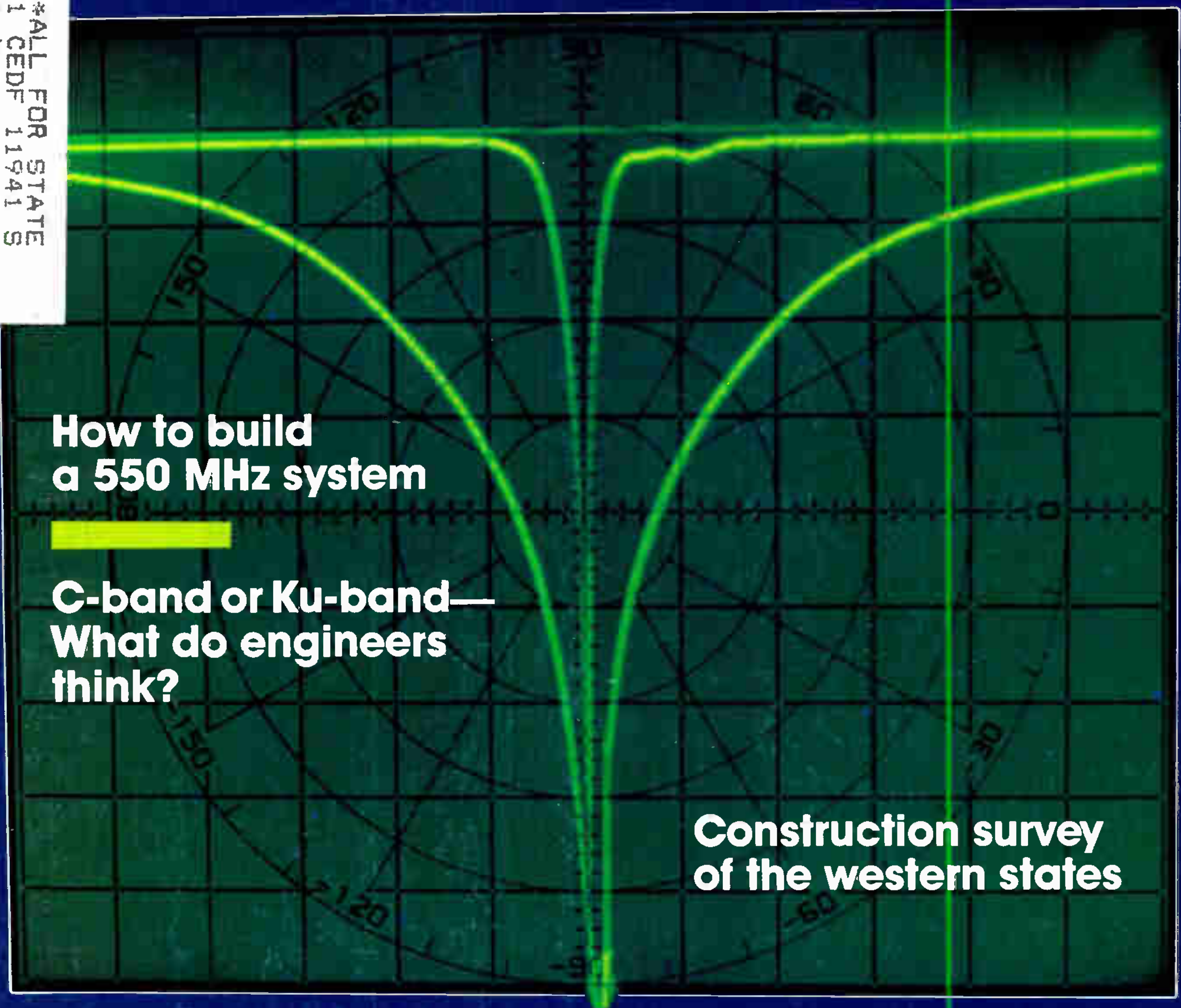
AUGUST 1987

COMMUNICATIONS ENGINEERING AND DESIGN
THE MAGAZINE OF BROADBAND TECHNOLOGY

CED

Denial systems: The shape of the future?



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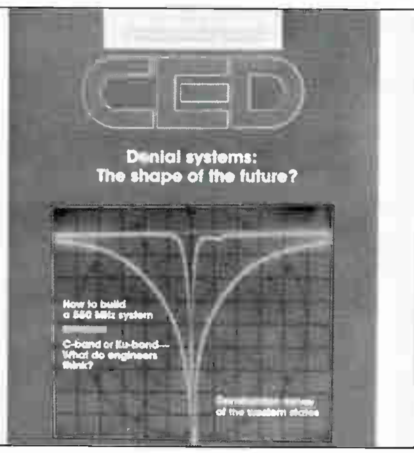
CED

August 1987 Volume 13, Number 8

About the cover
Scientific-Atlanta's new positive trap features a radically improved notch. The cover shows a traditional notch and the new trap's performance.



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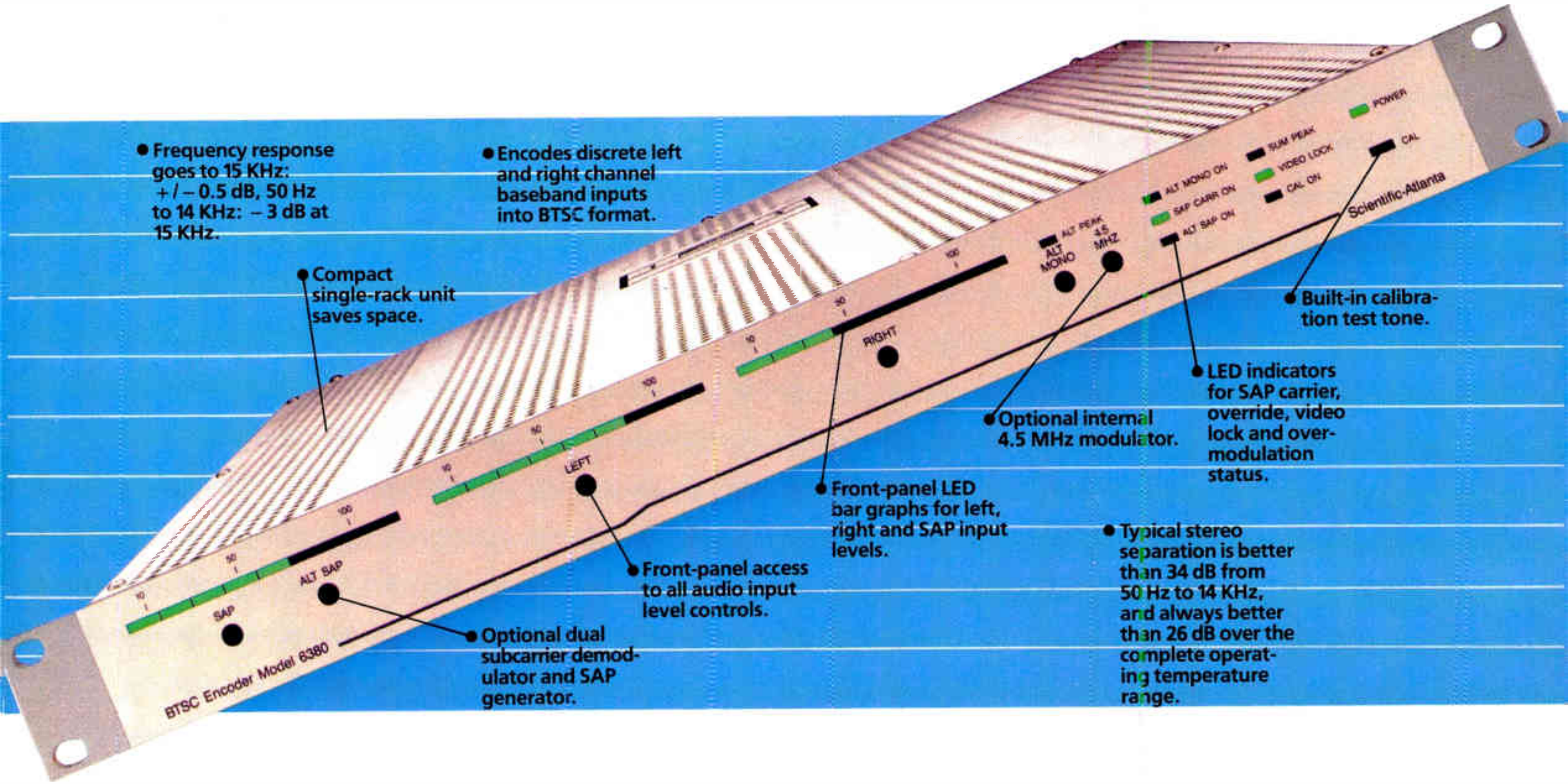

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Circle Reader Service No. 3


Tom Martin

Martin's R&D effort has industry converting

To a newcomer, the cable industry's technical community must appear to be a confusing hodgepodge of opinions, viewpoints and approaches with no clear-cut, definitive method to attack the same problems. To a subscriber equipment manufacturer, the industry's uncertainty of addressability and the raging debate over in-home vs. out-of-home deployment of products takes the task of product development to a new pressure level.

So, when you put the two together and wind up with a newcomer in charge of product development, all hell could break loose. Or, as in Tom Martin's case, new, fresh approaches to old problems could lead to a company's resurgence.

Martin's abilities brought him to the top of Tocom's engineering department on a fast track. As director of research and development for the lesser-known division of General Instrument, Martin is chiefly responsible for making the Tocom set-top descrambling converter one of the most popular.

After receiving his master's in electrical engineering from Cornell University in 1973, Martin was hired by the Collins Radio Division of Rockwell International in Dallas. While there, he concentrated on circuit design for terrestrial microwave equipment, but got to "play with everything from low-frequency audio up through the microwave frequencies," he says.

In 1981 he was lured to Tocom by a technician friend who urged him to make the jump to cable. Martin, intrigued by the talk of interactive systems and the company's growth potential, jumped in with both feet. Although the industry has changed a lot in the last six years, Martin remains happy with his role at Tocom. "It's a challenge to develop simple, cost-efficient, yet elegant products," he says. "The challenge of getting the most performance out of the simplest circuit intrigued me then, and it still does."

As manager of RF engineering, one of Martin's first projects was designing the 5503 converter, a second iteration of the firm's baseband box. Since then, the 5503 family of converters has sold more than 1.2 million units by integrating an ever larger number of features into a shrinking enclosure. It is that product line that Martin remains most proud of.

In 1984, Martin was named director of R&D and presently oversees the work of the RF Group (which does the RF and analog design work), the Systems Group (digital hardware, custom ICs and firmware), the Software Group (control systems) and Engineering Services (documentation).

Despite his lack of years, Martin has the uncanny ability to view the marketplace, determine what its needs are and respond accordingly. Consequently, features like impulse capability, volume control, parental control and VCR timing circuits have been added to Tocom's product. The result has been large orders for 5503-VIPs from MSOs owning systems in Dallas, Fort Worth, Queens, Philadelphia and Toledo, Ohio, to name a few.

Never one to rest on his past achievements, Martin remains concerned about the challenges that continue to face cable. Among his primary questions are: What does the industry need to do to prepare for High Definition Television? How can the consumer interface problem best be overcome? What can cable do to offer high quality premium audio services? How big is the impulse pay-per-view business and how much farther will interactive services go?

"Consumers are becoming more aware of what quality audio and quality video is and they will demand more quality in the future," warns Martin. "Cable equipment providers and operators need to rise to that demand." The arrival of enhanced picture quality via improved VCR design (see In Perspective, pg. 16) may indeed force cable operators to place more emphasis on delivering high quality signals to the home. And for operators serving large urban markets where broadcast signals are of good quality, the pressure to deliver good, clean signals is even greater. Consequently, present operating and design practices ought to be re-examined, suggests Martin.

But those same competitive forces ought to be driving more research work, says Martin. "The level of commitment to research and development by the industry is good," he says, "but there should be more done in the area of true research rather than design and development of previously released products. Some real good basic research could go a long way toward keeping cable competitive as these new technologies hit the marketplace. But I also believe cable will rise to the challenges."

As proof of his last statement, Martin points to the EIA MultiPort device as a prime example of what can occur when the cable industry joins with consumer electronics interests to settle on a way to get over the interface issue. Now that a subcommittee within the NCTA Engineering Committee has been formed to examine the ramifications of HDTV, perhaps that looming threat will instead become cable's greatest asset.

