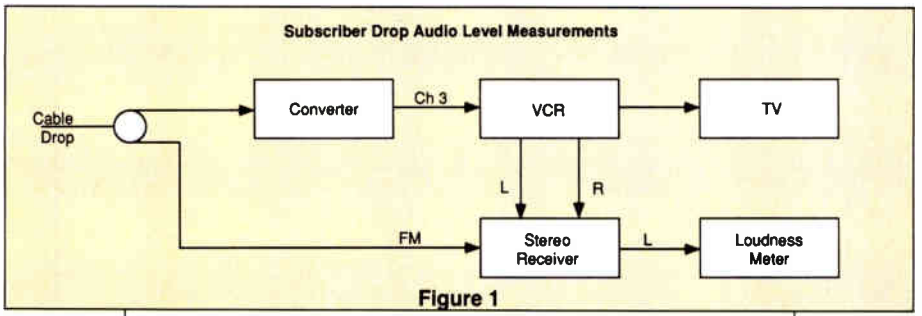
The quest for quality audio on cable

While the American public waits patiently for the governmental machine known as the Federal Communications Commission to test and select a high definition television standard, technological innovation in consumer electronics continues to press on. The excitement created by advanced television's resolution capabilities led many manufacturers to explore ways of improving the picture delivered by today's NTSC sets. Improved- and enhanced-definition receivers have since debuted, featuring improvements like line doublers, designed to improve resolution.



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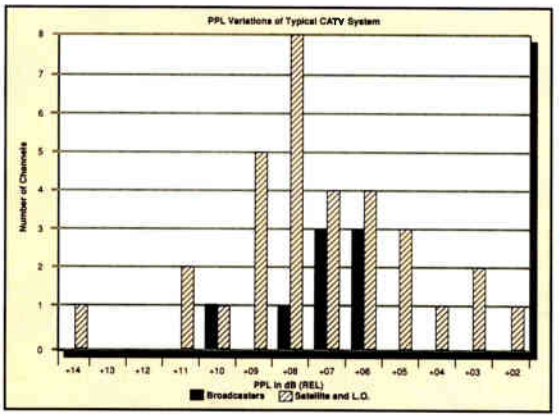

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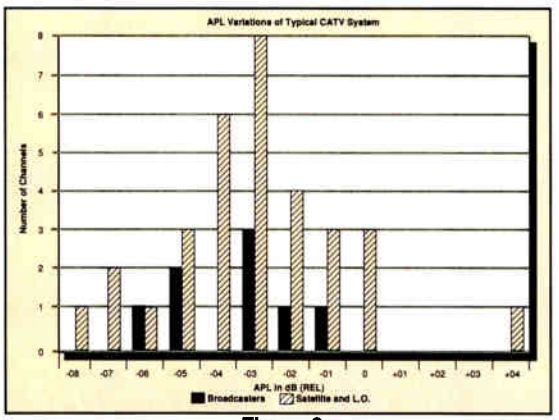

Figure 3

Audio emphasis

In the never-ending search for a new gimmick (which is the essence of the consumer gear industry), the latest emphasis is toward a concept called "home theater." At last summer's Consumer Electronics Show in Chicago, the show floor was dominated by huge booths that featured theater-like atmospheres, complete with darkened rooms and comfortable chairs.

It's worth noting, however, that such displays made use of (typically) 35-inch CRT televisions married to laser disks with the audio sent out through Surround Sound networks. In other words, the "new" portion of the network is the audio segment.

That trend hasn't escaped the attention of cable's key observers. A presentation was made by Brian James of CableLabs at the International Conference on Consumer Electronics last June that focused on how to take advantage of audio over cable. At about the same time, NCTA Engineering Committee chairman Dr. Walter Ciciora, formed a subcommittee on quality audio. The subcommittee, led by Ned Mountain, VP of marketing for Wegener Communications, was asked to investigate audio and how it relates to cable television's competition.

Improved audio hasn't escaped the private sector either. New products, designed to help control audio levels have been unveiled in the last six months.

Establishing a starting point

Mountain began the subcommittee work by trying to determine how cable systems are performing today. He picked a cable system at random and set up a test with a low-cost loudness meter and measured both peak and average program levels. The effect was to determine how consistently a given cable system controls audio levels from channel to channel. The meter was connected as illustrated in Figure 1. According to Mountain, the set-up was calibrated using test tones so that +8 dB = 25 kHz peak deviation at 400 Hz.

"There is no standard method to measure audio like there is for video," says Mountain. "In audio it's much more subjective. The deviation measurement is a standard (measure for a single channel), but that doesn't show differences between channels."

The results of Mountain's admittedly unscientific survey was, regardless, eye-opening. As can be seen in the charts accompanying this article, peak program levels (PPL) varied by as much as 14 dB. But 17 of the 32 satellite services measured were within ±1 dB of each other.

Average program levels (APL) showed a 12 dB variation. However, two-thirds (21 of 32) of the satellite services fell within a 3 dB window and six of eight broadcasters fell within the window.

Here's where the subjective part comes in. Many times, according to Mountain, "a very low level signal was an adjacent channel to a real 'screamer.' " And, even in cases where

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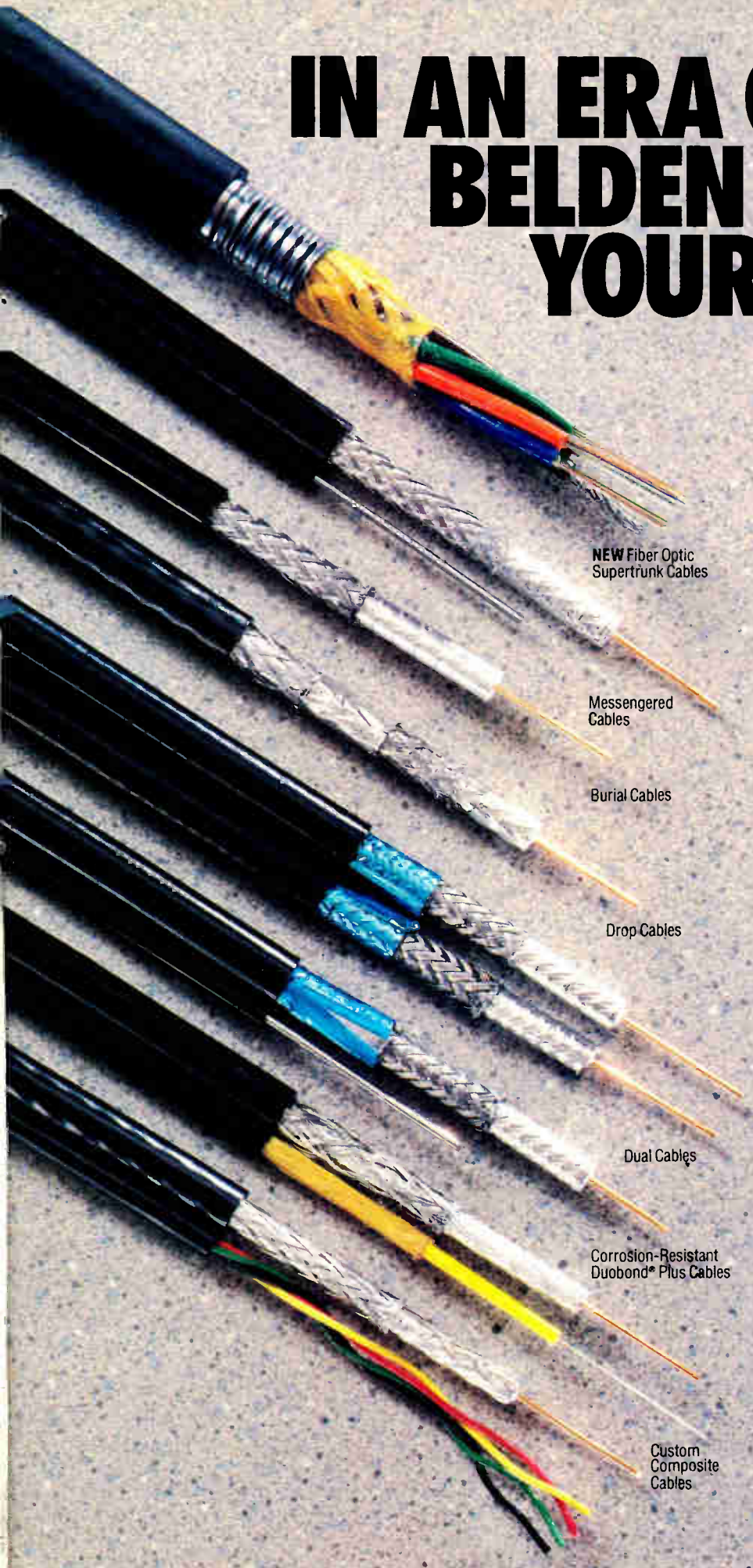

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For example, HDTV will require greater CNR than most current CATV systems provide.

Count on changes

System performance is directly affected by optical link margin for all types of systems. Even digital links, measured in Bit Error Rate (BER), will show more errors at some point as optical receive power decreases. AM systems are even more sensitive to receive power.

But why all the fuss about link margin? Once a system goes in it doesn't change, does it?

It certainly does. In fact it seems that all you can count on is change. There is talk afoot about constantly expanding systems in a cost effective manner. Two of the more popular concepts revolve around fiber optics.

Normally in a fiber link each signal is run from the headend with its own transmitter and receiver (see Figure 1). Assume that the price of the transmitter is $20,000 and the price of the receiver is $5,000. Each link would then cost $25,000.

One method is to optically split the light at the headend. This would help tremendously because a much greater percentage of the link cost is in the transmitter. In this manner the cost of the laser could be amortized among a number of links (see Figure 2). The total system cost would be $20,000 for the transmitter, $1,000 for the splitter and $10,000 for two receivers for a total of $31,000. Each link would then cost $15,500 instead of $25,000 for the non-splitter design.

Now for the bad news.

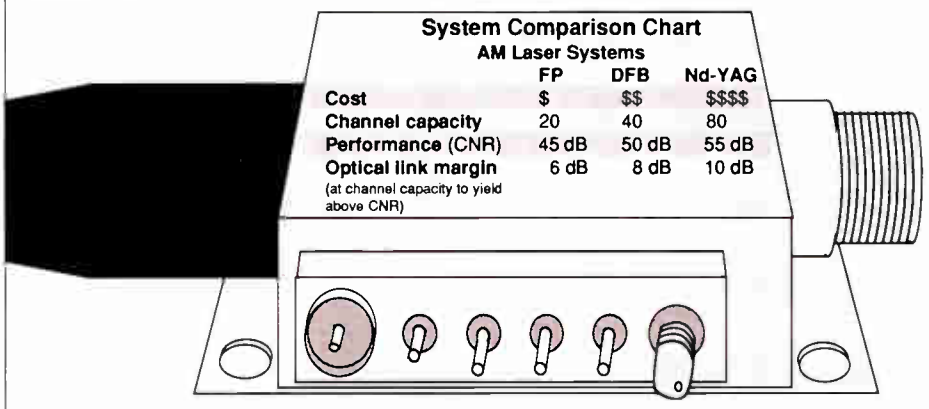

Figure 5

Leaving adequate margin

A number of AM systems advertise 7 dB of total link margin. A 50/50 splitter has 4 dB of loss (3 dB for the split and 1 dB for intrinsic loss). This would leave 3 dB of margin. Adding in connector and splice loss brings the margin down another 2 dB to a total of 1 dB of margin. One would guess that there aren't many engineers out there who would feel comfortable with a 1 dB link margin. Even if the fiber path was extremely short so that it fell within 1 dB, the other system components would still require an aging factor to be built in. Fiber optic designers typically allow 1 dB to 3 dB for total system aging.

A four-port splitter would yield even better economics (see Figure 3). The total system cost would be $42,000 with an amortized per link cost of $10,500. The optical loss involved would be 7 dB for the splitter alone. After the other losses are added, it becomes obvious that an FP laser would not work. At this point either DFB lasers or YAG lasers would have to be used.