In the meantime, Martin will continue toiling in his Dallas labs, quietly churning out new products and enhancements to make a cable operator's life easier. He may be a newcomer, but his marketing and engineering prowess belie that fact.

—Roger Brown

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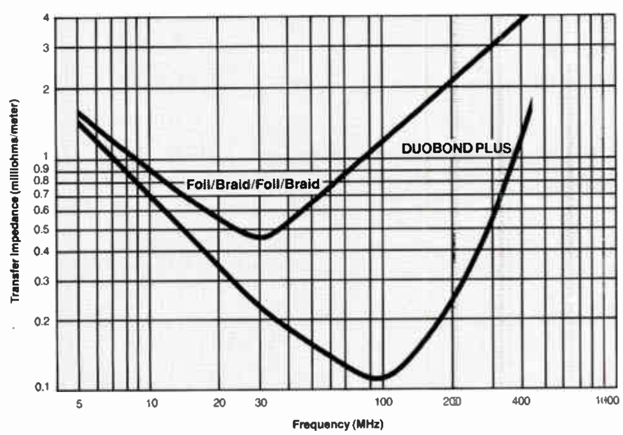

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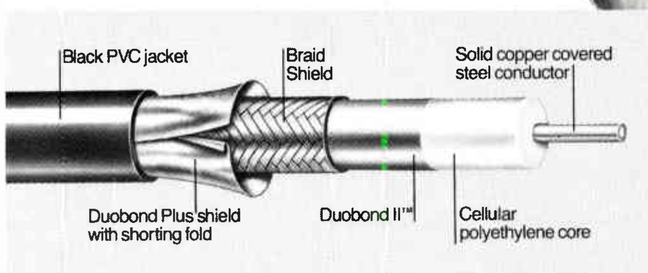

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Reader Service Number 4

The view from Montreux

With 2,000 registered symposium participants and more than 30,000 exhibition visitors, the 15th biennial International Television Symposium and Technical Exhibition in Montreux, on Switzerland's beautiful Lake Geneva, must be one of the largest gatherings of TV technical personnel in the world. Three full days were dedicated to broadcasting and three to CATV. The enormous Exhibition Hall was constantly crowded. Roughly 85 percent of the exhibit space was occupied by TV production facilities, led by Sony, Ampex and Panasonic. Not more than 10 percent was used for transmission hardware, for either broadcasting or cable. The remainder involved test equipment, publications and other related products. There were no programming software displays; it was all technological.

The focus of the exhibition, as well as the broadcast segment of the symposium, was HDTV and the MAC family of component television signal techniques. Contention between the 1125/60 Hz and the MAC/50 Hz proponents provided some memorable moments of controversy in the broadcasting symposium. Sony managed to dominate the exhibition, partly with one of the largest displays, featuring a New Orleans jazz trio. Panasonic countered with a colorful floor show in which leggy beauties, all decked out in Star Trek style, performed dance routines in Jazzercise rhythms.

In a separate sideshow, entitled, "HDTV Par Excellence," Sony exhibited a mobile HDTV production facility; NHK displayed a baseball game on the wide screen, recorded in the MUSE format after actual multi-hop terrestrial transmission; and GE used its light-valve projection system to display HD video on a screen nearly nine feet high by 16 feet wide.

I find the wide-screen display exciting. It is as though the blinders have been removed, opening up new scope for peripheral vision. Pictures were clean, no artifacts, even after complex transmission and recording processes. Moreover, the motion distortion problem was virtually undetectable, even at close viewing distances.

However, if the pictures actually had detectably higher definition, it was not sufficiently noticeable to be impressive. An Australian broadcaster commented that no matter how high the definition, producers would generally soften the pictures for artistic reasons. Could it be that there is an aesthetic optimum definition; that high resolution is not necessarily better, so long as the picture is clean and noise-free?

According to the little-known Taylor Principle, proclaimed some 30 years ago in the Montana valleys, television does not have to be good; just better than it was. If you are accustomed to pictures with 25 dB C/N, ghosts and fading, a solid 30 dB picture with only a few weak ghosts looks "good." But if you are accustomed to a ghost-free picture at 45 dB C/N, it will take something as dramatic and easily detected as the wide screen to attract attention. Engineers will step up close and look at the test pattern wedges to see how much more resolution there is. But the typical viewer is likely to see only a better picture than he has ever seen before, without knowing that it is better because it is free of artifacts, scan lines are not visible, and it may even seem sharper. In fact, it probably will be sharper, but only if the origination facilities (camera, lenses, VTR, transmitters, antennas, microwave, modulators, transponders, receivers, *et al*, actually send out sharper picture signals which have not been deliberately "softened" for aesthetic effect or degraded in transmission.

Wide-screen, clean pictures will be noticed and hailed as improvements. "High definition," i.e. "resolution," is only one aspect of a "clean picture" and not even the most apparent; at least not on conventional size 20- to 29-inch TV sets with screens 12 to 18 inches high.

In 1945, Major Edwin Armstrong promoted FM radio broadcasting as a "high fidelity" medium. For two or three decades, however, FM radio licenses were acquired with only a faint hope of eventual profitability. Telephone lines equalized to 15 or 20 kHz were hard to obtain. The few available high fidelity musical transcriptions could not come close to filling the broadcast day. Too many FM receivers that moved onto the market were low-cost versions, with inadequate limiting, no AFC, tiny loudspeakers and audio systems that could make a telephone handset sound good by comparison. Advertisers merely laughed. FCC authorized SCA (subsidiary communications authorization) in order to allow FM broadcasters to obtain revenue from background music and other ancillary services. Stereo FM was authorized to enable FM broadcasters to offer something new to attract viewers and advertisers.

Had FM radio been promoted in the 1950s on the basis of its other most valuable characteristic, freedom from interference, it might well have taken over the foundering AM radio broadcasting industry without hindering its inherent high fidelity capability. FM radio is not subject to sky-wave interference and is as easily received at night as during the day. With a few exceptions in major cities and university towns, FM audiences and advertisers today are attracted by personalities and musical fads far more than by high fidelity. Thus it seems likely to be with high definition. Once the wide-screen, clean pictures without scan lines become commonplace, resolution will matter only to those viewers using very large screens at close viewing distance.

There was constant reference in the CATV Symposium to D-2/MAC, C/

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

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Reader Service Number 5

The futures of TV broadcasting, cable and telecommunications are not writ in stone.

MAC and D/MAC (but not B/MAC), as Europeans grope for a universally secure, single standard for DBS and CATV satellite transmission. They are hoping to avoid the politically chaotic situation that produced the backyard dish explosion in the U.S. If they succeed, however, it will probably be because of the tight control exercised by the PTTs and other government agencies over communications facilities. Everyone agrees that a single world-wide television standard would be preferable to the present multiplicity. The 1125/60 NHK standard is rapidly becoming *de facto* for production studios around the world (most of which are in the U.S.). However, the dream of a world-wide transmission standard appears unlikely.

A recurring theme in the symposium was the common European perception that the technical quality of American TV, and especially cable TV, (not to speak of the content) is clearly inferior to what they consider to be the much more professional European product. On the other hand, it was also evident that Europeans are presently hard at work generating new technology at costs that could only become reasonable and viable in the presence of high volume demand for which no evidence, or substantial government subsidies, exist. "Solutions looking for problems to solve."

I believe the European perception of American technical quality may be only partly factual. American quality is probably better than they perceive it to be (often viewed in hotels); and the high quality claimed by Europeans is sometimes more evident in the text of the voluminous regulatory standards than on the TV screens at home. Nevertheless, we do have plenty of room for improvement. Super-VHS and wide-screen videotapes are likely to force us to do something about it.

Papers presented at the CATV portion of the symposium were largely tutorial, providing historical background, explaining design techniques and philosophy, or analyzing trends. Not much original, creative work was presented.

Perhaps the most impressive presentations came in the special Highlight Session entitled "The Cold Winds of Change." Panelists, including NCTA President Jim Mooney, WPIX President L.J. Pope, Group W TV President (and Chairman of Group W Satellite Communications) W.F. Baker, BBC's B. McCririck and others, generally agreed that whether the winds were cold or warm depends on your own point of view. Television is changing our lives. We know what Afghan rebels look like and how they live. We can share, almost at first hand, the tragedies of the people of Beirut, and the life and time of the Russian people as we never could before television. Politics, eating habits and lifestyles are changing everywhere as television signals relayed by satellite bring us all closer together. There is no hiding place for accidents like the Challenger or Chernobyl.

The futures of TV broadcasting, cable and telecommunications are not writ in stone. Like living organisms, these industries must adapt to the changing environment or perish. Europeans tend to look toward the merging of the transmission facilities of television and telecommunications under government or joint "privatized" control, entirely dissociated from the program supply. In America, on the other hand, television programming and transmission are inseparably linked, under private control with limited government supervision; while telecommunications transmission operates under more intensely supervised private control, but in a common carrier mode with no responsibility for, or interest in, the content of the communications.

Satellite and fiber optics are changing this situation. Footprints do not recognize national boundaries. Transmissions suppliers must necessarily assume responsibility for programs. Public constituencies are no longer satisfied with the limited program fare provided by governments and are demanding greater choice and variety. Will American telephone companies get into the programming business? Will American cable TV surrender duplex telecommunications to the telcos? Will VCR or DBS or a telco fiber service drop make both cable TV and 130-channel "cable-ready" TV sets obsolete?

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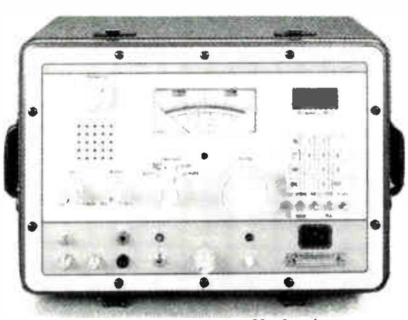

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Reader Service Number 7

WAVETEK®

frontline

Positive attitude key to service provider

In this column last month I spent some time talking about the frustration level that customers can achieve when certain everyday common occurrences transcend their preconceived notions of the level of service they should be getting from a service provider to whom they pay a monthly fee. The thoughts and ideas I expressed therein are based on 20 years of experience in the customer service business.

The vast majority of my customer service experience was not involved, however, with residential customers (as that term is used and meant in the cable television business) but with commercial and business customers instead. These customers were frequently paying monthly bills of staggering proportions. Indeed, it was not uncommon to have a customer (who was paying $20,000 or $30,000 a month) call the trouble line with the same attitude and concern as that customer of yours who is paying $10 or $15 a month.

This fact leads to the issue I would like to talk about this month: the attitude displayed by the person who receives a call or deals with a customer, be it residential or commercial, on the phone. It's very easy (I hope) to see that a business customer who has taken the trouble to pick up the phone and call the service department of a telecommunications service provider, such as AT&T or MCI, is in all likelihood not calling to say, "Gee, you guys do a great job, I've certainly enjoyed this month's worth of service and I am pleased to be sending in my check. Thanks a lot."

Customers don't call to congratulate you, they only call when they're unhappy with you. They're unhappy with you indirectly because of a breakdown in the service for which they are paying. The hardest thing I ever had to do in my time as a manager was to convince the people who answered the phones that even though they were under pressure to answer the phones promptly, collect a lot of data and keep a substantial record of every call in writing, and even though it may be half an hour past their lunch hour or an hour past quitting time and their car pool was honking outside, that the customers could detect whether or not the person had a smile on their face when they were talking to them on the phone. It's almost as if the customer could detect whether or not the person dealing with their problem was in a receptive mood to understand that the complainant had a problem and that the problem was serious to that customer.

I have never quite figured out how this smile, this attitude, communicates itself through a telephone line, but rest assured, it does. If you have anyone on your staff who answers the phone but cannot communicate an attitude of openness and interest and who is unwilling to try to generate a positive attitude which communicates itself through the telephone line you should talk to that person because, absent some direct view by the customer of a dispatcher or technician's face, the only thing most of our customers have to deal with in this situation is the voice and its quality over the phone line.

The other attitude that seems to communicate itself in some unusual way to our customers is competence. Callers quickly get a feeling about whether the person they are talking to has an idea at all about what the customer is talking about or what the potential problem might be. I, just like you, I'm sure, have more than once hung up the phone after talking to a service department somewhere and said to myself, "I wonder if that person understood what I was talking about and what my problems are?" Like you, I usually just wait and see. If my problem gets handled correctly, I'm a bit amazed that the problem got handled even though the person I talked to didn't demonstrate any competence over the phone. I don't know about you, but I would be distressed to think that most of my customers were amazed that their troubles were actually fixed. Our customers should demand and should be given an expectation that when they call in, their troubles will be handled competently and cheerfully.

While the articles and essays printed in this magazine by myself and others tend to concentrate on the basic business of pay TV for the home subscriber, most if not all of the things we have discussed are of importance in the area of enhanced services for business. When the commercial customer is involved, the issues of reliability, response time, employee competence and improving technology are more relevant.

It also goes without saying that the general level of technical understanding of commercial customers is higher than that of the average residential customer. This means that non-specific responses to the question, "What's wrong?" or "When will it be fixed?" will not be tolerated by a business customer who has paid substantial sums for service. We should strive to offer the same level of service to all of our customers.

In the next issue, I'll share a case study of the efforts of a cable system to get into the commercial business and the issues and actions they had to deal with. The way in which this company identifies and attacks the relevant areas is instructive for us all.

By Wendell H. Bailey, NCTA, Vice President, Science and Technology

in perspective

Super-VHS is the new standard

High definition TV may or may not get here anytime soon. It may or may not represent a unique marketing opportunity for CATV. But extended definition TV will be commercially available this year and will confront the CATV and broadcasting industries—and the existing standard VCRs—almost immediately as a new standard of picture quality.

Super-VHS, using a technique called high-band recording, is a quantum leap in VCR technology. Just how big a leap? Early tests indicate it will almost double the resolution obtainable from current VHS recorders, the best of which now deliver between 220 and 240 horizontal lines. S-VHS will deliver 440. With resolution of that quality, S-VHS pictures will exceed even the quality of broadcast video, which runs something less than 350 horizontal lines of resolution. In fact, S-VHS will deliver pictures on a par with one-inch tape, observers say.

Super-V works by shifting the luminance information in a TV signal from 3.4 to 4.4 MHz to 5.4 and 7.0 MHz. By moving the luminance components to the higher frequency, JVC, the originator of Super-V technology, was able to expand the bandwidth allocated to luminance information. In today's standard VCRs the luminance information occupies 1 MHz; in S-VHS the bandwidth is 1.6 MHz. What that means is more picture detail and better resolution. Sony has used a related technique to improve the quality of pictures on its Beta decks (Super Beta, Hi-band Beta and extended definition Beta. Some industry wags believe the ED Beta format will deliver pictures even better than S-VHS).

Like conventional VCRs, S-VHS uses FM recording techniques and the same chrominance component recording technique. Audio recording remains unchanged. S-VHS will, however, transmit the chrominance (C) and luminance (Y) signals separately to specially adapted monitor/receivers, instead of combining them in the normal NTSC composite signal. That has several advantages. Cross-talk, dot crawl and other intermodulation artifacts are avoided.

What makes the new technology possible is a new type of videotape that is chemically similar to current VHS and Beta format tapes (cobalt-doped ferric oxide) but using smaller and more uniform magnetic particles that observers say pushes the outer envelope of current ferric oxide technology. Because ferric oxide tape is used, current video record and playback heads will coexist with S-VHS—at least to a point. Normally formatted VHS tapes can be played on the S-VHS machines. But S-VHS formatted tapes cannot be played on older, standard VHS machines.

Early reports indicate that S-VHS pictures will look better than standard VHS when played back on any available monitor/receiver. But they'll look even better on monitor/receivers that can take the Y/C component signal format. We understand that the actual Y/C interface used in component monitors isn't expensive and that production quantities of S-VHS machines will hit shelves in the United States sometime between the fall and Christmas, possibly at initial retail prices of $1,300 to $1,700 or so with a relatively rapid fall to a three-digit price.

VCR giants JVC, Sharp, Matsushita, Hitachi and Mitsubishi expect S-VHS to be the format of choice for most consumers in the future. What this all means is that the consumer electronics industry has once again upped the ante for the CATV and broadcast industries.

The question now is how soon S-VHS achieves significant market penetration. Not long, we'd guess. VCRs, being mechanical, are replaced at a much higher rate than monitor/receivers. That should give S-VHS a big boost into the replacement market as prices begin to fall.

Videophiles say S-VHS is the single biggest innovation in home video technology since the introduction of the VCR itself. We tend to think consumers are going to go crazy over extended definition TV. And we definitely think everybody who competes with S-VHS had better figure out quick how to compete with it.

The industry's growing recognition that better signal quality has to be delivered into the home is a big step in the right direction. And we tend to agree with some industry engineering leaders who say high definition and extended definition TV offer a unique marketing position for cable TV. However, we don't dismiss the thought, advanced by other technical leading lights, that consumers haven't even seen a good NTSC signal yet, and that once they do, they may not be willing to pay for true HDTV.

We think what they won't pay for, after they've seen S-VHS, is pictures run on cascades that are too long, with margins that are too low, on cable that has been spliced too often and hooked up to connectors that corrode. We don't think consumers will happily pay for pictures run on cascades that haven't been swept recently. We don't think they'll enjoy pictures run through amplifiers using the wrong pads or through eight-way taps when design specs only pass enough power for four drops.

S-VHS and plant improvements offer cable TV a marketing opportunity in the near term and leaves options open for HDTV in the future, should it develop quickly.

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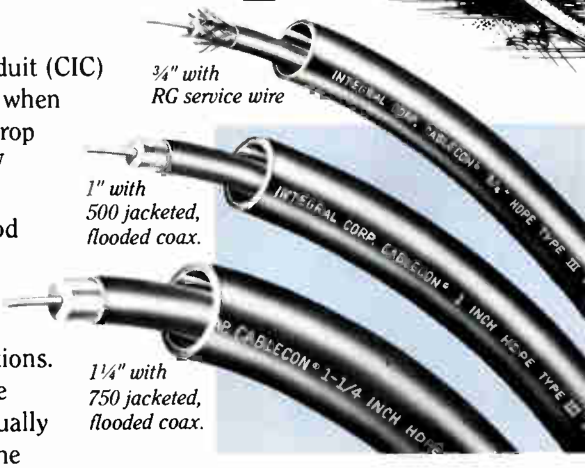

Cablecon Cable-in-Conduit (CIC) provides you with flexibility when installing trunk, feeder, or drop cables in underground CATV applications.

CIC is a low-cost method of protecting coaxial cables and can be universally used in trench, vibratory plow, and street cut applications.

Cablecon's polyethylene conduit is formed by continually extruding it as a pipe over the cable assembly ... permitting it to be manufactured to almost any desired length. Crush resistant, yet flexible, it is much easier to handle than PVC during installation ... greatly reducing installation time and overall labor costs.

Why direct-bury coax when you have Cablecon's added benefit of long-term protection, *plus* a lifetime "hole-in-the-ground" for future upgrading?

For complete information on CIC, drop-in-conduit, empty duct with pull-string pre-installed, or prelubricated conduit, contact Integral Corporation or Channell. Direct sales representatives and distribution facilities are located throughout North America.

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- Tampa • Los Angeles
- Toronto

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Reader Service Number 9

C-band or Ku-band?

South Florida cable operators have expressed concern with Ku-band rain fade based on preliminary experience. Florida's climate is severe enough although not unique in the United States. Figure 1 on page 26 of the June issue of *CED* illustrates that Florida has up to 100 lightning days a year. When we have lightning, it rains. It is not uncommon to have average rain rates of six to 10 inches per hour during short but severe thunderstorms. During the rainy season these storms form every afternoon like clockwork.

Past long-term experience with AML links in the state shows that rain fades continue to be a major problem that negatively impacts customer relations. Many systems in the state are backing up AML links with supertrunks. Short-term experience with Ku satellite links have produced outages in excess of 15 minutes on a 5-meter dish and we still are not into the rainy season.

The Florida SCTE Chapter, with the support of the state system operators and HBO, are in the process of instrumentating three to five Ku-band receive sites. We will be able to measure instantaneous rain rates and signal fade as a function of time during the upcoming rainy season and possibly on through the balance of the year. The data collected will be analyzed and presented in a report or series of reports with the expectation of being able to quantify the reliability of Ku-band.

Any system or organization in other areas of the country that would be interested in participation in the study would be most welcome and can contact me at the following address: J. Richard Kirn, Florida SCTE Chapter, P.O. Box 7835, Sarasota, Fla., 34278, (813) 924-8541.

J. Richard Kirn
Florida SCTE Chapter

After reading the article entitled "C-band or Ku-band: Which is better for cable?" in the June 1987 issue, I have the following comments:

Both articles were written by respective proponents of the two technologies, C-band and Ku-band. Each of them have substantial vested interests in furthering the acceptance of their satellite frequency choice. For this reason, their individual comments must be considered accordingly.

I would like to see articles on this subject written by impartial experts on satellite technology.

I also have the following requests:

A cost comparison between Ku-band and C-band equipment, uplinks, both fixed and transportable; cost comparisons of satellite space segment, Ku-band and C-band; and manufacturers of Ku-band and C-band uplink and downlink facilities.

John Palker
Pittsburgh

Numbers

I write this letter apropos Archer Taylor's column in the July issue of *CED* magazine (pg. 8).

I am given to understand that the reason that 51.5 ohms was a standard impedence for "hard line" rigid air dielectric coaxial line is that it used standard copper tubing or pipe sizes for both inner and outer, while 50-ohm line required fabrication of special diameter tubing for the inner conductor. Our test equipment collection still includes several "bullets" for interconnecting 50 and 51.5 line in 3⅛, 1⅝ and perhaps ⅞ line sizes.

When transmission line for high power and low loss applications began to be predominately Heliax or other continuously fabricated line, the cost difference disappeared.

I recall several years ago repairing a section of 1⅝ 51.5-ohm line in an AM directional plant. The line had been bent when a farmer mowing the field ran his tractor into the transmission line trough, mounted on posts about two feet off the ground. The AM plant in question was designed by one Archer Taylor.

Benjamin Dawson III
Consulting electrical engineer

I too am interested in origins of standards. Too many of them have been explained to me as "that's the way we've always done it."

There is a very easy explanation for 51.5 ohm transmission line. When rigid transmission line became necessary in the late 1940s for early TV and FM transmitters, RCA and other manufacturers used off-the-shelf copper tubing for coaxial transmission line. The combination of standard sizes for inner and outer happened to be 51.5 ohms.

Once there was sufficient demand for rigid transmission line to justify the tooling costs the inner tube was changed to a special size for 50 ohm line.

At 1⅝ inches the difference between 51.5 ohm and 50 ohm rigid coax is slight and a lot of older installations use the two interchangeably. At larger coax sizes (3⅛ inches and up) you need a special inner connector, "bullet," or a filler piece, "whiskey cup," to transition from one size to another.

There was no reason to develop rigid transmission line until TV and FM. Most AM transmitters until recently used either open wire balanced transmission line, open wire "coax" made up with an inner wire and four outer wires, or fed the antenna directly from the transmitter. Modern transmitters and directional arrays are less tolerant of impedence variations, variable losses in transmission line and have stricter radiation standards which has resulted in most of the open wire being replaced with coax.

Bill Ruck, NCE
Engineering Manager
KFOG, San Francisco

We're Listening!

Send in your letters to the editor of *CED*. Attention managing editor, Roger Brown, 600 Grant St., Suite 600, Denver, CO 80203.

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Innovation in Cost-Effective CARS-Band Microwave Technology

Turn your cable expansion goals into a working reality with MICRO-BEAM™, the Channel Master® CARS-band microwave relay system designed for cost-efficiency and flexibility...two important bottom line considerations in any cable expansion plan.

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Standard Equipment & Services

- **450 MHz Transmitter**
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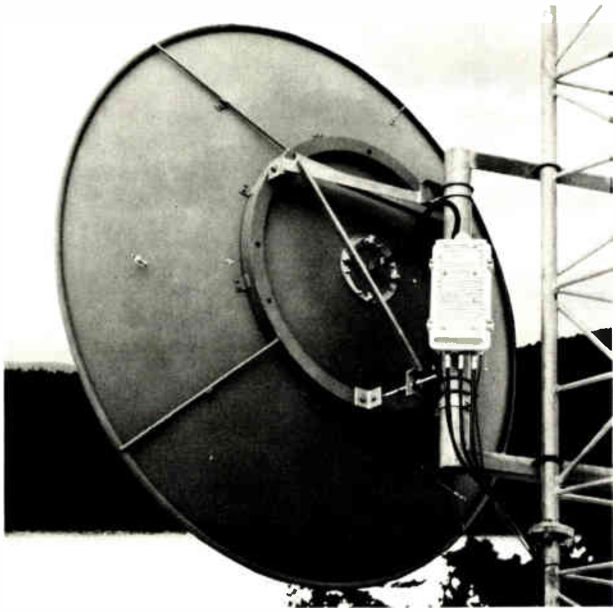
(In Continental U.S. Only)

That's why small cable operators, as well as some of the top MSO's like United Cable, Centel Cable, Cable Entertainment, Sonic Communications and Telescripts, use MICRO-BEAM™



as an alternative to the more expensive systems on the market today. They know that a MICRO-BEAM™ CARS-band system will put their money to work profitably.