DFB systems typically have a maximum optical link margin of 10 dB. Counting in connector and splice losses that only leaves 2 dB. A YAG laser might provide 4 dB more margin, but at a cost of $75,000 for the system. An operator would *have* to use at least a 4-way splitter to make that economical.

Wavelength division multiplexing

Another technique for expansion is the use of Wavelength Division Multiplexing (WDM). WDM allows a fiber optic engineer to combine multiple optical signals on the same fiber even if those signals are dissimilar in electrical content. For example, a digital voice system could be combined with an analog CATV video system on the same fiber as long as they operate at different wavelengths (see Figure 4).

Each WDM has about 1 dB to 2 dB of loss *per end*. The total additional link loss would be 2 dB to 4 dB for the

WDMs and 2 dB for the additional connectors, resulting in a total loss of 4 dB to 6 dB. This also does not leave much room for the span length and margin. In fact, another technique is to use a splitter in reverse, as a combiner, in order to save money. Singlemode WDMs cost on the order of $500 per port, so a two wavelength WDM would run about $1,200, including terminations.

Repeaters

The ability to repeat a signal is an idea that is gaining attention and one that is affected greatly by receive optical power. This becomes an issue when a system is first being designed on a long fiber run or when an existing system needs to be extended. An AM FP system at its minimum receive power level cannot be repeated at all. In these cases a new fiber needs to be used from the headend where another transmitter and receiver are used. This is actually all right as long as the additional fiber exists. If it doesn't exist then it may be necessary to replace the AM DFB system with a much more costly YAG system. This system would be adversely affected by a service outage if no backup is available. The other thing that can be done is to install an FM or digital system, remodulating the signals down the line. This causes operation and cost concerns.

Reconfiguration is another consumer of optical power. There are times when either the fiber cable or the equipment needs to be reconfigured. When this happens a new splice or an additional fiber jumper cable may appear. This typically will consume about 0.5 dB to 1 dB of power.

System atrophy

System aging consists of events such as lasers, photodiodes or fibers themselves going bad so that they reduce the link margin. Laser output degrades over time so most manufacturers utilize feedback circuitry in order to stabilize this. Photodiodes and fibers themselves degrade at a much slower rate but should be factored into the equation. Power changes in a fiber system turn out to be not as important as linearity changes.

Linearity changes are a complex issue related to channel loading, performance, and, you guessed it, optical link margin. For optical link margin, the greater the receive signal, the less linearity changes will affect the system's performance. Systems with higher channel loading are increasingly more susceptible to lower and lower optical receive levels. The performance figures that are affected are signal harmonics and cross modulation.

Worth the effort

It would seem that the desire to have more channels is not worth the tradeoffs. This is not so. It is essential that certain capacity and quality be built into a system so that it may endure for a suitable economic life. This is the difficult goal of system designers.

The chart shown in Figure 5 gives a brief summary of the parameters that have been discussed and some relative data.

What can be done in the midst of all this confusion? While no one has the answers today this is certainly one of the foremost issues that begs for an economical solution. This information can be summarized by the following:

1. Establish a "suitable" optical budget. What is the link budget today? Are things like WDM and splitting a consideration?
2. Establish the economic life of the system. When and how expensive is upgrade/replacement? Is there a system downtime? What is involved with labor to replace/retrain?
3. Establish short- and long-term goals of the system. What are the services to be delivered? How will they affect the design? Will the system migrate to other technologies? What are performance goals?
4. Establish other influencing factors. How will maintenance be handled now and in the future? Is network management a consideration? Is a "smart" system (redundancy, self-healing) a consideration?

The reader can now appreciate the concern on the parts of the customers and the manufacturers for a suitable product. There are a number of efforts underway to deliver a product that resolves these issues. Time pressures are considerable so the wait should soon be over. ■

Editor's note: *Palm Teknologies is a research and development company dedicated to the advancement of fiber optic technologies specifically for CATV systems. Mr. Galli has worked in fiber optics for the past 10 years and has recently specifically applied himself to network designs for large campuses, CATV environments and integrated high data rate telephone applications.*

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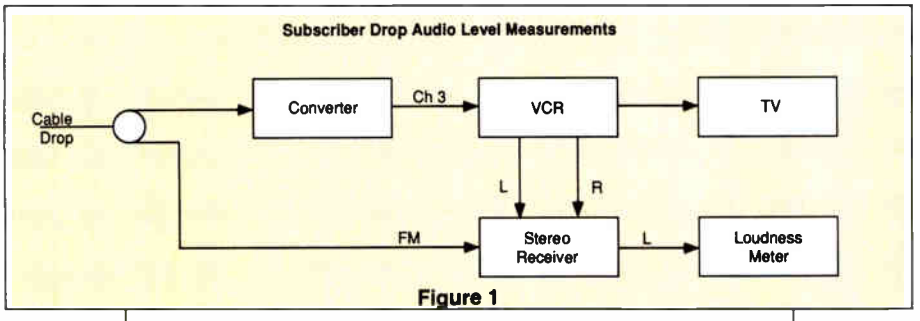

Figure 1

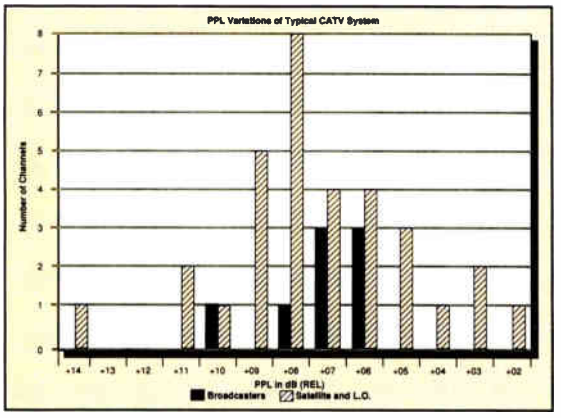

Figure 2

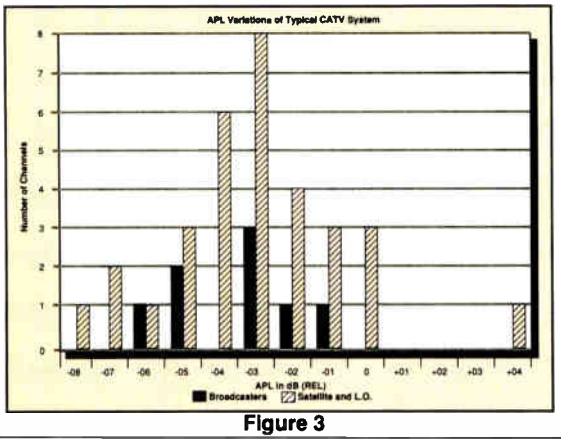

Figure 3

Audio emphasis

In the never-ending search for a new gimmick (which is the essence of the consumer gear industry), the latest emphasis is toward a concept called "home theater." At last summer's Consumer Electronics Show in Chicago, the show floor was dominated by huge booths that featured theater-like atmospheres, complete with darkened rooms and comfortable chairs.

It's worth noting, however, that such displays made use of (typically) 35-inch CRT televisions married to laser disks with the audio sent out through Surround Sound networks. In other words, the "new" portion of the network is the audio segment.

That trend hasn't escaped the attention of cable's key observers. A presentation was made by Brian James of CableLabs at the International Conference on Consumer Electronics last June that focused on how to take advantage of audio over cable. At about the same time, NCTA Engineering Committee chairman Dr. Walter Ciciora, formed a subcommittee on quality audio. The subcommittee, led by Ned Mountain, VP of marketing for Wegener Communications, was asked to investigate audio and how it relates to cable television's competition.

Improved audio hasn't escaped the private sector either. New products, designed to help control audio levels have been unveiled in the last six months.

Establishing a starting point

Mountain began the subcommittee work by trying to determine how cable systems are performing today. He picked a cable system at random and set up a test with a low-cost loudness meter and measured both peak and average program levels. The effect was to determine how consistently a given cable system controls audio levels from channel to channel. The meter was connected as illustrated in Figure 1. According to Mountain, the set-up was calibrated using test tones so that +8 dB = 25 kHz peak deviation at 400 Hz.

"There is no standard method to measure audio like there is for video," says Mountain. "In audio it's much more subjective. The deviation measurement is a standard (measure for a single channel), but that doesn't show differences between channels."

The results of Mountain's admittedly unscientific survey was, regardless, eye-opening. As can be seen in the charts accompanying this article, peak program levels (PPL) varied by as much as 14 dB. But 17 of the 32 satellite services measured were within ±1 dB of each other.

Average program levels (APL) showed a 12 dB variation. However, two-thirds (21 of 32) of the satellite services fell within a 3 dB window and six of eight broadcasters fell within the window.

Here's where the subjective part comes in. Many times, according to Mountain, "a very low level signal was an adjacent channel to a real 'screamer.' " And, even in cases where

the numbers may show levels similar to each other, programming type seems to make a difference. For example, non-commercial broadcasters are often found to be "quieter" because they aren't trying to gain viewership by sounding louder than the competition. This notion is similar to the trend shown in the chart of FM radio broadcasters. Mountain found that 13 out of 15 commercial FM broadcasters had PPL within 1 dB and APL within 2 dB—incredible consistency.

Commercials

And, of course, audio can vary on a single channel when a "loud" commercial featuring rapid speech and music follows a quiet segment of a movie. Arguably, there is little that can be cost-effectively done about that except that a programmer could re-dub the spot and/or "turn down" the volume.

Most complaints from subscribers come when they tune from one channel to another and the volume button must be employed each time a new channel is tuned. That's where automatic gain control devices come into play.

As part of his "experiment," Mountain illustrated the effect of a commercial-grade AGC device on the audio line. (Mountain noted that although the device was placed at the receive site, it should approximate the results obtained with an AGC placed in the headend.) As the chart shows, PPL was controlled within a 1 dB window and APL was constrained to a 3 dB window.

"It's my belief that the only way to solve the problem is by putting devices in the headend," says Mountain. "I'm looking for data to prove that." Specifically, Mountain would like to compare customer complaint data before a limiting device was installed to the number of complaints made after such apparatus was inserted.

One new product has apparently made a good impression with several cable operators. Audio Rider 2000 was unveiled at the National Cable Show in Atlanta this year and has generally been well received.

Ted Hartson, an engineer with Post-Newsweek Cable and inventor of the Audio Rider, says the device was designed to "hear" programming the same way a cable subscriber does. Hartson calls his device an intelligent gain control because it learns by experience what the "proper" audio level of various channels should be and places them there.

"Operators today set up their headends the same way they did 25 years ago," says Hartson. "They put on a channel and they compare the audio to the audio of a broadcast station."

Who's to blame?

But why should cable operators have to be responsible for leveling out the audio coming from several different sources? Why can't programmers agree on an acceptable audio program level and adhere to it?

Paul Resch of The Disney Channel doesn't believe program level is the issue; the thinks the problem is a lack of agreement over dynamic range. Resch, like Mountain, subscribe to the thought that judicious processing at the headend (or in Resch's case, the uplink site) is beneficial to everyone. But there are programming "purists" who shudder at the idea of compression—they want to transmit as much dynamic range as possible and deliver a

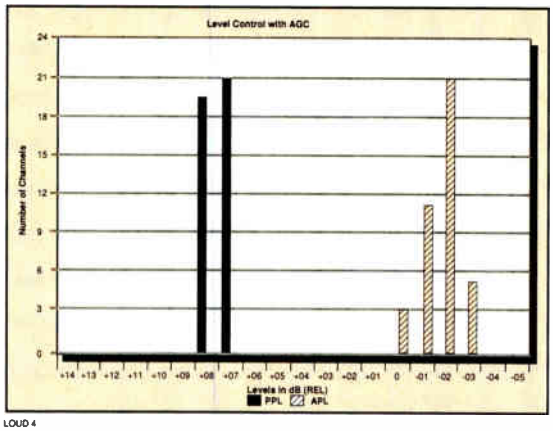

Figure 4

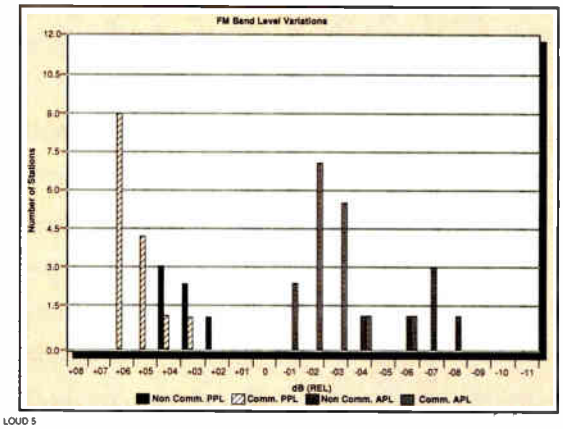

Figure 5

movie the way the director intended it.