Eliminates Additional Headends

MICRO-BEAM™ reaches isolated subscriber pockets and spans natural barriers without additional remote headends, adapting to your entire service including audio, video, data and addressability signals and commercial insertion capabilities. MICRO-BEAM™ also saves you that $500 per-channel descrambling cost by allowing you to descramble each channel at the main headend. In fact, MICRO-BEAM™ is so compact, it allows you to transmit from a weatherproof unit that mounts behind the antenna. It can even be mounted on water towers, and can be placed anywhere in your system, not just at the headend!

Two New Microwave Products

Channel Master® has added a new microwave repeater and microwave multiplier to its line of CATV equipment products for even greater CARS—band system expansion.

The new **Repeater**, available in 1 and 5 watts, is a low noise amplifier designed to consolidate transmitter and receiver functions, allowing microwave links to be cascaded or hopped without down-converting and then up-converting the signal.

The new **Multiplier** allows the systematic addition of microwave paths to a single transmitter location without utilizing tube type equipment. Also available in 1 or 5 watts, the new multiplier is designed with adequate gain to allow full output power over a wide range of input power, allowing microwave paths to be added as needed.

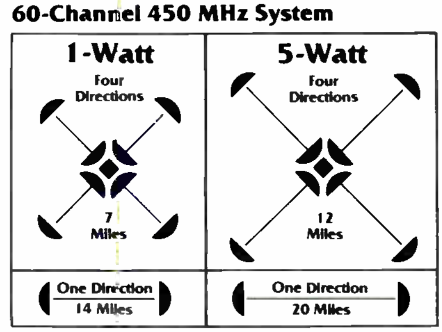
Versatility In Signal Delivery

36-Channel 300 MHz System

1-Watt: Transmits a fully loaded signal up to 9 miles in four directions.
5-Watt: Transmits a fully loaded signal up to 15 miles in four directions.

Sample Applications:

60-Channel 450 MHz System



Contact us today and let our staff of qualified specialists show you how flexible and cost-efficient your cable system expansion can be, now and in the future with MICRO-BEAM™.

Contact: Jim Crownover

Channel Master®

Division of Avnet, Inc.
Industrial Park Drive, Smithfield, N.C. 27577
(919) 934-9711

from the headend

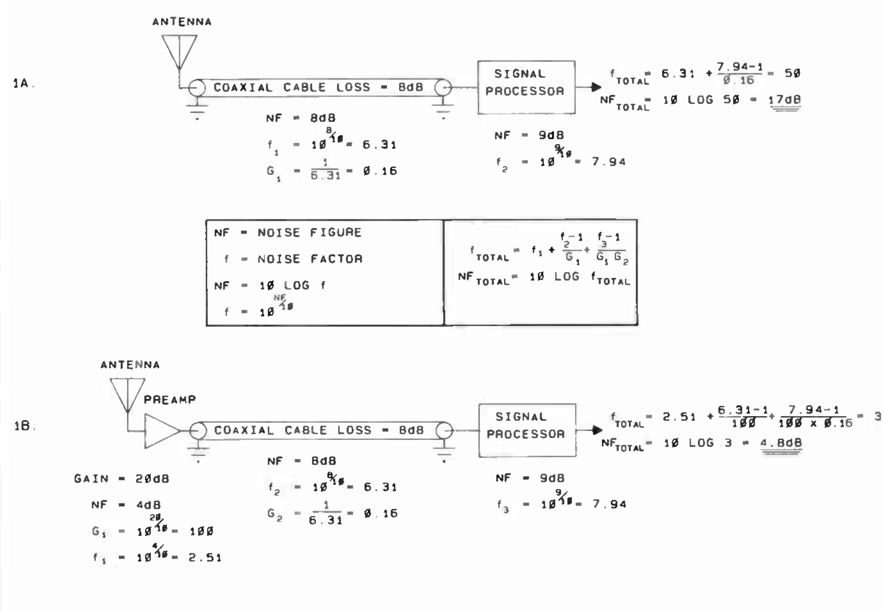
Noise figure and its application

This month we investigate the subject of noise figure as it relates to the headend, and examine how it affects the signal's noise performance. We also identify a simple step we can take to improve this performance; thus taking another step toward improving our signal in comparison with the competition.

The noise figure of a device is a measure of how much noise the device effectively adds to a signal passing through that device. In a perfect or noise-free amplifier for example, the signal-to-noise ratio at the output of an amplifier would be exactly equiv-

By Chris Bowick, Engineering Dept. Manager, Scientific-Atlanta

FIGURE 1



This month we investigate the subject of noise figure as it relates to the headend.

alent to the signal-to-noise ratio at the input to the amplifier. In the real world however, all amplifiers will add some amount of internally generated noise to the signal. As a result, the signal-to-noise ratio at the output of a practical amplifier will always be lower or worse than the input signal-to-noise ratio.

In a CATV headend, there are several areas where the noise figure of a device, or chain of devices, can drastically affect the signal-to-noise performance of the headend. The most notable of these areas of course is the LNA/LNB, which, by its very nature is intended to have a very low noise figure since it helps to set the C/N for satellite delivered programming. The LNB, the satellite receiver, and their interface cable are the subject of a future column. Another interface, which has become increasingly important in light of the recent A/B switch ruling by the FCC, is the equivalent interface for off-air broadcast applications: the signal processor or strip amplifier.

Figure 1 shows two possible methods for distribution of an off-air signal via a signal processor and the impact that each of these scenarios will have on the overall S/N quality at the output of the headend.

In both cases, the signal processor is located 400 feet from the off-air antenna. In Figure 1A however, the output of the antenna is fed directly into 400 feet of coaxial cable having a loss of 8 dB at the channel of interest. The signal processor, having a noise figure of 9 dB, combines with the loss of the cable, using the formula shown, to give an overall equivalent noise figure of 17 dB for the chain.

In Figure 1B, a preamp having a gain of 20 dB and a noise figure of 4 dB, is inserted at the output of the antenna and before the long run of coax. In this case, we see that the combined noise figure for the chain, which now consists of the preamp, coax and signal processor, is only 4.8 dB. This is only 0.8 dB worse than the preamp itself. In other words, placing the preamp with its high gain and low noise figure prior to the long run of coax has improved the noise figure, and ultimately the signal-to-noise ratio of the headend by over 12 dB. Of course, this argument assumes that the input signal level to the preamp has been measured to be sufficiently low so as not to overload either the preamp or the signal processor.

There are those who argue that it is the distribution plant, not the headend, that determines the ultimate signal-to-noise performance at the subscriber's drop. While this is true to an extent, it certainly doesn't mean that the headend should degrade system performance any more than necessary.

Construction survey of the western states

CED's final regional construction survey for 1987 is 65 percent complete and shows some surprising results. Activity in the western region seems to be as busy as the northeast. The western region includes the states of Arizona, California, Colorado, Idaho, Iowa, Minnesota, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington and Wyoming. The figures are based on the 1,037 cable systems surveyed by in-house staff, using questionnaires and follow-up telephone interviews.

Total figures for the year, based on a 79 percent return of approximately 6000 cable systems show that each region is basically equal in percentages of construction and addressability plans. Overall, statistics for the entire United States remain the same with 32 percent of the cable systems putting up new plant, 18 percent planning rebuilds of existing plant and 16 percent expanding their channel capacity within the year. Addressability and PPV plans are a little slower, with 21 percent of the systems currently addressable and 7 percent planning on going addressable in the future. Only 7 percent of the cable systems surveyed said they offered PPV, with an additional 14 percent planning PPV in 1987 and 1988.

As a reminder when looking over the western region results, the data on construction activity is based on a "number of systems in a range" basis. Therefore, when looking at the number of systems planning rebuilds in the 0 to 20 mile range, it is important to remember this is an estimate, and many of these estimates are on the low end of the scale.

CONSTRUCTION ACTIVITY

SUMMARY:

Miles	Newbuild aerial	Newbuild underground
0-20	130	117
21-50	19	20
51-100	5	4
100+	5	7

Miles	Rebuild aerial	Rebuild underground
0-20	62	57
21-50	22	11
51-100	13	6
100+	18	10

Channel Upgrades
# of systems = 91
10-34 channels = 29
35-37 channels = 20
40-47 channels = 7
50-56 channels = 11
60-80 channels = 0

Currently addressable systems
# of systems = 178
# of subs = 1,175,360

Systems going addressable in 1987
# of systems = 35
Anticipated new subs = 156,741

Pay-per-view
# of systems now offering PPV = 70
Additional systems to offer
PPV in 1987 = 25
Additional systems to offer
PPV in 1988 = 51

Arizona:

Miles	Newbuild aerial	Newbuild underground
0-20	7	5
21-50	2	4
51-100	1	0
100+	0	0

Miles	Rebuild aerial	Rebuild underground
0-20	1	7
21-50	4	0
51-100	2	1
100+	0	0

Channel Upgrades
# of systems = 5
10-34 channels = 2
35-37 channels = 1
40-47 channels = 1
50-56 channels = 0
60-80 channels = 0

Currently addressable systems
# of systems = 6
# of subs = 42,069

Systems going addressable in 1987
# of systems = 4
Anticipated new subs = 19,548

Pay-per-view
# of systems now offering PPV = 4
Additional systems to offer
PPV in 1987 = 1
Additional systems to offer
PPV in 1988 = 1

California:

Miles	Newbuild aerial	Newbuild underground
0-20	44	39
21-50	3	5
51-100	1	2
100+	1	3

Miles	Rebuild aerial	Rebuild underground
0-20	14	16
21-50	6	5
51-100	3	2
100+	11	7

Channel Upgrades
# of systems = 19
10-34 channels = 5
35-37 channels = 3
40-47 channels = 3
50-56 channels = 5
60-80 channels = 0

Currently addressable systems
# of systems = 65
# of subs = 638,216

Systems going addressable in 1987
# of systems = 10
Anticipated new subs = 67,898

Pay-per-view
# of systems now offering PPV = 39
Additional systems to offer
PPV in 1987 = 7
Additional systems to offer
PPV in 1988 = 20

Source: Cablefile Research, International Thomson Communications Inc.

No other switcher stacks up to the Panasonic® VCS-1.

If you thought all switchers were created alike you owe it to yourself and to your subscribers to compare any other switcher to the new VCS-1 from Panasonic.

Compare functions. If recording a pay channel while watching a basic channel is important to your subscribers, you should know that not all switchers can do it. The VCS-1 can. In fact, it lets your subscribers record any CATV channel while they watch any one of four video sources. Like a second VCR, video games, even a video camera.

Compare picture quality. Don't be surprised to find that every device will have a negative effect on the picture. On the other hand, the VCS-1 meets your high standards of quality with zero insertion loss and isolation of 65dB.

The VCS-1 is completely compatible with stereo signals and all non-addressable and one-way-addressable systems. What's more, it will also deliver your addressable signals, even when its power is turned off.

The VCS-1 also stacks up nicely with all other CATV components because its controls and indicators are located on the front panel. And they're soft-touch control. So you don't have to push the switcher off the shelf to activate the buttons.

The VCS-1. It represents the difference between a standard switcher and a Panasonic switcher.

For more information, contact:
Panasonic Industrial Company,
Video Communications Division,
One Panasonic Way, Secaucus,
NJ 07094. Or call:
East Coast: (201) 392-4109
West Coast: (415) 672-2592

Panasonic
Industrial Company

Reader Service Number 13

Colorado:

Miles	Newbuild aerial	Newbuild underground
0-20	9	8
21-50	2	2
51-100	0	0
100+	1	0

Miles	Rebuild aerial	Rebuild underground
0-20	3	4
21-50	2	1
51-100	0	0
100+	0	0

Channel Upgrades
# of systems = 7
10-34 channels = 2
35-37 channels = 1
40-47 channels = 0
50-56 channels = 1
60-80 channels = 0

Currently addressable systems
# of systems = 22
# of subs = 105,608

Systems going addressable in 1987
# of systems = 6
Anticipated new subs = 16,500

Pay-per-view
# of systems now offering PPV = 4
Additional systems to offer
PPV in 1987 = 5
Additional systems to offer
PPV in 1988 = 7

Idaho:

Miles	Newbuild aerial	Newbuild underground
0-20	5	2
21-50	1	0
51-100	0	0
100+	0	0

Miles	Rebuild aerial	Rebuild underground
0-20	5	0
21-50	1	0
51-100	0	1
100+	1	0

Channel Upgrades
# of systems = 3
10-34 channels = 0
35-37 channels = 2
40-47 channels = 0
50-56 channels = 0
60-80 channels = 0

Currently addressable systems
# of systems = 5
# of subs = 810

Systems going addressable in 1987
# of systems = 1
Anticipated new subs = 4,500

Pay-per-view
# of systems now offering PPV = 0
Additional systems to offer
PPV in 1987 = 1
Additional systems to offer
PPV in 1988 = 1

Iowa:

Miles	Newbuild aerial	Newbuild underground
0-20	5	6
21-50	0	0
51-100	0	0
100+	0	0

Miles	Rebuild aerial	Rebuild underground
0-20	2	3
21-50	0	2
51-100	2	0
100+	1	0

Channel Upgrades
# of systems = 4
10-34 channels = 1
35-37 channels = 1
40-47 channels = 0
50-56 channels = 1
60-80 channels = 0

Currently addressable systems
# of systems = 4
# of subs = 1,332

Systems going addressable in 1987
# of systems = 1
Anticipated new subs = 3,295

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Cable Services can do your entire construction job, including design and field engineering. But our responsibility doesn't end there. We're also a full-line supplier of everything from the head-end to the drop materials. If you need service, we have a complete repair facility. And, if you need something overnight, we'll get it to you. All of this means fewer headaches for you.

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Reader Service Number 15

Pay-per-view
# of systems now offering PPV = 1
Additional systems to offer PPV in 1987 = 1
Additional systems to offer PPV in 1988 = 1

Minnesota:

Miles	Newbuild aerial	Newbuild underground
0-20	7	7
21-50	5	3
51-100	0	0
100+	0	1

Miles	Rebuild aerial	Rebuild underground
0-20	6	3
21-50	1	1
51-100	1	2
100+	2	0

Channel Upgrades
# of systems = 10
10-34 channels = 4
35-37 channels = 2
40-47 channels = 0
50-56 channels = 2
60-80 channels = 1

Currently addressable systems
# of systems = 16
# of subs = 23,483

Systems going addressable in 1987
# of systems = 2
Anticipated new subs = 13,200

Pay-per-view
# of systems now offering PPV = 8
Additional systems to offer PPV in 1987 = 2
Additional systems to offer PPV in 1988 = 4

Montana:

Miles	Newbuild aerial	Newbuild underground
0-20	0	0
21-50	0	0
51-100	0	0
100+	0	0

Miles	Rebuild aerial	Rebuild underground
0-20	0	1
21-50	1	0
51-100	0	0
100+	0	0

Channel Upgrades
# of systems = 2
10-34 channels = 1
35-37 channels = 0
40-47 channels = 0
50-56 channels = 0
60-80 channels = 0

Currently addressable systems
# of systems = 6
# of subs = 3,281

Systems going addressable in 1987
# of systems = 0

Remember, back in 1951, when TV stations were low in power and antennas not very efficient? Milton Jerrold Shapp, the founder of Jerrold, didn't realize he was helping to create a new industry when he developed an amplifier that Bob Tarlton needed for his Lansford, PA community antenna system.

Cable was new, but it grew rapidly. And Jerrold grew with it, developing improved amplifiers, channel equipment, and numerous innovations that increased revenue potentials for operators, and established Jerrold as the leading supplier in the industry.

Remember when 20, 12 - even 5 channels were your maximum potential? Now...

Rebuilding? Save Money With JERROLD

Expand the bandwidth of your system - and your revenue-producing channel potential - simply by dropping in Jerrold STARLINE® SJ-330 modules. This quick and easy upgrade to 330 MHz can help you maximize your revenues and requires:

- No respacing of trunk amplifiers
- No major equipment costs
- No prolonged construction

Regardless of the make or vintage amplifiers now in your system, Jerrold can show you how to rebuild economically. If you have STARLINE 20 equipment, you'll realize the biggest savings with Jerrold STARLINE SJ-330 drop-ins. Other amplifiers can be replaced easily and economically by a complete STARLINE SJ-330 station. Detailed information on what you will need and what savings you can achieve is contained in a new Jerrold STARLINE 20 SJ Series brochure - yours for the asking.

And Jerrold has other possibilities for you too. For longer cascades and greater channel capacity, there's Jerrold STARLINE X feedforward and power doubling amplifiers. Whatever your specific needs, there's a reliable, low-cost Jerrold product to satisfy them.

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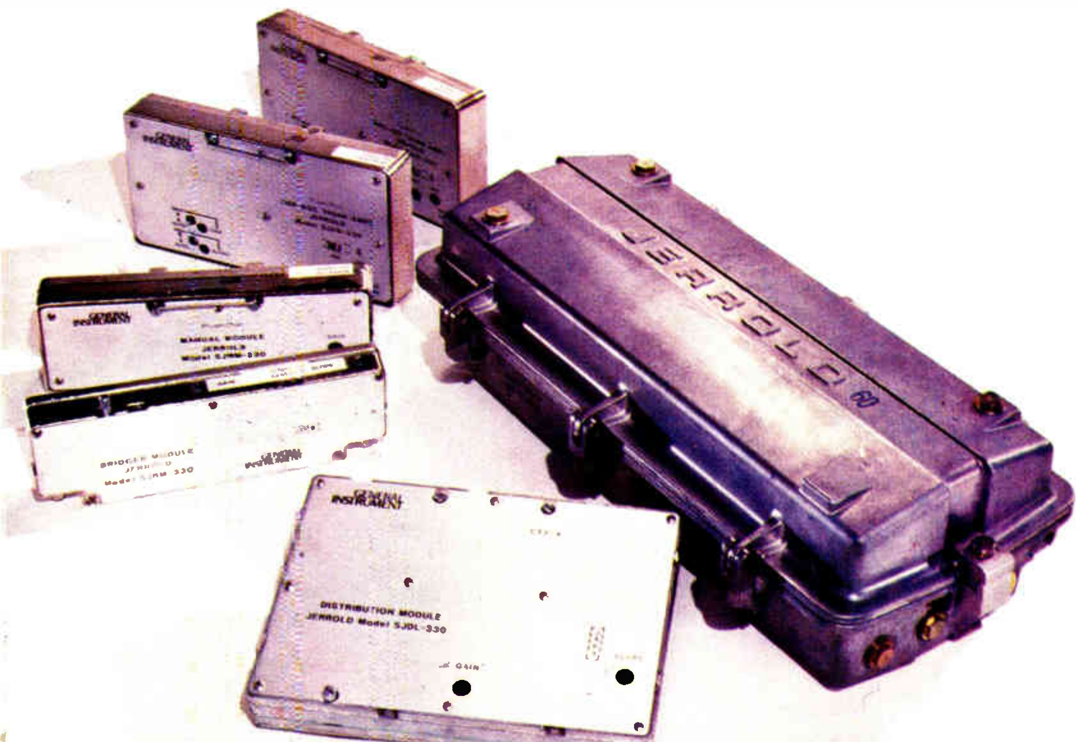
You know we'll be there.



GENERAL INSTRUMENT

Reader Service Number 17

Anticipated new subs = N/A

Pay-per-view
# of systems now offering PPV = 1
Additional systems to offer
PPV in 1987 = 0
Additional systems to offer
PPV in 1988 = 0

Nebraska:

Miles	Newbuild aerial	Newbuild underground
0-20	0	3
21-50	0	1
51-100	0	0
100+	0	0

Miles	Rebuild aerial	Rebuild underground
0-20	2	0
21-50	0	0
51-100	0	0
100+	1	0

Channel Upgrades
# of systems = 2
10-34 channels = 1
35-37 channels = 0
40-47 channels = 0
50-56 channels = 0
60-80 channels = 0

Currently addressable systems
# of systems = 3
# of subs = 17,582

Systems going addressable in 1987
# of systems = 0
Anticipated new subs = N/A

Pay-per-view
# of systems now offering PPV = 1
Additional systems to offer
PPV in 1987 = 1
Additional systems to offer
PPV in 1988 = 2

Nevada:

Miles	Newbuild aerial	Newbuild underground
0-20	4	3
21-50	0	2
51-100	0	0
100+	0	0

Miles	Rebuild aerial	Rebuild underground
0-20	0	3
21-50	2	0
51-100	0	0
100+	0	0

Channel Upgrades
# of systems = 3
10-34 channels = 0
35-37 channels = 0
40-47 channels = 1
50-56 channels = 1
60-80 channels = 0

Construction marketplace

Reader Service Number 19

Reader Service Number 43

Reader Service Number 40

Reader Service Number 44

Reader Service Number 41

Reader Service Number 45

Reader Service Number 42

Reader Service Number 46

Currently addressable systems
# of systems = 3
# of subs = 75,002

Systems going addressable in 1987
# of systems = 0
Anticipated new subs = N/A

Pay-per-view
# of systems now offering PPV = 1
Additional systems to offer
PPV in 1987 = 0
Additional systems to offer
PPV in 1988 = 0

New Mexico:

Miles	Newbuild aerial	Newbuild underground
0-20	9	5
21-50	0	0
51-100	1	0
100+	0	0

Miles	Rebuild aerial	Rebuild underground
0-20	4	1
21-50	1	1
51-100	1	0
100+	0	0

Channel Upgrades
# of systems = 4
10-34 channels = 0
35-37 channels = 2
40-47 channels = 2
50-56 channels = 0
60-80 channels = 0

Currently addressable systems
# of systems = 7
# of subs = 14,244

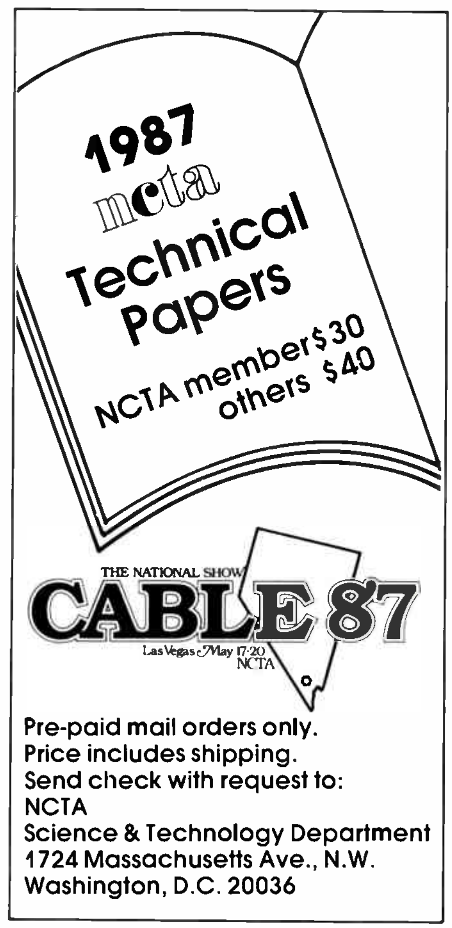
Systems going addressable in 1987
# of systems = 0
Anticipated new subs = N/A

Pay-per-view
# of systems now offering PPV = 2
Additional systems to offer
PPV in 1987 = 1
Additional systems to offer
PPV in 1988 = 1

North Dakota:

Miles	Newbuild aerial	Newbuild underground
0-20	2	2
21-50	0	0
51-100	0	0
100+	0	0

Miles	Rebuild aerial	Rebuild underground
0-20	1	1
21-50	0	1
51-100	1	0
100+	0	0



Channel Upgrades
# of systems = 4
10-34 channels = 2
35-37 channels = 0
40-47 channels = 0
50-56 channels = 0
60-80 channels = 0

Currently addressable systems
# of systems = 5
# of subs = 11,490

Systems going addressable in 1987
# of systems = 0
Anticipated new subs = N/A

Pay-per-view
# of systems now offering PPV = 2
Additional systems to offer PPV in 1987 = 0
Additional systems to offer PPV in 1988 = 3

Oregon:

Miles	Newbuild aerial	Newbuild underground
0-20	10	9
21-50	0	0
51-100	0	0
100+	0	0