"We 'earball' our programming all the time," says Resch. But, he adds, programmers have little, if any, control over the quality of spot ads that run on a network. "I don't believe programmers typically fiddle with their levels very much."

Needless to say, getting past this age-old discussion of audio levels, dynamic range and perceived loudness will be a challenge—and one that could frustrate him before too long. When his work is done, he'd like to recommend a procedure on how to set levels in order to gain consistency. And, he wants to work with the programmers, too. "I'd like to develop a procedure, or philosophy, of consistency programmers should adhere to," says Mountain. "Establish an ID, a footprint."

But his overall mission is even bigger than those few desires, and he's looking forward to moving ahead. Mountain would like to explore audio's potential and find out what competitive services can offer. For example, can cable-TV systems faithfully transmit Surround Sound or Lucasfilm's THX audio standard? Mountain has been told it can be done, but he intends to actually perform a test.

Those goals may be a bit ambitious, if the current debate is any indication of the size of the hornet's nest waiting to be stirred up. But if cable operators want to satisfy their subscribers, they should be keenly interested in Mountain's work. In fact, they should be measuring their own audio levels to get a sense of where they stand. ■

—Roger Brown

How to get hometown response from a national telco distributor

You no longer have to choose between the fast, personalized response of a hometown distributor and the broad stocks and purchasing power of a national firm, Power & Telephone Supply offers you both.

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Reader Service Number 31

Earth grounding design for cable TV systems

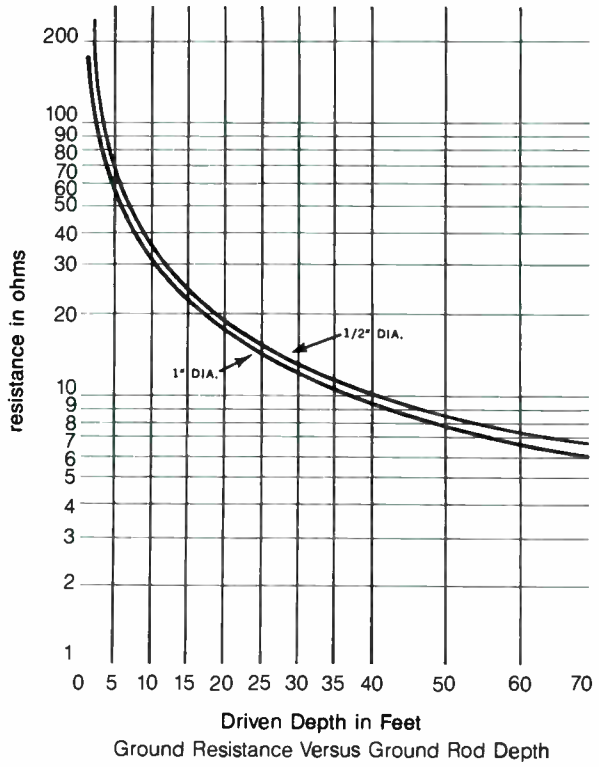
Proper grounding of cable TV systems is imperative to assure personal safety and structural safety, prevent service outages and thus reduce operation and insurance costs for system operators.

The National Electrical Code (NEC) defines specific grounding design and application criteria and should be the basis of any construction procedures. Each geographical area has individual earth characteristics that can affect the materials and procedures for each specific locality. Compromising these requirements can not only affect system equipment, but can result in structural damage and personal injury from ungrounded surge currents.

Grounding cable television systems, like electrical systems, must provide cost-effective 30-year integrity to assure equipment protection and personal safety. The system must be designed to meet National Electrical Code requirements. The system components of earth grounding are calculated and selected based on the following principles and code standards.

To be totally effective, a grounding system must:

- Provide a low impedance path to ground for personnel and equipment protection and effective circuit relaying.
- Withstand and dissipate repeated fault and surge currents.
- Provide corrosion resistance to various soil chemistry to ensure continuous performance for the life of the equipment being protected.
- Provide rugged mechanical properties for easy driving with minimum effort and rod damage.



Ground Resistance Versus Ground Rod Depth

FIG. 1

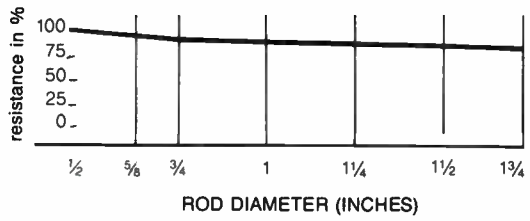


FIG. 2

By Larry White, Product Manager, Anixter Cable TV and Roger J. Montambo, P.E., Director Marketing and Sales, American Electric Co.

To provide a low impedance to ground, a system must not only be designed with high conductivity, but with permanence and reliability. Electrical continuity is an absolute requirement: there can be no weak link in the system; no high resistance electrical connections during the life of the system.

Materials used to manufacture ground rods and clamps will determine the integrity and life of the grounding system. U.S. National Bureau of Standards tests show copper to be the most corrosion resistant of all metals tested, in most soils. The only ground rod listed by Underwriters Laboratories is a 10-mil copper covered steel rod at least eight feet in length and one-half inch in diameter. Clamps and sectional couplings must be made of high copper content (mimimum 80 percent) silicon bronze.

Standards and specifications

Many specifications cover the vital features expected of a copper covered steel ground rod. These standards, in existence for decades, have been developed by Underwriters Laboratories, utilities and government agencies.

In most cases, the specifications are similar. The grounding equipment requirements of Underwriters Laboratories Inc. serve as the basis for approval for grounding of the National Electrical Code. The NEC, in turn, provides the grounding premises of the Occupational Safety and Health Act (OSHA-1971). The most comprehensive specification developed for copper jacketed rods is the "Standard for Safety -Grounding and Bonding Equipment," published by Underwriters Laboratories Inc. as ANSI/UL 467-1984.

This specification requires:

- A heavy, pure copper jacket having 0.010-inch minimum thickness.
- A copper jacket adherence test.
- A bending test with no cracking of the copper jacket.

The required thickness of the copper jacket was determined by the National Bureau of Standards and published in Circular 579. Table 48 in Circular 579 contains a compilation of weight loss per year of copper specimens buried in 43 different soils for periods of 8 to 13 years. Dividing these values by the

density of copper, an average penetration per year was established. Extrapolating the average penetration figures to 30 years showed that 10-mil solid copper resists corrosion penetration in virtually any type of soil.

Therefore, it can be concluded that ground rods with a copper thickness of 0.010-inch or greater would guarantee a minimum 30-year installation service life.

It is also important that the copper be metallically bonded to the steel core in order to achieve the long service life required of a ground rod. Without this integral bond, any electrolyte which enters the copper/steel interface could implement rapid corrosion. This phenomenon exists with any unbonded, bimetallic ground rod.

ANSI/UL 467-1984 also requires clamps and couplings to be a minimum of 80 percent copper.

Application

The National Electrical Code, Underwriters Laboratories and OSHA require that a copper bonded ground rod shall have a minimum diameter of one-half inch and shall also be at least eight feet in length. If the ground resistance of a rod is not 25 ohms or less, an additional electrode shall be installed.

When circumstances make it difficult to obtain the ground resistance required by the NEC, several methods of lowering the ground resistance can be employed, including parallel rod systems, deep-driven rod systems utilizing sectional rods, chemical treatment of the soil, buried plates, buried conductors (counter poise), electrically connected building steel, electrically connected concrete reinforced steel, and connecting to metallic water pipe.

The nature of an earth electrode

Now, let's look at

—RESISTIVITIES OF DIFFERENT SOILS**

Soil	Resistivity, Ohm-cm (Range)		
Surface soils, loam, etc.	100	—	5,000
Clay	200	—	10,000
Sand and gravel	5,000	—	100,000
Surface limestone	10,000	—	1,000,000
Limestones	500	—	400,000
Shales	500	—	10,000
Sandstone	2,000	—	200,000
Granites, basalts, etc.	100,000		
Decomposed gneisses	5,000	—	50,000
Slates, etc.	1,000	—	10,000

**Evershed & Vignoles Bulletin 245.

Figure 3

EFFECT OF MOISTURE CONTENT ON EARTH RESISTIVITY*

Moisture Content, % By Weight	Resistivity, Ohm-cm	
	Top Soil	Sandy Loam
0	$1,000 \times 10^6$	$1,000 \times 10^6$
2.5	250,000	150,000
5	165,000	43,000
10	53,000	18,500
15	19,000	10,500
20	12,000	6,300
30	6,400	4,200

*From "An Investigation of Earthing Resistance," by P. J. Higgs, I.E.E.E. Jour., vol. 68, p. 736, February 1930.

Figure 4

the other half of the ground connecting system—the earth itself.

Resistance to current through an earth electrode system has three components:

- Resistance of the ground rod itself and connections to it.
- Contact resistance between the ground rod and the earth adjacent to it.
- Resistance of the surrounding earth.

Of the three components involved in "resistance," the resistance of the earth is most critical and most difficult to calculate and overcome.

The resistance to earth formula for single ground rods is:

$$R = \frac{\rho}{2\pi L}\left[\left(\ln\frac{4L}{a}\right) - 1\right]$$

ρ = average soil resistivity, ohm - cm
L = ground rod length, cm
a = ground rod radius, cm
R= resistance of ground rod to earth, ohms

Factors affecting resistance

Rod size. Whenever a ground rod is driven deeper into the earth, its resistance is substantially reduced. Doubling the rod length reduces resistance by an additional 40 percent (see Figure 1). Increasing the diameter of the rod, however, does not materially reduce its resistance. Doubling the diameter, for instance, reduces resistance by less than 10 percent. Figure 2 shows this relationship. The diameter is determined by the difficulty of driving only. Generally 5/8-inch diameter is determined by the difficulty of driving only. Generally 5/8-inch diameter is sufficient to drive an 8-foot rod in all but very rocky soils.

Soil resistivity. Soil resistivity is the key factor that determines what the resistance of a grounding electrode will be and to what depth it must be driven to obtain low ground resistance. The resistivity of the soil varies widely throughout the world and changes seasonally. Soil resistivity is determined largely by its content of electrolyte, consisting of moisture, minerals and dissolved salts. A dry soil has high resistivity, but a wet soil may also have a high resistivity if it contains no soluble salts.

Some values found for earth resistivity are given in Figure 3.

Figure 4 shows, for two samples of soil, the variation of resistivity with *moisture content.*

These two samples of soil, when thoroughly dried, became in fact, very good insulators, having a resistivity in excess of 10^9 ohm-centimeters.

The resistivity of the soil is influenced by *temperature.* Figure 5 shows the variation of the resistivity of sandy loam, containing 15.2 percent moisture, with temperature changes from 20 degrees Centigrade to -15 degrees C. In this temperature range the resistivity is seen to vary from 7,200 to 330,000 ohm-centimeters.

Best results are obtained if the ground rod reaches the permanent moisture level.

In some locations, the resistivity of the earth is so high that low-resistance grounding can be obtained only at considerable expense and with an elaborate grounding system. In such situations, it may be economical to use a ground rod system of limited size to reduce the ground resistivity by periodically increasing the soluble chemical content of the soil.