Miles	Rebuild aerial	Rebuild underground
0-20	9	9
21-50	2	0
51-100	2	0
100+	1	0

Channel Upgrades
# of systems = 8
10-34 channels = 3
35-37 channels = 3
40-47 channels = 0
50-56 channels = 0
60-80 channels = 0

Currently addressable systems
# of systems = 8
# of subs = 95,868

Systems going addressable in 1987
# of systems = 4
Anticipated new subs = 1,400

Pay-per-view
# of systems now offering PPV = 2
Additional systems to offer PPV in 1987 = 2
Additional systems to offer PPV in 1988 = 4

South Dakota:

Miles	Newbuild aerial	Newbuild underground
0-20	1	1
21-50	0	0
51-100	0	0

100+	0	0

Miles	Rebuild aerial	Rebuild underground
0-20	1	0
21-50	0	0
51-100	0	0
100+	0	0

Channel Upgrades
# of systems = 1
10-34 channels = 0
35-37 channels = 1
40-47 channels = 0
50-56 channels = 0
60-80 channels = 0

Currently addressable systems
# of systems = 4
# of subs = UKN

Systems going addressable in 1987
# of systems = 1
Anticipated new subs = UKN

Pay-per-view
# of systems now offering PPV = 0
Additional systems to offer PPV in 1987 = 1
Additional systems to offer PPV in 1988 = 0

Utah:

Miles	Newbuild aerial	Newbuild underground
0-20	5	6
21-50	3	1
51-100	0	0
100+	3	3

Miles	Rebuild aerial	Rebuild underground
0-20	4	1
21-50	0	0
51-100	1	0
100+	1	1

Channel Upgrades
# of systems = 4
10-34 channels = 1
35-37 channels = 0
40-47 channels = 0
50-56 channels = 0
60-80 channels = 0

Currently addressable systems
# of systems = 4
# of subs = 7,000

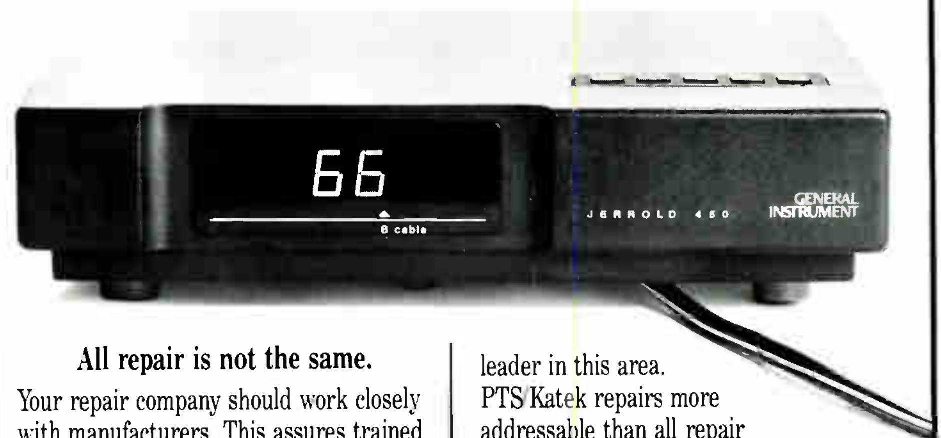
Systems going addressable in 1987
# of systems = 2
Anticipated new subs = 400

Pay-per-view
# of systems now offering PPV = 0
Additional systems to offer PPV in 1987 = 1
Additional systems to offer PPV in 1988 = 2

Continued on page 74

How to buy, sell and repair converters.

Managing your converter inventories for profit may require turning old converters to cash, purchasing new and used equipment as well as repairing existing inventories.



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Where do you look for the buyers and sellers of each converter make and model? Service reps at PTS/Katek talk to more system managers everyday about converter

needs than anyone in the business. PTS/Katek buys all makes, all models and sells only to authorized cable systems. If it's not in stock, PTS/Katek knows where to find it.

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Many distributors only want your big orders and work from manufacturers' inventories. PTS/Katek has one of the largest private inventories. Plus they ship every in stock order, large or small, within 24 hours.

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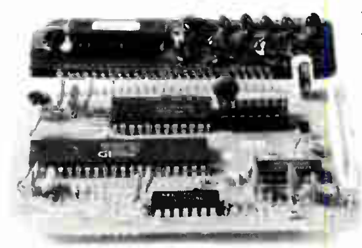
Your repair company should work closely with manufacturers. This assures trained technicians with factory support. Consider parts availability, turn-around, warranty, and quality in addition to price. It's important to know the company you ship your converters to will be in business tomorrow.



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Newbury Park, CA (805) 499-8702	Norfolk, VA (804) 853-5844	North Highlands, CA (916) 334-2012	Pittsburgh, PA (412) 787-3888	Westfield, MA (413) 562-5205	Yeadon, PA (215) 622-0450	

A new option in subscriber control

We introduce in this paper a new concept in subscriber control based on program denial outside the home. The technique is rooted in positive trapped systems, but is believed to offer improvements in both security and in quality of recovered signal. It is optimized for protection of services having relatively low but significant penetration.

Two novel ideas are presented. The technology used for program denial is new, as is the packaging technique. The packaging is not an integral part of the program denial technology, nor is the denial technology integral to the packaging. However, the two together do form a nice package for the intended application.

Background

Early cable television systems transmitted only on the 12 standard VHF channels. Later, non-standard channels were added and a set-top converter was used to convert them to a standard channel.

With the introduction of premium services, traps were added to the system as a way to control which subscribers received premium services. Negative traps were used to remove premiums for basic subscribers, but carried a significant cost disadvantage when the pay-to-basic ratio was low. Positive trap systems overcame this cost disadvantage by requiring traps only at the homes of the premium customers (who were already paying extra). Positive traps, however, remove part of the desired signal along with the interfering signal. This resulted in poor picture quality and violated one of the first premises of cable television, which was the delivery of a good quality signal. Also, as the technology became known, easy defeats (twin lead and aluminum foil) were discovered by pirates.

In an effort to make premiums more secure, cable operators moved to more sophisticated scrambling techniques, placing the descrambler in the subscriber's set-top converter. This limited interface continues to serve well. Additional functionality is now required by the video revolution, with its proliferation of remote controls, VCRs and multiple TVs. Several ideas have been proposed to ease the interface between the cable system and the cable subscriber. One new system is described here.

New technique helps eliminate piracy.

This system is based on a new and improved positive trap technology. It employs an interfering signal that is much harder to remove and a trap technology that removes only a small, redundant part of the desired TV signal. This makes compensation easier. Advantages to the cable operator include removal of equipment from the subscriber's premises, a lower cost when serving multiple sets, a capital cost proportional to pay subscribers, and subscribers who perceive a higher value to their cable service. Advantages to the subscriber include easier interface to multiple sets and VCRs and the full use of features included in remotes and cable-ready sets.

The system removes the cable operator's equipment from inside the home and provides a broadband outlet to the cable subscriber. This broadband signal contains all purchased premiums descrambled simultaneously and is easily routed to all TV sets and VCRs.

The new system

Positive trap technology has been used in the CATV industry for many years. This technology is based on the simple concept of inserting an interfering signal within a television channel at the headend and removing that interference with some form of filter

By Alex M. Cook Jr., James O. Farmer, Lamar E. West Jr., Scientific-Atlanta Inc.

Off-premise's reliability, friendliness top MSO list

Five or six years ago, equipment vendors were touting new, off-premise systems as the wave of the future. With features like addressable control of any combination of channels, these systems were seen as a way to offer subscribers the features they wanted while restoring full use of their electronic gear by removing the in-home addressable set-top descrambling converter.

But from the industry's standpoint, the new systems were too expensive and would force the operator to base his entire plant on unproven technology. Now, however, although the price and reliability questions remain, the friendliness issue is forcing some of the top MSOs to rethink and re-examine off-premise, addressable tap and other out-of-home denial technologies.

Of course, the most obvious sign of this trend is the approach TCI is taking with its "on-premise" enclosure. Based on the notion of giving the subscriber control of the system, TCI is presently in the process of attaching plastic enclosures, which house a combination of positive and negative traps, on subscriber's homes all across the country. By bringing cable service to the home and then letting the subscriber take over from there, TCI wins the friendliness game by letting subs split the signal to multiple outlets, allows subs with VCRs to record a channel while watching another and generally returns control of those devices to the customer. And, as cable-compatible TVs and VCRs grow in installed base, TCI can get out of the converter business.

Although no other MSO has announced plans to take the same track, the approach is being watched carefully. And one thing's for sure—the friendliness issue has returned to the forefront of leading engineers' minds.

In its on-premise scheme, TCI employs the use of Pico active negative traps (first developed for the OTAS off-premise system) and a new positive trap developed by Scientific-Atlanta. Spurred by TCI's interest and orders for potentially millions of the traps, these companies and other vendors are scurrying to cash in on the resurgence

Continued on page 40

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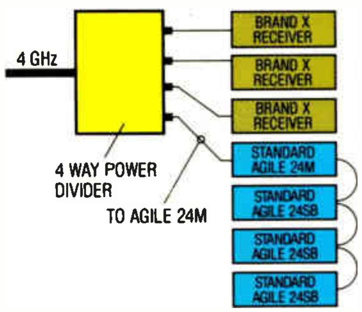

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Reader Service Number 24

The conventional embodiment of this technology involves the use of an L-C notch filter that is located at the subscriber's home.

FIGURE 1

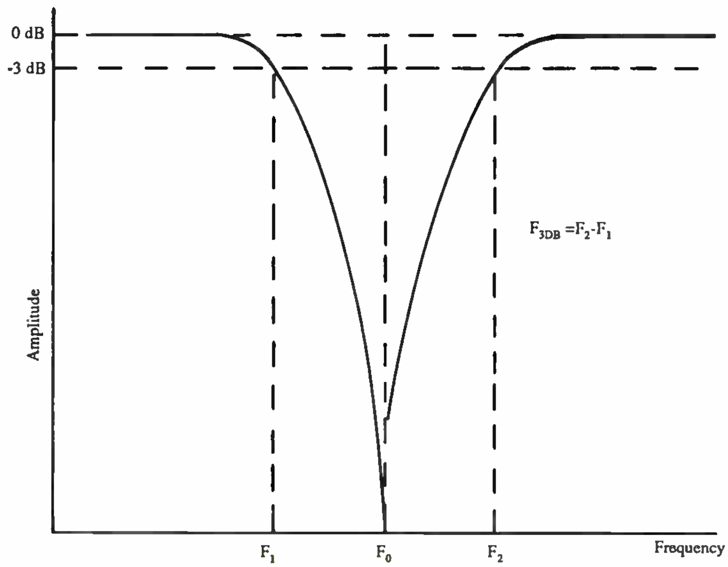

Figure of merit for a notch

at the subscriber's home. The goal of the design of this filter is to remove the interference without producing perceptible artifacts in the recovered television signal.

This technique has several attributes that may be desirable to the CATV system operator. One of these attributes is that the secured channels are scrambled on the distribution plant. Secondly, capital investment is required for filters only at the subscriber locations where premium services are being purchased.

The conventional embodiment of this technology involves the use of an L-C notch filter that is located at the subscriber's home. A notch filter (or band reject filter) is a frequency selective device that attenuates a band of frequencies while passing all others. Unfortunately, L-C technology has some inherent limitations when used for this application. In the positive trap scenario it is desirable to make the notch filter as narrow as possible so that the interfering signal may be removed without removing or significantly affecting the desired television information.

One figure of merit for quantifying the performance of a notch filter is Q. Q is defined as the ratio of the notch center frequency to its 3 dB bandwidth:

$$Q = \frac{F_0}{F_{3DB}}$$

See Figure 1. Typical maximum values of Q for a conventional L-C notch filter are around 30. This means that a trap for channel 7, near 177 MHz, will have a 3 dB bandwidth of about 5.9 MHz, essentially the bandwidth of a TV channel.

In order to minimize the effect of a notch filter on the recovered signal it is important to maximize the Q (i.e. decrease the 3 dB bandwidth). It is difficult to accomplish this goal with conventional L-C technology, especially as center frequency is increased. This constraint has limited the use of positive trap technology to the low end of the CATV spectrum.

Q characteristics limit the number of choices for placement of interfering signals in positive trap scenarios. In the conventional configuration the interfering signal is placed midway between the picture carrier and the sound carrier (see Figure 2). This area of the

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Direct cost reductions through improved battery performance and

simplified system maintenance were brought about by Alpha's temperature compensating and performance monitoring circuit designs. In addition to these technological contributions, Alpha has

established the highest quality and safety standards. To date Alpha remains the only Standby Power manufacturer offering UL, CSA and SEV listed products to the CATV industry.