Figure 6 shows the substantial reduction in resistivity of sandy loam brought about by an increase in chemical salt content.

To calculate the ground rod depth required to obtain a desired resistance, a device called the grounding Nomograph (Figure 7) is used. The Nomograph example indicates that to obtain a grounding resistance of 20 ohms in a soil with a resistivity of 10,000 ohm-centimeters, a 5/8-inch diameter rod must be driven 20 feet.

When these design and application factors have been determined, measured and calculated for each geographical location and applied to NEC requirements, the optimum safe, cost-effective and 30-year trouble-free service grounding system can be implemented. ■

—EFFECT OF TEMPERATURE ON EARTH RESISTIVITY†

Temperature C	Temperature F	Resistivity, Ohm-cm
20	68	7,200
10	50	9,900
0	32 (water)	13,800
0	32 (ice)	30,000
−5	23	79,000
−15	14	330,000

†For sandy loam, 15.2% moisture

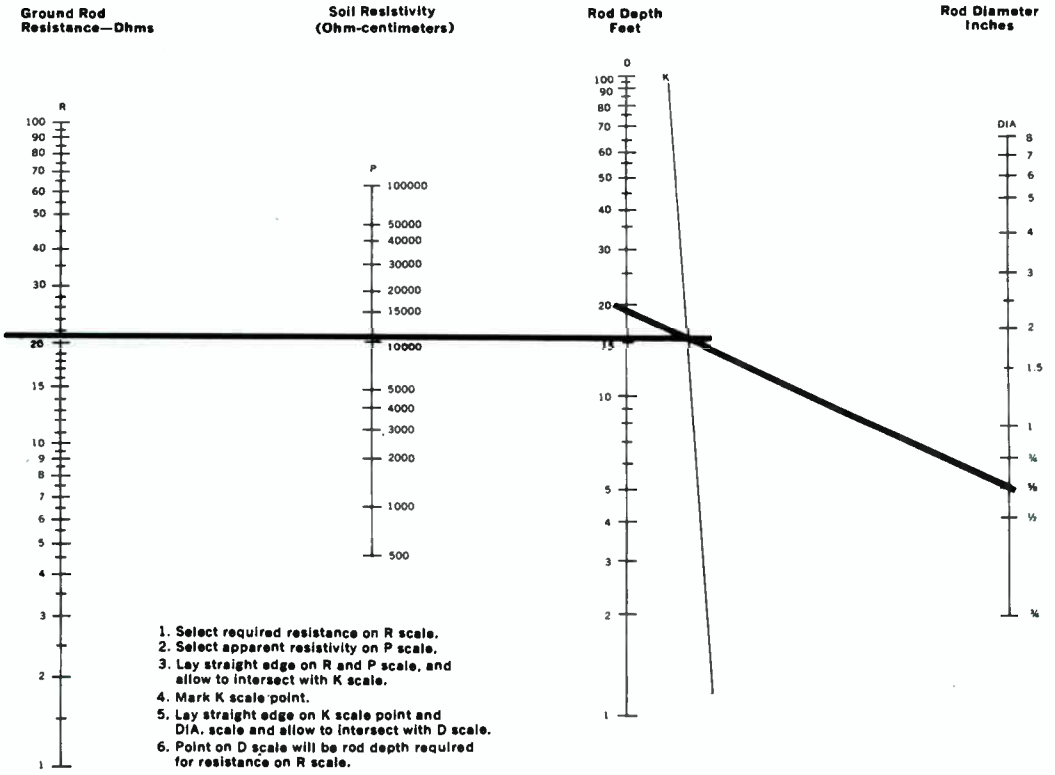
Figure 5

THE EFFECT OF SALT* CONTENT ON THE RESISTIVITY OF SOIL
(Sandy loam. Moisture content, 15 per cent by weight. Temperature, 17°C

Added Salt (Per cent by weight of moisture)	Resistivity (Ohm-centimeters)
0	10,700
0.1	1,800
1.0	460
5	190
10	130
20	100

*Include sodium chloride, copper sulphate, sodium carbonate, and others.

Figure 6



GROUNDING NOMOGRAPH

Figure 7

An OSHA primer

OSHA. Just the mention of it leaves most people with two reactions. First, a feeling of Big Brother Government looking over their shoulders, wasting tax dollars and meddling where it shouldn't. And second, a feeling of fear that OSHA could find fault with a cable system and implement fines and other painful actions.

OSHA decade

While the first is a matter of opinion and perspective, the second is an ever-looming possibility. The 1990s have been called the "decade of OSHA," and OSHA has made it clear that it plans stronger regulation and stiffer fines in the coming years.

As a preliminary to this month's "OSHA Compliance for Cable Television Operators" seminar presented by National Cable Television Institute and co-sponsored by *CED* magazine, the following information will give you a better understanding of what OSHA is and what its interests are in cable television systems.

OSHA history

To put the "wasting of tax dollars" reaction in perspective, whether the threat of an OSHA inspection is appreciated or not, OSHA was created in response to some very real hazards in the workplace. During 1969 and 1970, Congress was hit with some staggering statistics. Testimony and documented evidence showed that more than 15,500 workers were being killed annually in job-related accidents. In addition, more than 2.2 million workers were being disabled each year, and approximately 390,000 new cases of occupational diseases were being reported each year, contributing to another 100,000 deaths. And, worst of all, the trend in each category was increasing.

In response to the testimony and statistics, in 1970 Congress passed the Williams-Steiger Occupational Act, which provided for the creation of the Occupational Safety and Health Administration—OSHA.

OSHA's stated purpose was to "assure, so far as possible, every working man and woman in the nation, safe and healthful working conditions and to preserve our human resources." Its jurisdiction extends to all employers and employees in all 50 states, including all cable systems. To fulfill its purpose statement, OSHA is empowered to create legally enforceable regulations, or "standards," governing conditions, practices or operations. To monitor compliance with the standards, its inspectors are authorized to do any of the following:

- Enter, without delay, any workplace where workers are working for an employer;
- Inspect and investigate during regular working hours any device, structure, machine, equipment and materials;
- Question privately any employee, employer, owner, agent or operator;
- Review any record related to the purpose of the inspection and any other records required by the OSHA Act.

Inspections are conducted without advance notice and penalties range from fines to a jail sentence.

OSHA and CATV operators

So what does OSHA require of a cable operator? The full answer to that is too lengthy for this space. However, by examining the accompanying National Safety Council's chart of "The Most Often Cited OSHA Standards," a reader can begin to develop an understanding of where cable systems are most vulnerable.

OSHA is particularly sensitive to fire hazards, potential sources of electric shock, hazardous materials, protective equipment such as hard hats, and ladder hazards and other potential sources of falls. Cable systems have potential problems in each one of these areas. OSHA is also particularly sensitive to preventive training, and open communication regarding potential hazards that do exist, especially relating to hazardous materials. It requires employers to take specific training, tracking and reporting steps. Violation of those training and documentation standards is in itself a punishable violation.

Should a compliance officer find any problems with the operation of a cable system, the findings are reported to the OSHA area director who determines what citations, if any, will be issued, and what penalties, if any, will be proposed. Citations inform the cable operator and employees of the regulations and standards alleged to have been violated, and of the proposed length of time set for their abatement.

Penalty types

The types of violations and penalties are categorized based on OSHA's perception of the severity of the problem. Categories include:

- **Other than serious violation.** A violation that has a direct relationship to job safety and health, but probably would not cause death or serious physical harm.
- **Serious violation.** A violation where there is substantial probability that death or serious physical harm could result, and that the employer knew, or should have known, of the hazard.
- **Willful violation.** A violation that the cable operator intentionally and knowingly commits. The cable operator either knows that conditions are in violation, or is aware that a hazardous condition existed and made no reasonable effort to eliminate it.
- **Repeated violation.** A violation of any standard, regulation, rule or order where, upon reinspection, a substantially similar violation is found.
- **Failure to correct prior violation.** A violation where the cable operator failed to correct a previously cited violation.

Penalties vary by the category of the violation, but it is interesting to note that even an "other than serious violation" can result in a penalty of up to $1,000 for each citation.

Plan now

OSHA is real and it is a more serious risk than ever before. If your system hasn't started implementing its compliance program, today is the day. If you have a program in place but know it is less than complete, now is the time to tune it up—not the day the inspector walks through the door.

For more information on the "OSHA Compliance for Cable Television Operators" seminar coming up later this month, call NCTI at (303) 761-8554. ■

By Tom Brooksher, General Manager, National Cable Television Institute

Most often cited OSHA standards

The following is a list of the OSHA standards most cited by federal compliance officers. Have you checked for these common safety problems at your sites recently?

- 1926.50(f)—Emergency telephone numbers not posted.
- 1926.50(d)(l)—Inadequate first aid supplies.
- 1926.500(a)(l)(iii)—Stair railing-less than 44 inches—open both sides.
- 1926.100(a)—Inadequate hard hat protection.
- 1926.602(a)(9)(i)—No back-up alarm.
- 1926.25(a)—Inadequate housekeeping.
- 1926.450(a)(4)—Ladders not secured.
- 1926.500(d)(1)—Opensided floors not guarded.
- 1926.450(a)(2)—Broken ladders.
- 1926.28(a)—Inadequate personal protective equipment.
- 1926.350(a)(9)—Gas cylinders not secured.
- 1926.21(b)(2)—No safety program-recognition and avoidance.
- 1926.152(g)(9)—Inadequate or missing no-smoking signs.
- 1926.450(a)(9)—Ladder side rails not extended 36 inches.

Electrical hazards

- 1926.400(h)(l)—No G.F.C.I. or assured equipment grounding program.
- 1926.400(a)—Electrical not in accordance with N.E.C.
- 1926.401(c)—No effective grounding—permanent and continuous.
- 1926.402(a)(10)—Worn or frayed electric cables.
- 1926.401(a)(4)—Attachment plug cord grip.
- 1926.402(c)(1)—Circuit breakers not marked.
- 1926.402(a)(11)—Inadequate extension cord protection.

Fire hazards

- 1926.150(c)(1)(i)—No fire protection for protected building area.
- 1926.152(a)(l)—Inadequate safety cans for flammable liquids.
- 1926.150(e)(2)—Fire alarm code not posted.
- 1926.350(j)—Inadequate separation of fuel gas cylinders in storage.

Source: National Safety Council

Power supply preventive maintenance

The following article is adapted from a presentation made to several SCTE Chapter and Meeting Groups recently.

When you stop to consider the importance of a power outage in your system, it becomes very clear that this type of problem would be best prevented from happening. Preventive maintenance on power supplies, both standby and ferroresonant, can be easily overlooked in the day-to-day activities of a busy cable system, but the consequences of ignoring it will manifest itself in outages and an increase in customer dissatisfaction.

Good preventive maintenance programs will involve the power supplies (both normal and standby) in routine inspections, data logging and trend evaluation. What could possibly go wrong with a ferroresonant transformer? Well, besides the obvious build-up of dirt and debris in the units, there is typically a device installed for surge protection. If that device has failed due to a catastrophic surge, it has served its purpose and needs to be replaced to protect the unit. With these concepts in mind, let's explore the actual procedures.

You write the book

Here is one of the first suggestions for a successful preventive maintenance program: Create a notebook with information about all the power supplies in the system. Include schematics, battery hookup procedures and troubleshooting guides for each power supply type in your system. Other information such as maps or physical locations could also be included. This log will not only help the technicians performing preventive maintenance, but will be invaluable to techs on call. Who wants to be called out of bed at 2 a.m. to answer a question about a power suppply that has been hanging there since the original system was built? This book is also the ideal place to outline procedures and instructions on a preventive maintenance program.

By Dave Cushman, Director of Engineering, Power Guard Inc.

In addition to providing the technician with the right information, it is a good idea to equip them with the right tools. These might include a good quality digital voltmeter, a resistive load battery tester, a clamp-on amp meter and, if wet cells are used, a device to check specific gravity. Due to the nature of the quasi-square wave produced by ferroresonant transformers, it is a good idea to have at least one RMS digital voltmeter to perform close checks on true voltage.

Standby Power Preventive maintenance Schedule

Hub #1 Technician: Kramer

Week	Power Supplies to be Served Local #1	Local #2
1	1	33
2	12	2
3	4	5
4	7	16
5	40	
6	24	32
7	6	9
8	10	39
9	30	29
10	31	
11	36	65
12	22	54
13	91	88
14	1	33
15	12	2

Train, train, train

Having the right tools is only half of the solution. Training everyone to safely use these tools reliably is the other half. Imagine you had a preventive maintenance program in place and had been collecting information for several years. You send a back-up out to perform that day's scheduled preventive maintenance. A few days later, you are logging the readings and discover that an entire area seems to have increased its draw on the power supplies by 3 amps. The regular technician is back, so you pull him from that day's duties to determine the problem—only to find out that there is no problem. A simple training function has cost at least one person's time and has created more work for the person logging the entries. Training takes time, but saves time.

Establish records, as in any other type of preventive maintenance program. Trend analysis can point to potential problems developing in the system. While later in this article a thorough check is established, recording only the line voltages, battery voltages and battery maintenance will enable you to see if there is an increase or decrease in values—indicating that something is changing—which points to a potential problem.

The procedures for checking out a ferroresonant supply also apply to the normal side of a stand-by supply. The most obvious test is the output voltage. It is best to check this voltage at the point where the power is delivered to the coax connector. If there is a problem in the supply wiring, a reading at the system's test point could be misleading. This also provides an opportunity to check that the connection is tight. Mechanical connections can work loose over time due to vibration or hot/cold cycling.

Carry spares

Next, check the input voltage and amperage. Another item that often gets overlooked is the cooling vents. Over a period of time, dust and dirt can collect that will block the screening material. Simply rubbing this material will dislodge most of the dirt, allowing better air circulation.

Another mechanical feature that often gets overlooked is the locking system. Spraying a lubricant such as WD-40™ or one that is specifically designed for lock lubrication into the lock can prevent freezing. During the life of the power supply, the indicator lamps may need to be replaced, so be sure to carry spares when performing maintenance. Check any surge protection devices according to the manufacturer's instructions to assure that they

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Reader Service Number 39

are still functional. Be sure to record the temperature at that location, so that the trend analysis can be evaluated for operation in different climates. Readings will change as conductors pass more amperage on colder days. Finally, check the input breaker box for damage, dirt build-up and breaker operation.

Standby power

On the standby power supply, check the status lamps before entering the cabinet to assure that the unit is in normal mode. Once the cabinet is open, transfer the unit into the standby mode to check its operation. If all is correct, start by checking the output voltage and current, as before. Allow the unit to go back into normal operation and check the output voltage and current again. Now check the rest of the items listed for a ferroresonant supply.

Additional tests on a standby supply primarily involve the batteries and the charging system. Check the physical appearance of the batteries. If the cases are swollen, this indicates overcharging and the batteries must be replaced. **Caution!** When handling batteries, be sure to wear protective devices such as a face shield and gloves.

The simplest battery test is to isolate the batteries from the charger system and take DC voltage readings with a digital voltmeter across the terminals of each individual battery. Isolating the batteries can be achieved by switching the battery breaker off or by removing one of the leads. The batteries should all be within 0.5 DC volts of each other. If the difference exceeds this amount, then a load type battery tester should be used to test each battery. If a bad battery is detected, it is best to replace all of the batteries.

Without going into a lengthy discussion on batteries, the reason for this is that batteries will change in the internal resistance over their life cycles and placing a new battery with lower resistance in the supply will cause a premature failure on the new battery. Ultimately, it is more cost effective and more reliable to replace the set. One exception to this is if the batteries are relatively new. Be sure to record the battery voltages by location so that they can be checked against the log for differences. While the charging system is disconnected from the batteries, the float voltage of the charger can typically be checked.

Using a digital voltmeter, check the test points for the charger or the leads from the power supply battery harness at the points where the battery chain starts and ends. If there is an indication of overcharging (refer to the manufacturer's specifications or system specifications for this value), refer to the instructions to set the float value. Some manufacturers do not allow field adjustment of this setting. While the batteries are disconnected, check the terminals for corrosion. Surface corrosion may be obvious, but it is possible for the corrosion to be only under the the terminals. It is best to clean the terminals each time and then use some type of coating to inhibit the corrosion.

If wet cells are being used, check the specific gravity of the electrolyte in each cell. This will determine if there is a weak cell in a battery. Also check the level of the electrolyte and refill those cells that are low with distilled water. This procedure is the most important maintenance item if you are utilizing wet cells. Reconnect the batteries or switch the battery breaker back on. Perform any other specific tests that your manufacturer calls for and then cycle the unit into standby one final time before leaving.

While performing the actual maintenance on the power supplies will improve the reliability, the whole maintenance system will depend on scheduled visits to each power supply location. A schedule that visits stand-by supplies five times a year (twice in the hot summer months) and ferroresonant supplies twice a year should be your minimum. If you are using wet cells, the visits to the stand-by supplies should be increased according to your climate.

Use colored index cards

One of the simplest techniques for this is to use two note cards of different colors. Have the technician record readings on both cards. Turn in one card and leave the other in the power supply housing. On the next scheduled visit, give the technician the card that was turned in to take back to the power supply. Have the tech record the readings again on both cards, but this time, bring back the other card. This information can then be kept on file, and anyone who has to service that supply in-between visits will have the readings available. If they perform any service on the supply, the card in the unit can be returned to the office so that the service record can be kept updated.

One of the tasks involved in preventive maintenance is keeping records. With the system described above, all that is needed is that the cards be filed in some logical order. But to gain trend analysis it is necessary to transfer the card information to a database where the readings can be sorted and/or evaluated. Many database programs are available today for PCs that are relatively easy to use. These programs can be customized to present the information and reports in a variety of different formats.

But if you are not a skilled programmer or do not have the time needed to organize a database, software is available that will schedule, track and evaluate a preventive maintenance program. The programs run on a PC and will inventory the power supplies in the system, track power supply repairs, schedule preventive maintenance vists and report on marginal power supply performance. Also included is the ability to generate and track work orders, generate exception reports based on entry values that are programmable, and maintain history logs on individual power supplies. Inventory analysis options allow the user to record technical information on the power supply as well as assign a number, hub location and other information.

No matter what you do for preventive maintenance on power supplies, the key concepts are routine inspections and documentation. It is impossible to specify in one article all of the points that you might need to check when visiting a power supply, but if you use these suggestions as a guideline and the manuals supplied with the power supplies, you probably won't miss much.

Power supplies are active components of your cable system and need to be checked routinely. With an active preventive maintenance program, you may be able to avoid that phone call one minute after the Super Bowl kickoff that starts off—"We've got a problem..." ■

The author thanks Bob Forney, president of Dumbauld & Associates, for help in the preparation of this article. Dumbauld and Associates produces a power supply preventive maintenance software package and may be reached at (602) 870-4977.

A historical look at signal level meters

In the beginning (early 1950s), Ken Simmons created the Jerrold 704 signal level meter. It was an AC mains powered, vacuum tube design, single conversion, super heterodyne meter that was tunable from channel 2 through channel 13. It had a tracking RF preselector and a video output jack which made it a favorite for making cross-modulation measurements for many years.

Solid-state electronics advanced and by the mid-1960s, Hank Arbiter, George Sike and John Austin developed the Jerrold Model 727. This instrument became the successful portable, battery operated signal level meter. The local oscillator was mechanically tuned by a rack and pinion, glass piston trimmer assembly that offered precision.

In 1973 the Mid State Communication's (now Wavetek) SLIM represented an attempt at a major step forward in signal level meter technology by introducing the first triple conversion super heterodyne receiver that had an upconvert front end. Only spectrum analyzers had used this technique previously. This technique offers the advantage of good broadband frequency flatness and the image frequency is hundreds of MHz above the desired frequency. The model was replaced two years later by the SAM series, which has become a fixture at many cable systems.

As these relatively top dollar instruments evolved, it is important to note and acknowledge the success of Harry Sadel in the lower priced segment of the market.

There are two other manufacturers offering meters with special features and prices in the upper strata. One is Sencore with its total measurement capability. The other company is Comsonics with its "Window," which has the unique ability to display a frequency versus amplitude plot of the entire frequency span on an LCD display.

If we look back at the really successful signal level meters, we see an evolutionary trend toward smaller and lighter weight, more frequency range, better frequency and amplitude accuracy. They also require less and less operator skill to use. Remember the amplitude compensation knob and channel chart on the Jerrold 727? The SAM-1000, with its up-convert front end, is naturally flat and doesn't need that channel-by-channel compensation, or if it does, the correct setting is programmed into ROM and is set automatically. But the operator still has to determine which amplitude scale to read according to the attenuator knob setting.

In the future, the same trend will continue. More surface mount components, more capable synthesizer ICs and more efficient switching power supply circuitry will lead to smaller hand-held digital signal level meters. The microprocessor will be used more cleverly to not only do things that enhance measurement accuracy, but also to improve ease of operation.

For the new technician this will mean less required training time. For the experienced technician, it will mean more operator ease, faster measurements and less likelihood of a measurement error. Like driving a fine race car, technology is on the move in the world of signal level meters. ■

By Doyle T. Haywood, President, Applied Instruments Inc.

Signal level meter basics

Let's review the internal operation of the signal level meter. The signal level meter must measure the voltage across the 75 ohm characteristic impedance of the cable drop. We are not interested in the composite voltage. We must be able to measure channel 2 to channel 78 individually.

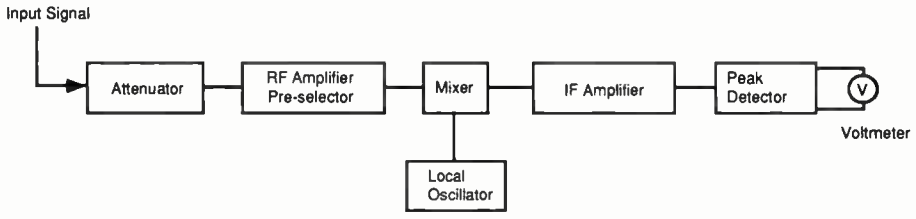

Figure 1

Figure 1 is a simplified block diagram of a single conversion receiver with a volt meter connected to the detector output. The desired incoming signal is attenuated to the basic sensitivity level of the receiver. A preselector tunes to the incoming signal while rejecting the image frequency. This signal is mixed with a local oscillator, whose frequency is such that the resulting difference frequency is the same as the IF amplifier frequency.

The bandwidth of the IF amplifier must be wide enough to allow sufficient energy at the detector to allow efficient peak detecting of the sync pulses, yet narrow enough and with steep enough skirts to reject upper adjacent video when we are measuring a 20 dB down sound carrier (see Figure 2).

Why a peak detector? The only stable part of a video signal is the sync pulse tips. Any other detection scheme would cause the signal level reading to vary as the scene changed from dark to light. Since a bright scene is represented by low video output and a dark scene is represented by maximum video output, the output from an average reading detector will change. The meter is calibrated such that the sync pulse tips and a CW carrier of equal amplitude will read the same.

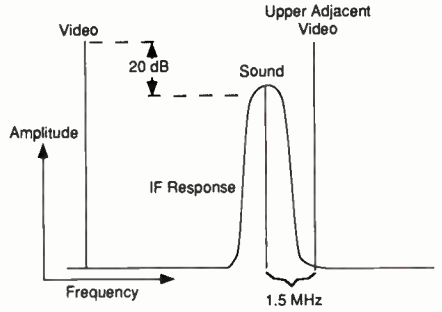

Figure 2

Only The FS74A Allows You To See The Picture, Hear The Audio, Plus Measure The Critical Levels, Ratios, Hum And Noise In Just Seconds. . .