The unique *Lifeline* status monitoring system provides diagnostic information and remote control facilities on *one-way* and two-way cable systems. This pioneering development now enables operators to optimize service strategies and reduce overall system maintenance costs. *Lifeline* is Alpha's latest in a series of historic status monitoring milestones: the first and only stand-alone power-supply monitoring system, hardware interfaces

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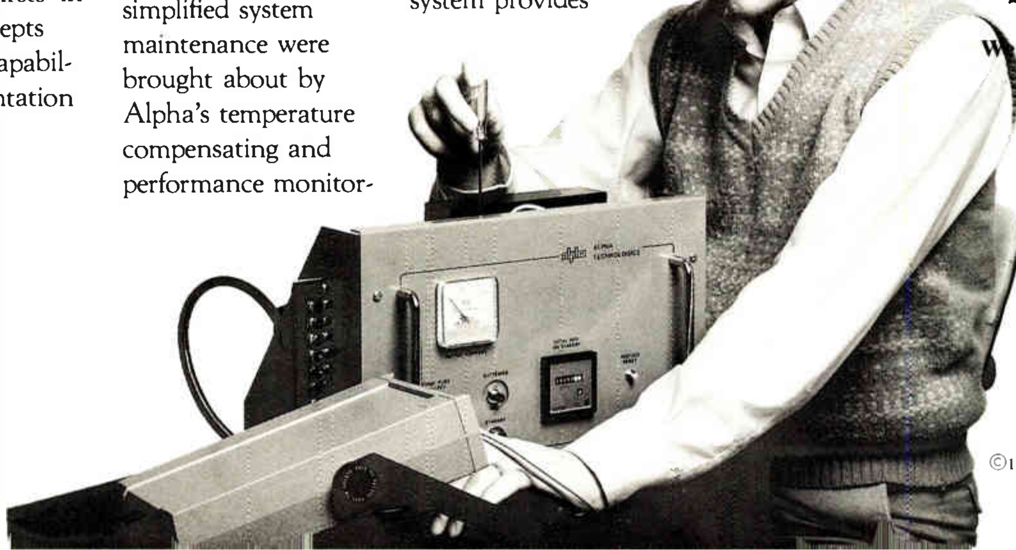
Alpha Technologies set the standards in Standby Power for one reason: Alpha's customers won't settle for second best.



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Reader Service Number 26

REEL P

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Take Sheila Yount for example. She's been with us 15 years. As a Customer Service Representative, she's here to take your order, to follow it through and to make sure your special needs are met. Even if that means performing minor miracles—like having an out of stock product manufactured and delivered within 48 hours, in an emergency.

Or consider Jim Sherrill. He's our Process Engineering Manager. His job is to make sure all of our equipment is in top running condition at all times. It's a career that puts him on call 24 hours a day. As Jim puts it, "My job isn't to put out fires. It's to prevent them from happening."

Then there's Lanny Parker, our Quality Control Supervisor. If Lanny and his staff don't say a reel is okay to ship, it doesn't get shipped. Period. That means everything that leaves our plant has to meet our high standards—from a cable's electrical properties right down to the appearance of its packaging.

Sheila Yount
Customer Service Representative
15 years with Comm/Scope

Jim Sherrill
Process Engineering Manager
28 years with Comm/Scope

EOPLE.

Also, there's Charles Floyd. He has a job that doesn't even exist at other cable companies. Charles is our Driver Supervisor. His job doesn't exist at other cable companies because other cable companies don't have their own carriers. Charles oversees 72 truckers. In short, he makes sure the cable you ordered is delivered where you want it, when you want it. Just as Sheila or another Representative promised you in the first place.

At Comm/Scope we're proud of Sheila, Jim, Lanny and Charles. They're great individuals who exemplify the kind of spirit and dedication you'll find throughout our ranks at Comm/Scope.

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Reader Service Number 27

Lanny Parker
Quality Control Supervisor
15 years with Comm/Scope

Charles Floyd
Driver Supervisor
5 years with Comm/Scope

The design goal for the new system was to develop a positive trap that is significantly more secure.

television channel was chosen due to the relatively low energy concentration occurring during normal television programming. Any information removed from this area of the spectrum has a minimal effect on the quality of the recovered signal.

Despite this location, L-C notch filters remove significant amounts of useful information so as to noticeably degrade the quality of the recovered signal. Additionally, this location makes it possible for the pirate to recover an acceptable signal using components that are readily available.

The design goal for the new system was to develop a positive trap that is significantly more secure and provides an improved recovered television signal when compared to the existing L-C notch system. The heart of this new system is an improved version of the notch filter. This filter has been developed utilizing SAW (surface acoustic wave) devices as resonant elements in the notch filter design. The SAW devices provide filter Qs far in excess of that of L-C technology (around 450 with SAW based notch filters as compared with 30 from L-C based filters). The resulting filter has a minimal effect on recovered signal quality. The improved notch filter supports the placement of the interfering signal in a part of the television channel that makes it much more difficult for a pirate to remove the interference using techniques generally at his disposal, without corrupting the recovered signal to the point of being unusable.

The development of an improved notch filter has necessitated the development of a new and unique SAW device as well as the utilization of this SAW device in a new filter topology.

Figure 3 shows measured data comparing the response characteristics of a SAW based notch filter to a conventional L-C based notch filter. Both filters are centered close to 200 MHz. Typical performance characteristics of a SAW based notch are given below:

The filter's low passband insertion loss makes it possible to cascade several notch filters at various frequencies. Classically, one associates SAW bandpass filters with high insertion loss. The present notch filters are not based on the same principles and the high loss conditions do not apply.

Continued from page 34

of interest.

According to Jim Quigley, sales manager of Pico's OTAS systems, "hundreds of thousands" of the active traps have been ordered and will be installed in TCI systems, beginning with the Miami, Fla., system. Despite heavy interest in the trap, he doesn't predict that operators will turn to the full-blown OTAS system anytime soon.

"The OTAS product is still available but we're concentrating on the SMATV market," said Quigley. "The initial OTAS was great but it had so many bells and whistles...it was really a lot more than the industry wanted and wanted to pay for," he admitted. But he does expect better things for the trap system. "By 1990, you'll see some technical changes (to the traps) that could be advantageous to operators" like addressability, said Quigley.

Mike Hayashi

Blonder-Tongue has quietly been making sales of its Guardsman off-premise technology to some top MSOs, said Glenn Tongue, vice president of sales and marketing. "Off-premise systems were never a bad idea, they were just approached poorly," he said.

The system consists of a subscriber module which utilizes off-premise scramblers to provide security and an address code transmitter in the headend to transmit channel or tier authorizations to the modules. It can be configured to be addressable or non-addressable. Up to six premium channels can be controlled. At each directional tap, a subscriber module is inserted to provide control by denying services the customer does not want. Frequency variable traps scramble unwanted services, totally obliterating both picture and sound. When a premium program is authorized, the proper trap is deactivated and the picture is passed through transparently. In a non-addressable system, channel authorization is achieved by inserting plug-in jumpers in appropriate sockets within the subscriber module.

Key feature compatibility

But perhaps its key feature is that it is compatible with existing plant, meaning it can be integrated anywhere without having to completely replace what's already up on the poles. It is also compatible with digital TVs, passes BTSC stereo without degradation and is entirely subscriber friendly, says Tongue. "It's a nice, clean way to deliver a broadband signal into the house or MDU."

Presently four cable systems have bought the Guardsman technology and 12 more are testing it, Tongue said. Right now it represents a small percentage of Blonder-Tongue's business, but it is forecast to be the company's biggest growth sector, added Tongue.

The Central Indiana Communications system in rural east central Indiana chose the Guardsman technology because it liked the addressability and friendly features, said Bill Kidwell, manager. With essentially two contiguous systems each controlled by a separate headend, Kidwell is able to compare the Guardsman system, installed since March, directly against a standard, non-addressable trapped system. After comparing trouble call figures, Kidwell said, "Guardsman operates well. It's not a flamboyant system, but you can control what you want to control."

Phil Verruto, vice president of sales and marketing at AM Communications (formerly AM Cable), which markets the Tier Guard system, reports that

Continued on page 48

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Reader Service Number 29

Several conflicting requirements are placed on the jamming signal location.

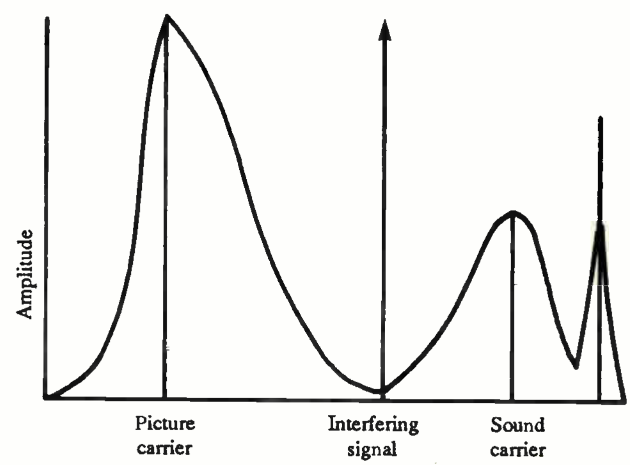
Jamming carrier location

The drastically reduced width of the notch filter allows placement of the jamming carrier much closer to the picture carrier. This makes the pirating job much more difficult, since simple traps which might remove the jamming carrier also remove the picture carrier and essential sidebands. While traps may be constructed which yield some sort of recovered signal, considerable degradation results. The jamming carrier is located on the vestigial sideband of the protected channel. This location was chosen because it allows reasonable jamming coupled with reasonable ability to recover a quality signal.

Several conflicting requirements are placed on the jamming signal location. A location as close as possible to the picture carrier is desired in order to improve the robustness of the system against the onslaughts of the pirates. On the other hand, a location as far as possible from the jamming carrier improves the ability of the SAW trap to recover a quality signal. The placement chosen represents the best engineering compromise between these requirements. Three considerations led to the final choice of a jamming frequency once the approximate limitations of the technology were determined.

FIGURE 2

Television channel spectrum



Traditional jamming carrier placement

In order to minimize the visibility of artifacts generated by incomplete attenuation of the jamming carrier (for a legitimate subscriber), the same technique is applied as is used to minimize effects of the color subcarrier beating with the picture carrier. The offset between the jamming and picture carriers is locked to an odd harmonic of one-half the horizontal line rate. It can be shown that doing so causes any beat which does result to be stationary on the screen, and a stationary beat is considered less visible than a moving beat.

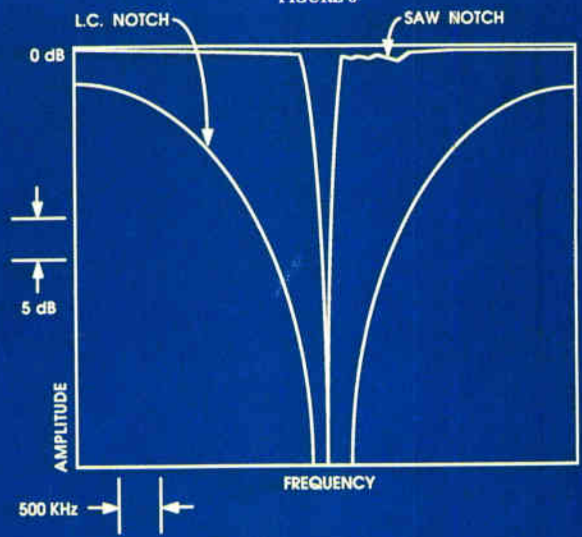
A second consideration is that the jamming carrier, being

A third criteria is that the artifacts relating to the notch must be minimized.

equal in amplitude to the picture carrier, must fall in one of the required offsets should the protected carrier be on one in the aeronautical band. Assuming that the picture carrier has already been offset to fall at one of the permitted offsets, it then becomes necessary to offset the jammer by a multitude of 25 kHz (for most channels) from the picture carrier, with a tolerance of 5 kHz.