If you're like most companies, your present field strength meter will allow you to check signal levels only, but many troubles in cable systems just don't affect the signal level! So how can you ensure your customers are receiving the absolute best signal? Sencore recommends the following **1, 2, 3** Go-No-Go testing!

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2 With the FS74A, hum and S/N tests are simple and error free. Simply tune to any RF channel, switch the function selector to either HUM or S/N and read the meter. There is no faster or more accurate method. (patented)

3 Use the FS74A Channelizer Sr. to actually view the video on the exclusive built-in monitor. The FS74A passes a full 4 MHz of video so you will see the beat, ingress, or ghosting problems on the video monitor. You simply step through your system while viewing the monitor.

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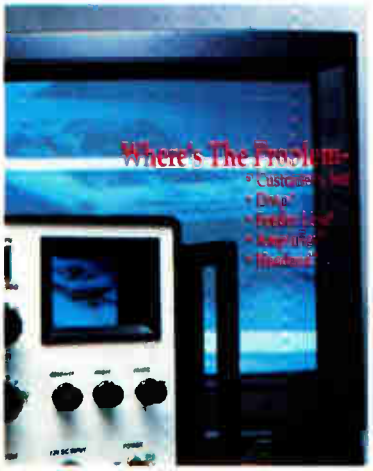

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WHAT'S AHEAD

SCTE

Following is a list of SCTE technical seminars with contact name. If known, location and seminar topic are listed.

October 9 *Greater Chicago Chapter* Embassy Suites Hotel, Schaumburg, Ill. BCT/E examinations to be administered. Contact Jim Grothendick, (800) 544-5368.

October 10 *Delaware Valley SCTE Chapter* Williamson Restaurant, Horsham, PA. Contact Dan McMonigle, (215) 265-4233.

October 11 *Chesapeake Chapter* "Video and Audio." Holiday Inn, Columbia, Md. Contact Keith Hennek, (301) 731-5560.

October 16 *Great Plains Chapter* BCT/E testing to be administered in categories II, III, IV and VII (tenative). To be held at United Artists Cable, Bellevue, Neb. Contact Jennifer Hays, (402) 333-6484.

October 17 *North Central Texas Chapter* "Interdiction." Contact M.J. Jackson, (800) 528-5567.

October 17 *Palmetto Chapter* Contact Rick Barnett, (803) 747-1403.

October 17 *Penn/Ohio Meeting Group* "Fiber Optics." Contact Bernie Czarnecki, (814) 838-1466.

October 19 *Miss/Lou Chapter* BCT/E examinations to be administered in all categories. Contact Dave Matthews, (504) 923-0256.

C-COR® ELECTRONICS INC

C-COR Electronics "state of the art" seminars are three-day events designed to instruct relatively new technicians in basic theory, installation and maintenance of cable TV systems. Attendance is limited to a maximum of three persons from one system. The fee is $245. Call Kelly Jo Kerstetter, (800) 233-2267, ext. 422 to register or for additional info on any of the following 1990 seminars.

October 16-18
Los Angeles, Calif.
November 13-15
Orlando, Fla.

SIECOR

Siecor Corp. will sponsor fiber optic training programs designed to meet the needs of installers and users of fiber optic products. Following are dates for the program "Fiber Optic Installation and Splicing for Outside Plant Applications." For more information on classes, pricing and registration call (800) 634-9064.

October 1-4
December 3-6

Scientific Atlanta

Scientific-Atlanta offers technical training for subscriber products as well as advanced training for the industry. The following seminars will be held at the Minneapolis Marriott Hotel in Bloomington, Minn. Contact Sylvia Rogers, (800) 722-2009 (press 1, then 2) to register.

November 6 Headend and Earth Systems Training
November 7 Distribution Systems Training

MAGNAVOX CATV SYSTEMS, INC.

The Magnavox CATV Systems mobile training center is a fully-equipped laboratory on wheels for CATV, fiber optic and LAN training. The three-day seminars combine instruction in theory and practical hands-on training. The fee is $350. Call Amy Costello Haube at (800) 448-5171 (in N.Y., (800) 522-7464) for information.

October 10-12
Greensboro, N.C.
October 16-18
Roanoke, Va.
October 23-25
Philadelphia, Pa.
October 30-November 1
Calais, Maine

Trade Shows

Mid-America Show
October 9-11 Kansas City, Mo. Contact Rob Marshall, (913) 841-9241

BCTA Convention
November TBA Location TBA. Contact British Cable TV Assocation, 011 44 01 437 0549

Western Show
November 28-30 Anaheim, Calif. Contact Trade Associates Inc., (301) 468-3210

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Fiberoptic Communications Corp.,a certified training facility for GTE, Anritsu and Ametek Controls, is offering 5-day fiber optic splicing and termination workshops . The course is college accredited, and available on the following dates:

October 22-26
November 12-16
December 10-14

For further details, call (800) 776-0518.

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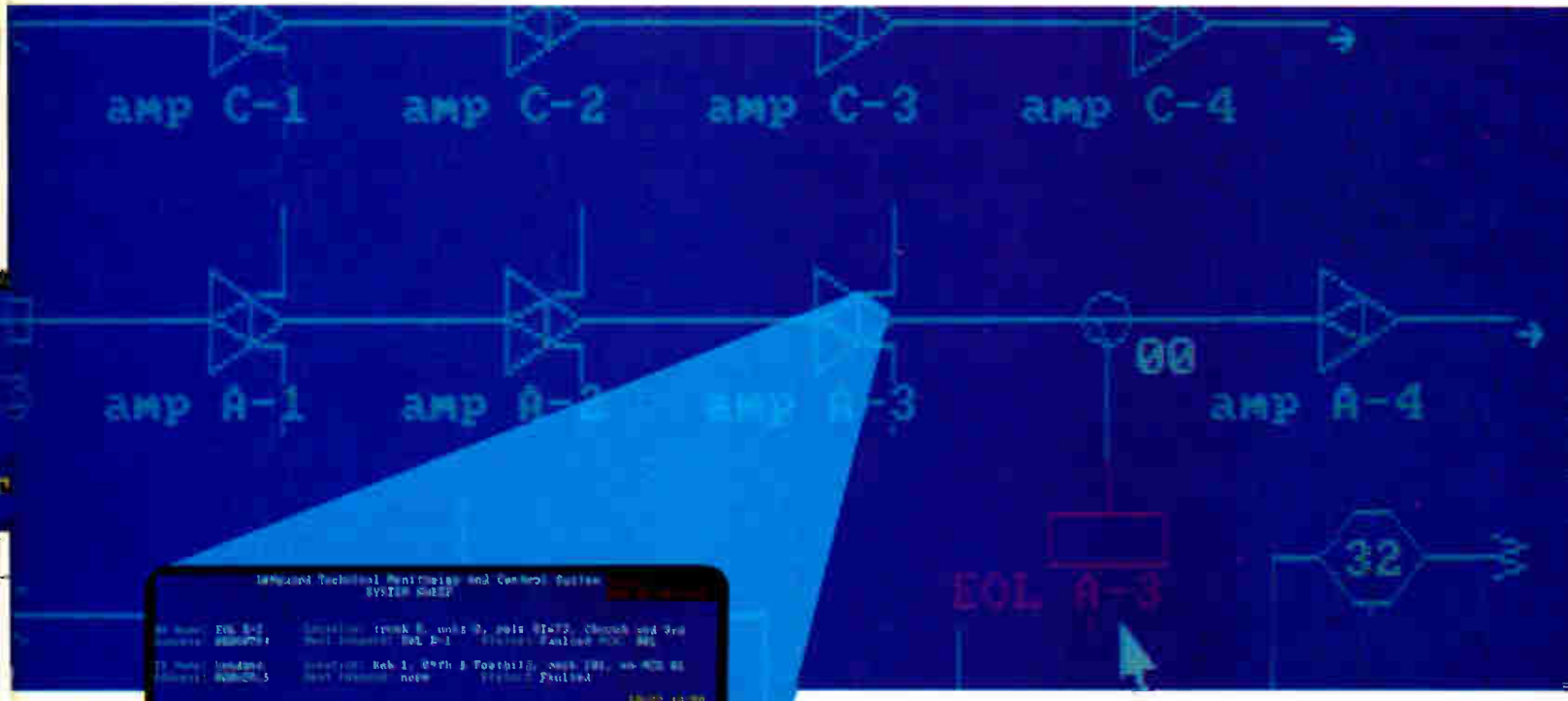

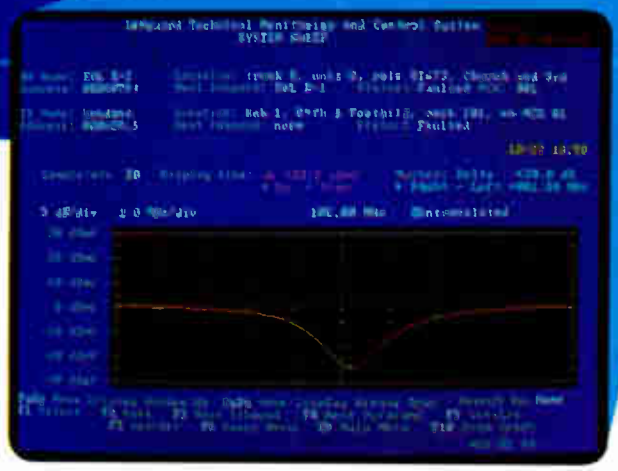

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Reader Service Number 44

A step by step guide to flyover preparation

The rear of Flight Trac's Beechcraft Dutchess aircraft, showing the protruding antenna system.

Recently, *CED* had the opportunity to survey an actual flyover operation in the Denver area hosted by Flight Trac, an Illinois-based company. The interview with pilots Heidi Mayer and John Berst was conducted while perched on the wing of the company's Beechcraft BA76 Dutchess aircraft, where the preparatory steps to a smooth flyover were discussed.

"No flyover could realistically be designated as 'typical'," chuckles Mayer, "but we do have a set of preparatory guidelines developed through experience that help us operate as effectively as possible." These guidelines include such items as adequate surface maps, necessary test equipment and tips on selecting a flyover test frequency.

Step one—maps

The first step in preparing to fly a system is to get an actual map of the service area. Because the pilots fly at a low altitude (1,500 feet), a road map with as many landmarks as possible is preferred to enable visual location verification. A Rand McNally-type map with the cable system boundaries clearly identified is the best choice—although in remote areas where such a map is not available, a topographical map can be substituted.

"Actually, we prefer a map with as much detail as possible," comments Ed Milner, VP of operations. "Our pilots rely heavily on city landmarks—a high school, hospital or football stadium located near the boundaries of the system helps us in knowing when to turn the aircraft and make the next pass."

Another important factor when preparing system maps is scale, which should be the same over the entire coverage area. For instance, if an operator whose service area includes two adjacent cities supplies two separate maps with two separate scales, one city may look quite larger than the other—particularly to a pilot unfamiliar with the area.

A glimpse into the cockpit of a Flight Trac aircraft.

Frequency selection and test equipment

After the maps have been received and accepted, the pilots must then begin the detailed process of selecting the test frequency to be used during the flyover. "This is based on two aspects," Moyer explains. "The first is where the operator has channels. The second is based on the navigational and communication channels for aviation." During this stage, flyover staffers will ask the operator to select a channel to be used as the test frequency.

Once a frequency is suggested, the pilots cross-reference it with aeronautical frequencies being used. If no conflicts exist, that test frequency is injected throughout the system for the duration of the flyover. Usually, FlightTrac opts for a test signal on channel A-1 or A-

2. "Chances are, signals in the range between 108 MHz and 120 MHz are used less frequently, because not all converters can tune to those channels," Milner explains.

However, the selection of a test frequency is where the most stumbling blocks can occur, according to Milner. He cites these pitfalls to avoid when determining a valid test frequency:

Microwave pilots. In systems using AML, it is important to take into consideration the frequency or frequencies of the microwave pilot(s). Quite often, the pilot frequency is identical to the selected flyover test frequency. In this case, the transmitted pilot signal will be picked up during flight and misinterpreted as excessive leakage.

Traps. Remember not to select a frequency that is negatively trapped anywhere in the system. If the test carrier were to be placed on a negatively trapped frequency, the result would be a series of homes that were ignored during the flyover—leaks and all.

Non-phaselocked microwaves. Although the number of non-phaselocked AML systems is few these days, an unstable microwave signal can be detrimental to the flyover process. "We have a very small window where our receiver looks for the test carrier," Milner explains. "So the test carrier has to be exactly on frequency. And if the quality of the microwave isn't stable, then on that remote cable system on the other end of the microwave, the test carrier could be outside our test window. So it would look like the cable system was totally leak free."

Commercial cable networks. If an operator is feeding non-aeronautical signals into a nearby hotel, government office or school, remember *not* to inject the test carrier into that portion of the plant. "FCC rules state that if you don't carry aeronauticals, you don't have to worry about leakage," Milner continues. "So if you're feeding hotels on, say, a beachfront cable system, and you're only giving them 12 channels that don't reach into the aeronautical band, you should be cautious not to put the flyover test signal in that portion of the cable. If you do, it'll go into the hotels and have the potential of being extremely leaky."

When Flight Trac's pilots arrive on site, they hand the cable operator a signal generator on which to tune the test frequency. To avoid inaccuracies or signal drifting, Flight Trac officials suggest the use of a frequency counter or spectrum analyzer to keep an eye on the quality of the signal being transmitted during the flyover. "Although flyover vendors may vary in their requirements, we suggest equipment that provides accuracy and repeatability of the test signal. Really, anything that measures the level and frequency of the signal during test," says Dom Stasi, president.

How it works

Flight Trac uses system developed by Rogers Cablesystems in Canada, with follow-on application enhancements by Flight Trac and ATC. The modular equipment, which fits into a small rack that sits on the passenger seat of the aircraft, consists of a high selectivity test receiver, a Loran C navigational unit and terminal, a CPU and a disk drive. An antenna (that looks much like a lethal bee stinger) protrudes from the rear of the aircraft and is used to measure leakage during the flyover.

Once airborne, Flight Trac employees literally have their hands full, with a map on the lap, a keypad strapped to one leg to enter Loran pass information, and the "minor" task of doing all this while keeping the aircraft operating along a precision track. Additionally, because of test frequency negotiations between the FAA, the cable operator and Flight Trac, the pilots often wind up flying in the early morning hours—midnight to 6 a.m.

After the flyover, the collected data is reduced, processed and returned to the operator in two forms: a CLI pass/fail analysis and a colored, computerized system map that highlights leak patterns by color intensity. "Our maps speak for themselves very clearly," Milner adds. "You look at the colors and see which colors correspond to low leakage. Then you see the gradation of the colors as they tend toward higher levels of leakage. When you look at the overall system—the overall completed flight map, and you see those bad areas, it's very helpful for trend analysis as well as CLI compliance. You can actually see what portions of your system are about to go bad." Reports and maps are returned to the operator as soon as two hours after the flyover, depending on the urgency of the situation. Normal turnaround, however, is about a week.

Flight Trac's preparatory advice doesn't just come out of the air—it is the outcome of miles and miles of plant flown to meet July 1 compliance deadlines. "Anything we can do to make both our jobs easier before we get there is beneficial. It's not good for either the cable operator or us to have to refly a system because of a simple error in frequency selection," Milner explains. "In terms of what would help the cable operator to get the most for his money, I'd say know the system. Know where the test signals should go, and know where you don't maintain cable networks to aeronautical specifications—because that's not a testable cable."

So when you're preparing to be "flown," make sure to dust off those system maps, check them carefully, give thorough consideration to frequency selection, and make sure you have adequate test equipment nearby because as the adage goes—"proper planning prevents poor performance."

Product news

Augat CATV Fiber Products has announced a new SMT single mode connector which offers low insertion losses and low back reflection characteristics. The field installable SMT connector system can be mated to ST-type connectors and features a keyed, bayonet-latching coupling mechanism

Augat's fiberoptic connector

to assure consistent alignment. The connector body is made of nickel-plated zinc and has a radiused zirconia ceramic ferrule. The backpost of the connector is blackened for easy differentiation from Augat's multimode connector. Pricing for the SMT single mode connector is $13.30 per 1,000. For more information, contact Channell Commercial Corporation at (800) 423-1863 or, inside Calif., (800) 345-3624.

New from **AML Specialties Inc** are seven 18 GHz microwave radios for the private and wireless cable industry. The radios offer up to 1 GHz of bandwidth, full redundancy, and a S/N ratio of 60 dB or better, company officials say. Single channel transmitters are offered in 1-, 2.5-and 5-watt power levels with up to 24 channels in one seven-foot rack. The new radios also feature AC/DC power with backup support. For more information, call (619) 569-7425.

Cable Information Technology Co. has announced a new computer software product, CostTrax, developed to assist cable operators in cost, budget and inventory activities. According to company officials, the software is capable of tracking all costs associated with CATV plant operations including labor (employees and contractors), parts and materials, and maintenance costs. Additional functions include automated purchasing, receiving, inventory and converter tracking, and fleet management. CostTrax was developed by a team of CATV system engineers and computer system developers. For details, call (415) 625-9768.

The **Cable Services Group** and **CNG Energy** have jointly announced a product integration of CNG Energy Company's C-ARDS (Computer Aided Radio Dispatch System) package to Cable Services Group's Cable Control subscriber management system. A commercial demonstration of the software was hosted by North Coast Cable of Cleveland, Ohio, ending in early September.

C-ARDS uses a customer's existing two-way radio system to transmit information from the CSG on-line system to mobile data terminals located inside service vehicles. Technicians use the mobile data terminal to display service calls and close out their jobs. Features of the interface include mobile access to customer information resident in the Cable Control system, downloading of installer route information from mobile terminals to the central office, automatic converter inventory adjustment, and detailed productivity reports.

Channel Master has announced the availablility of a new 0.75 meter nonpenetrating roof mount to its line of VSAT receive systems. The system features a fully adjustable AZ-EL Cap which allows for 360 degrees of azimuth adjustment, elevation fine tune adjustment and a stamped elevation scale for ease of installation. The mount is preassembled and manufactured of corrosion-resistant cadmium with a dichromate

ChannelMaster's AZ/EL

finish. For more information, call (919) 934-9711.

Conifer Corporation has announced the availability of the Model PA-1033 high performance, low noise preamp designed for use by wireless cable/MMDS and ITFS operators. The preamp is designed to enhance the fringe area receoption and provide additional gain when using long cable runs. The Model PA-1033 also features compact size and weight, so that it can be directly mounted on the downconverter without mounting hardware or a jumper cable.

According to company officials, the PA-1033 operates over a wide range of power supply voltages, and requires a maximum of 20 mA of current. Power is provided through the existing downlead, while passing the unaltered IF output signal back to the decoder/receiver. Internal circuitry also includes MOV lightning and voltage surge protection. Additionally, the preamp yields 10 dB gain and a 1.5 dB noise figure. The maximum benefit of the PA-1033 preamp, officials say, occurs when used under low signal conditions where an effective decrease in the downconverter noise figure will improve picture quality. For more information, call (319) 752-3607.

New from **FM Systems Inc.** is the Cable Stereo Performance Meter (CSPM-1), which enables operators to measure stereo separation on live programming without the use of test tones. Stereo audio can be tested in three places—at the 4.5 MHz TV stereo modulator output, at the 41.25 MHz/45.75 MHz TV modulator IF, and at the TV channel 3 output of a set-top converter. Applications include headend stereo alignment and proof of stereo performance at the subscriber's home. The CSPM-1 is battery operated and portable. It lists at $3,150. For more information, contact FM Systems at (800) 235-6960 or in Calif., (714) 979-3355.

Faraday Technology Ltd. has announced an expansion of its range of wide bandwidth delay lines developed for the high definition television (HDTV) market. Faraday's range of passive 30.0 MHz video delay lines is designed to delay 30.0 MHz bandwidth video signals with minimal distrotion.The maximum delay time of 100 nanoseconds has now been extended to 200 ns without cascading, which offers both high quality response and space savings. The range of eight lines, with delay times from 10 ns to 200 ns, can be further programmed in units of 2, 4, 8, 16 and 32 ns. All Faraday delay lines can be further cascaded to give a wider range of delay times. For further information, contact Faraday's exclusive U.S. distributor, RF technology, at (800) 762-4369.

New from **Signal Vision Inc.** is the QF F-fitting, which uses compression technology forming 360 degrees of contact between the cable braid and center post of the fitting to reduce RFI leakage. The QF fitting has completed 12 months of field testing, with full documentation available. The fitting uses bright tin plating for superior weather and corrosion protection, and a silver plated center post for high electrial conductivity and migrating properties. Also featured is a pull strength of 40 pounds and an operating frequency range of DC to 1.5 GHz. For free samples, literature, or more information, call Signal Vision at (714) 586-3196.

Cheetah, a new computer aided test-

ing system, has been announced by **Superior Electronics Group Inc.** The HE 4650 system monitors signal level and distortion measurements as well as AML hub site level and AGC voltage monitoring. An additional AFC frequency counter module is available as an option to the HE 4650, which measures CATV visual and aural frequencies. The Cheetah PC-4650-D has the added capability of FML hub site level monitoring. For more information, contact Superior Electronics at (813) 351-6700.

Telecorp Systems Inc. has expanded its line of telephone call processing products to include the Telephone Traffic Overflow Register. The product allows operators to monitor the exact number of calls lost because of busy signals and the time of the lost calls. For more info, call (800) 347-9907 or (404) 587-0700 inside Georgia. ■

—Leslie Miller

ADVERTISER'S INDEX

The evolution of on-screen guides

How do viewers decide what to watch on television? More importantly, how can we as an industry focus those decisions on cable programming?

Those are questions the industry has been asking for more than a decade, ever since cable programmers and systems alike recognized they had something competitive to offer viewers. We've been asking (and answering) those questions since long before the inception of Prevue Guide Channel.

Prevue is the latest, most technologically advanced of our on-screen guides, the result of more than nine years of research, development and marketplace experience in the psychology of choosing TV programming as well as the most efficient technology to deliver that information to cable TV households.

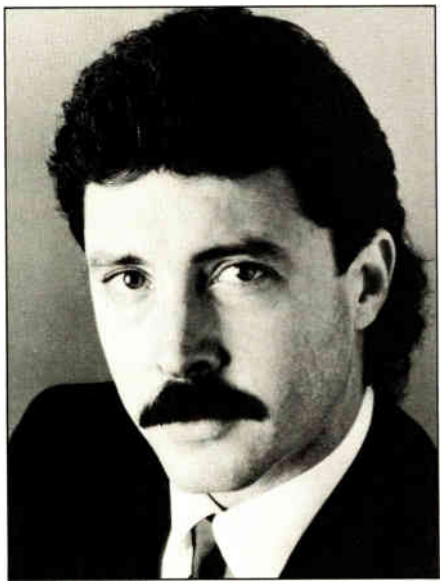
Today, newer technology and market research have combined to offer Prevue viewers in nearly 20 million cable homes a sophisticated, "point-of-purchase" on-screen guide to aid them in their program choices and to point them toward cable.

Pointing viewers

In fact, that is the key—pointing viewers toward cable programming when they're making program viewing decisions. Yes, today's on-screen guides perform a valuable service as information providers. But for cable operators, the function of guides is not simply to inform subscribers, but to entice them to sample the myriad of program choices available to them through cable. A service that can do that is worth the channel space to any cable operator serious about program promotion.

One that can improve subscriber satisfaction and help sell more services is a powerful advantage to the operator. And in today's increasingly competitive home entertainment marketplace, a service such as Prevue is not a luxury but a necessity.

Independent research has shown the value of video guides like Prevue. Malarkey-Taylor studies have shown a significant impact on viewership of basic and pay channels, as well as a higher propensity to order pay-per-view as a result of viewing Prevue. One such study revealed that among frequent users of the service, almost 76 percent of viewers were encouraged to watch their pay channel more often. That leads to subscriber satisfaction and decreases pay churn, the bane of premium channel marketers on the system and programmer level. Similar research showed that almost 70 percent of subscribers indicated Prevue was "very or somewhat important" in helping decide what to watch on TV.



Joe Batson

Where do guides go from here?

If video guides are the 1990 state-of-the-art, what's next? What about interactive guides? We believe so strongly in their eventual usage in the marketplace that we're actively involved in research and development in this area. But interactive guides, from which subscribers can access category or "mood-specific" programming information at the touch of a button, will never replace video guides.

Instead, they will augment the information that is already available in several different forms. To think interactive guides are the end-all solution to program listings for cable viewers is naive, and exhibits a lack of understanding of how people choose what they watch on TV.

Our extensive viewer behavior research has clearly demonstrated that people use more than one source of programming information to select their viewing. Accessability, accuracy and amount of information are among the reasons for this, but more than any other factor, it is convenience that dictates usage.

This convenience factor has created tremendous viewer acceptance of Prevue and has enabled the service to deliver, via video, impactful program promotion spots that expose viewers to a cable sales pitch while they are in the information-seeking mode.

What does the future hold? Certainly interactive guides will become a fixture in the electronic landscape in the future, but traditional patterns of consumer acceptance of new technologies indicates it will be later rather than sooner.

The younger half of the video generation (i.e., the children of Baby Boomers) is growing up. They're more comfortable with the kind of technology that would bring interactive guides into wider usage. But they're also becoming more accustomed to the ease of use and convenience of video as well as printed guides.

Embracing interactive guides as the all encompassing answer to programming information is akin to building a car with one wheel. Effective promotion is built on a solid mix of elements, not on a single component. Interactive guides will have to prove their effectiveness in showcasing cable's wares, in increasing cable viewing and improving satisfaction with cable service. Only then can they take their place as a component of cable's program information mix. ■

Editor's note: *The above is an editorial inspired by a column written by Dr. Walter Ciciora of American Television and Communications in the May 1990 issue of* CED *(see pg. 138). The opinions expressed do not necessarily reflect those of* CED *magazine.* CED *invites readers to respond to articles and commentary appearing in the magazine.*

By Joe Batson, VP and COO, Prevue Networks Inc.

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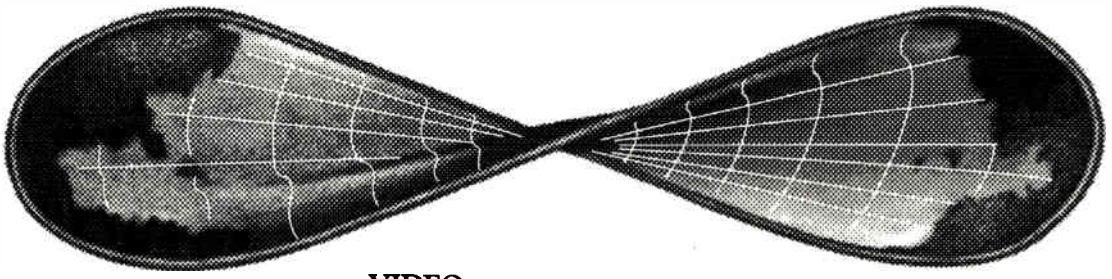
You will develop and implement systems for the powering of environmentally hardened electronics cabinets and underground enclosures. A BSEE and 5+ years' experience in remote power systems operated from the secondary distribution network for the RF and/or CATV industry are required. You must be familiar with NEC and NESC. Knowledge of standards and requirements for Europe is desirable. Please respond to Job Code: PSE.



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You will be involved in the development of environmentally hardened RF electronics cabinets, environmentally hardened RF electronics and cable enclosures as well as standard 19" rack equipment. An AS and 3+ years' experience in electromechanical engineering technology are necessary. Good planning, organizational and documentation skills are required. You also must be capable of performing thermal, EMC and mechanical testing under the direction of an engineer. Strong communication and interpersonal skills are essential. Please respond to Job Code: EMT.

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You will define performance criteria for fiber optic based video transmission. You will also perform lab experiments and theoretical calculations as well as analyze data to determine overall performance. Interface with Marketing/customers in system definition will be involved. You must be familiar with electro-optic systems, communications theory, modulation techniques, and systems distortion mechanisms. A BSEE (MSEE desirable) and 4-6 years' directly related experience are required. Please respond to Job Code: VSE.

RF DESIGN ENGINEERS

You will design and develop low noise, low distortion RF circuits and components for fiber optic based communication systems. A BSEE with 8+ years' experience in RF and analog circuit design are necessary. Component level RF design in the UHF frequency band is desirable. Please respond to Job Code: RFE.

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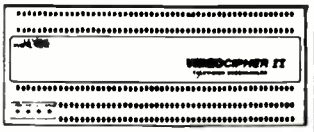

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Video compression in cable-TV

As of this writing, the public has not yet seen video aggressively compressed in real-time on a system prototype. Let's be clear about this. I don't mean computer simulations. I mean analog video going into a reasonably sized box of electronics that could be sold for a reasonable price. This signal then is modulated onto an appropriate carrier, passed through a transmission system, and demodulated, decoded, and converted into analog form for display. This should be done with a small number of small-sized printed circuit cards populated with a small number of large scale, special purpose integrated circuits. By "real-time," I mean a constant stream of viewable video going in and a constant stream coming out at the same rate. One final caveat—the observer gets to choose the video: a videotape of his own choosing or a video camera.

Some of us have been privileged to see aggressively compressed real-time video. About the only thing that can be said without breaking confidentiality agreements is that video compression must be taken seriously by the cable industry.

By Walter Ciciora, Vice President of Technology, American Television and Communications

The DBS application

The DBS application is rather straightforward. Video compression is the way out of a bandwidth limit that has made any potential DBS service a weak sister to cable. With 4-to-1 compression, 5-to-1, or even 8-to-1, a reasonable sized satellite can deliver enough video to satisfy most appetites. Because DBS is inherently consumer electronics unfriendly, the addition of a decompression box constitutes no further encumbrance. A separate box has always been required for each TV and VCR which is to be tuned to a different program.

The cable application

Consider a cable system hybridized with fiber to produce a 1 GHz bandwidth. This contains about 160 channels, each of 6 MHz bandwidth. We can consider segmenting that bandwidth into sections to carry three types of signals for at least four applications.

First and foremost, let us not forget good old NTSC. There are 200 million NTSC receivers out there now and they're growing at the rate of about 22 million per year. There are about 70 million NTSC VCRs. Every year's new batch is better, cheaper and longer lasting than the last year's product. This population deserves at least 60 of our channels. Let's serve these existing NTSC products in a consumer electronics friendly way. Let's make it easy for our subscribers to get maximum enjoyment from their hardware investments.

Next, let's consider HDTV. It is safe to assume that HDTV will be expensive and slow to grow. But let's also assume that cable subscribers will be early adopters and want their signals from us. Let's be generous and allocate 30 channels for the simulcast HDTV system the FCC may select in 1994. Best guess is that the first HDTV product will go on sale in 1995. Thirty channels will please that market.

This leaves us with 70 6 MHz channels. Let's be aggressive with these. Let's apply 5-to-1 video compression. That yields 350 channels. Consider two applications for this capability: impulse pay-per-view (IPPV) and switched video.

Such a large bank of channels will make a very special form of PPV possible: Near Video on Demand (NVOD). In this case, the most popular movies are repeated on several channels. If the repetition rate is every half hour, a subscriber may have to wait, on the average, 15 minutes for the movie to begin. That's less time than a trip to the video store. If a break is needed because of an interruption, a microprocessor can easily keep track of which channel to return to so as not to miss any of the movie.

The number of channels allocated and the repetition rate are marketing decisions. They don't have to be the same for all movies. The 10 most popular movies may have relatively short repetition rates with correspondingly large numbers of channels allocated. Special interest subjects may be played only once a night or once a week. The VCR, with suitable electronic assistance, can time shift for these categories. The most popular movies may be treated so that they cannot be recorded. Perhaps a higher fee would be charged for the right to record.

Recall that the technology which made the 1 GHz bandwidth possible was fiber. The fiber topology feeds a modest number of homes per fiber, perhaps 200 or 300. If "switched video" becomes important, this kind of architecture and these technologies can provide switched video very cost effectively. If switched video never becomes commercially important, we have all the more channels for NVOD, HDTV, or good old NTSC.

Since PPV, NVOD and switched video are all special services with premium prices, only one decompression box will likely be needed per home. A clear future of this approach is that the cost of the extra hardware is only incurred for a subscriber who will bring extra income. The major cost of a decompression box only comes when a revenue opportunity has been generated.

More important than HDTV?

There are several reasons to believe that compressed video will become more important than HDTV and do this sooner. The most important is that in situations of choice between better video quality and larger video quantities, consumers have taken the "more" option almost without exception. The second reason is that consumers already have NTSC equipment. They don't have HDTV hardware. Finally, a decompression box will be orders of magnitude less expensive than an HDTV receiver. It will provide a new life to PPV, make NVOD possible, and quickly pay for itself. ■

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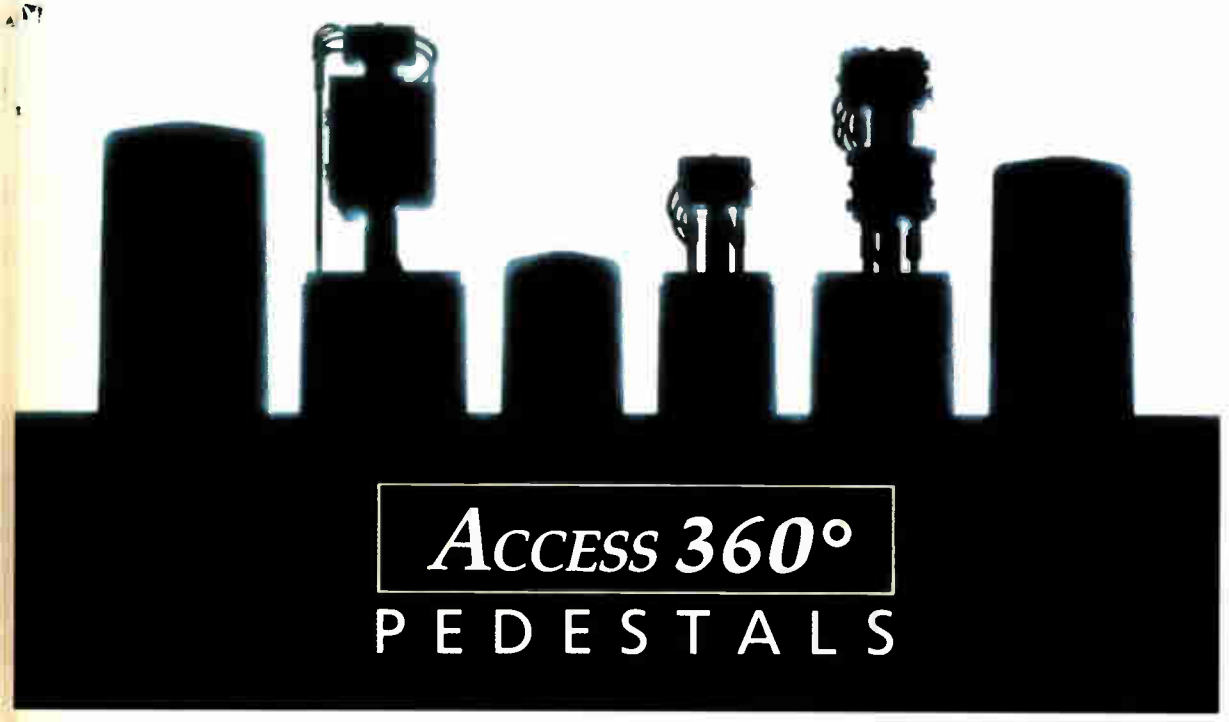

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