A third criteria is that the artifacts relating to the notch must be minimized. One way of doing this is to place the notch at such a point that the energy contained in the horizontal sync is minimally disturbed. Figure 4 shows the horizontal sync signal and the spectrum which results. Not shown are the 15.734 kHz components resulting from the frequency of the sync signal. These components may be shown to follow an envelope, which is shown, having a sin(x)/x shape. This envelope exhibits nulls in the spectrum at frequencies equal to the reciprocal of the

FIGURE 3



Comparison of New and Traditional Notch Performance

If the chosen frequency falls close to a null in the sync spectrum, so much the better.

width of the sync pulse, W. A standard NTSC sync pulse has a width of 4.7 microseconds, so the nulls in the spectrum occur every 212.8 kHz.

Thus, in finding frequencies suitable for the jammer, one looks for offset frequencies equal to an odd multiple of one-half the line rate, which also fall very close to an aeronautical offset (in this case we look for frequencies removed from the picture carrier by a multitude of 25 kHz). If the chosen frequency falls close to a null in the sync spectrum, so much the better. One suitable frequency is an offset equal to 29/2 of the horizontal line rate, about 228.1 kHz from the picture carrier. This is close to an aeronautical offset, though tighter than normal tolerances would be required to utilize an aeronautical frequency. Further, it is acceptably close to a null in the sync spectrum.

Modulation

The jamming carrier is modulated with a sine wave locked to the horizontal line rate and phased such that the envelope of the jamming signal is maximum during the middle of the TV line, when the amplitude of the picture carrier is lower. The jammer is then at minimum amplitude during the sync tip, when the picture carrier envelope is maximum. Thus, the modulation reduces the system loading. We have found that the scrambling effect is considerably enhanced by the modulation. This appears to be because the sync separator in the TV frequently takes the peak of the jammer to be sync. We are also experimenting with other forms of modulation on the jamming carrier, which appear to create additional irritation for the pirate, without being visible to the legitimate subscriber.

Jamming carrier generation

Figure 5 shows one possible method of generating the jamming signal. The jamming is done at the modulator IF in order to ease selection of the protected channel. Depending on the modulator, interface may be the same as interface with RF sync suppression scrambling. A bandpass filter, F1, selects the picture carrier from the modulator. It is mixed with the jamming carrier from OSC 1, which in turn is locked to an offset derived as shown below. The difference frequency is recovered in lowpass filter F2, and applied to a phase detector PD 1, along with a frequency at the correct offset. The error from the phase detector is integrated and applied to the jamming oscillator to keep the offset between the jamming and picture carriers equal to the frequency of offset oscillator OSC 2.

The offset oscillator is controlled within a second phaselocked loop, the reference for which is horizontal sync derived from a sync separator. Video is looped through the sync separator before being applied to the modulator. Predistortion of the video amplitude and delay is also performed, in order to compensate for the errors introduced by the trap. The horizontal sync frequency is divided by two and applied to phase detector PD 2. Output from OSC 2 is divided by 29 and applied to PD 2 as the other input. The error from PD 2 is integrated and used to correct the frequency of OSC 2.

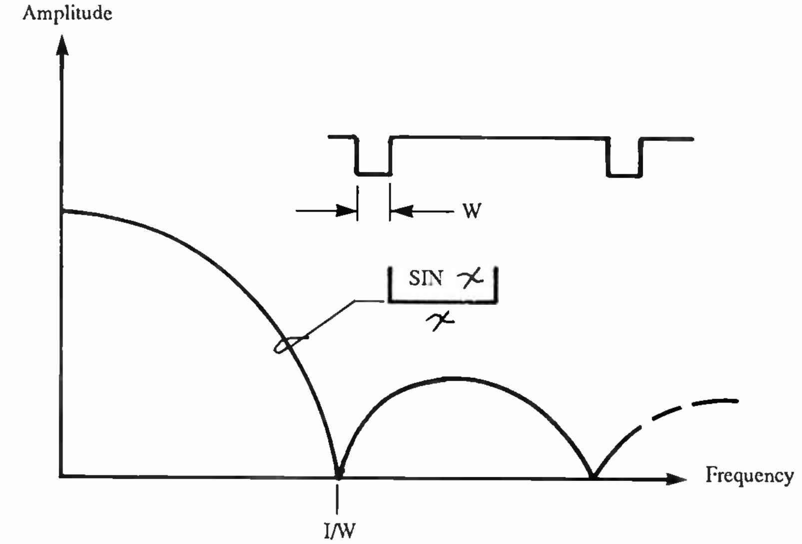
Finally, the output from the jamming oscillator is modulated with a horizontal rate signal and added to the picture carrier before up conversion to the desired output channel. We should note that, in practice, the interface with the modulator may be different, but the above illustrates the technique involved. In order to set the level of the picture and jamming carriers with simple equipment, the jamming carrier generator includes provisions for individually turning off the picture and jamming carriers.

Expandability

Consideration has been given in the design to future applications and growth. It is anticipated that an amplifier module will be developed. Other modules are possible also. An addressability module has been discussed that would replace the input/output module and jumpers and would allow the use of existing filter modules. The addressability module would be mounted to the mounting grid array and existing filter modules would be inserted into it. The cost of an addressable upgrade would be minimized in this manner. Power would be supplied to the unit from the subscriber's residence through the center conductor of an output cable or through a separate set of wires.

Mechanically, the unit is designed to expand in two ways. First, a deeper lid would allow the mounting of electronics in the lid. The cable operator could remove the existing lid in the field and replace it with a new one. Secondly, provisions have been made

FIGURE 4

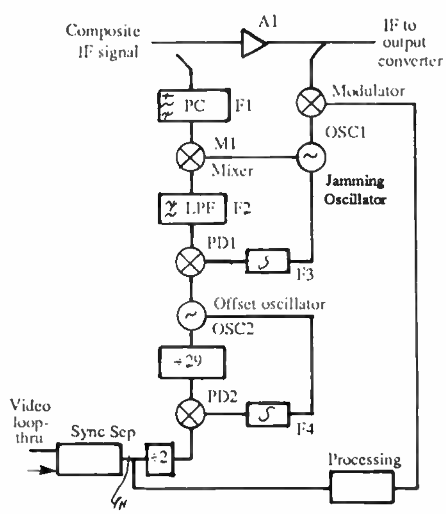


Horizonal sync spectrum

Reader Service Number 32

A number of issues must be evaluated when considering a new system like this.

FIGURE 5



Generation of jamming carrier

for a subscriber-accessable enclosure to be mounted directly below this enclosure. This would allow a subscriber or contractor access to the output cable to perform the signal splitting function or for connection to a pre-wired residence.

Evaluation of issues

A number of issues must be evaluated when considering a new system like this. Cost is a major issue. The system obviously bears an initial cost for the housing. Since individual traps are employed for each channel, the cost is going to be related to the number of channels protected, in contrast to a set-top terminal which is generally insensitive to the number of channels protected. Should one configure this system with a number of channels under addressable control, the cost could become higher than that of an addressable set-top terminal, though the ability of one box to serve the entire subscriber premise is an obvious advantage.

Mounting to the side of a house as currently planned is an unusual concept in the CATV industry. This has been practiced for years by the electric and gas companies, and recently telephone companies have been using a box which performs an identical interface function. The box is a convenient point of demarcation between the subscriber's equipment and the cable company's equipment.

As currently configured, the equipment is passive so powering is not an issue. However, future enhancements will require power. This power logically comes from the subscriber's home, but getting it to the box raises issues of safety and practicality.

Security is a big issue with any program denial technique. The system is certainly more secure than a conventional positive trap as a result of the proximity of the jamming carrier to the picture carrier. On the other hand, one would be reckless to assert that pirating was impossible. Rather, this system is intended to complement the contemporary notion that security must be evaluated in the context of the probability of turning a pirate into a legitimate subscriber. If positive trap-

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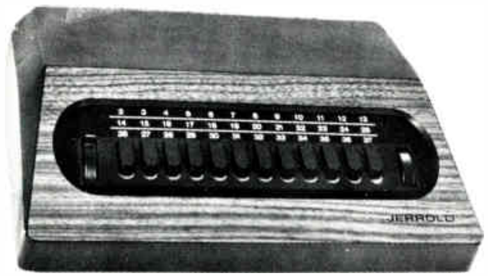

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Modulation on the jamming signal reduces the loading effect of the jamming carrier.

ping has been considered a viable protection alternative, then this new system should surely allow improved confidence.

While modulator interface is similar to that of an RF sync suppression scrambling system, the requirements on the modulator are somewhat different. Since a second carrier equal in amplitude to the picture carrier is added, the modulator must have adequate linearity to handle it. At this early stage of development, we are unable to comment on the suitability of all modulators in existence. But, for example, a recently produced Model 6350 modulator is suitable, though we recommend some simple modifications for optimum results.

Addition of the jamming at a processor is technically feasible given the availability of a demodulated signal for phaselocking. However, baseband predistortion of the video must be accomplished somewhere in the system. Video delivered to subscribers not using a trap should not be predistorted except possibly during a change-over period.

Transmission of a jammed signal over FM microwave links is not feasible since the jamming signal must be added at RF. An AM microwave system can theoretically handle the scrambled signal, though generation of the transmitted signal may be complicated by the lack of sufficient upconverter linearity to handle the extra signal. This can be overcome by individually upconverting the picture and jamming signals and combining at the transmitted frequency.

Modulation on the jamming signal reduces the loading effect of the jamming carrier, though it is not eliminated. With the parameters currently planned for the system, addition of the jammer creates a peak voltage in the channel which is 4.6 dB higher than

Continued from page 40

interest in off-premise systems has surged now that engineers are being pressured to help hold the line on operational costs. According to Verruto, the cost of two truck rolls at $25 each more than pays the cost of a port in the Tier Guard system. "Off-premise is, absolutely, a means of economizing."

But, more importantly, Verruto says he's detected a new attitude from potential buyers regarding off-premise systems. "Operators are now saying the technology is valid and are trying to determine if it's operationally valid. We're now a viable product in the marketplace."

Verruto noted that two "pilot systems" have been installed to help operators determine if the technology is operationally sound. One of the operators has increased revenue by $10 per sub per month with it, he said. AM expects great things from Tier Guard, especially now that ATC is interested.

One of the pilot systems was shipped to an ATC system in the Southeast last month, where Verruto expects the technology to be put in place "in a big way" after first being integrated into MDU locations. Although he declined to be more specific, Verruto noted that he is close to an agreement to place Tier Guard in a "very, very big operation in the Southwest."

Jim Chiddix, vice president of engineering at ATC, admitted he is interested in off-premise systems and has been talking with AM Communications and another well-known equipment manufacturer regarding out-of-home denial systems. "I'm a big fan of the interdiction idea," he said, "but the problems have been associated with its price and reliability. If there was a system that was *extremely* reliable and it came in at the right price, I'm convinced the economics are there for it to be an attractive system." He went

Jim Chiddix

on to say ATC will be doing some testing to determine if the economics are present to support such a system.

Addressability a must

But, in addition to being economically viable, it must be addressable, able to handle impulse pay-per-view orders and delivery, and be flexible enough to allow delivery of HDTV signals. If done right, Chiddix said, "this kind of technology can be a major boon to the industry."

But Verruto, like Pico's Quigley, noted that operators are asking for technology that is simpler to use and simpler to operate. "MSOs are telling us to keep the technology simple from an applications point of view," he said. Consequently, AM will be introducing "Drop Guard," essentially an addressable tap, later this summer. The new product will cost about $25 per port and will simply be an on/off switch to the drop, Verruto said. He added that it will work best in high churn areas and will be easily upgraded to full-blown Tier Guard status should an operator decide to add more control.

In addition to AM Communications' new product entry, Eagle Comtronics will be introducing a new product early in 1988, according to Joe Ostuni, vice president of sales and marketing. Ostuni gave no other details, other than the project has been in development for about 18 months and that it has been targeted toward "specific MSOs." So, clearly, there are signs of a new warming to the off-premise or addressable tap market.

Although they don't have specific product announcements to make at this time, you can bet vendors like Pioneer, S-A and Jerrold are exploring their options and will break out with new product should the market show signs of supporting them. Engineers and marketing representatives from each of these vendors have said they remain ready to develop and offer a product should oper-

A new positive trapping system has been shown which is believed to offer significant advantages.

the voltage normally present on the picture carrier alone. Another way of looking at the increase is that it is equivalent in terms of system loading to adding another picture carrier, but at a level 3.1 dB below other picture carriers on the system. In most systems the increase in loading is probably not a big factor, but this needs to be examined in marginal situations.

Conclusions

A new positive trapping system has been shown which is believed to offer significant advantages when compared with conventional positive trap systems. These advantages accrue from the use of very narrow traps realized through the use of SAW resonators. Security is enhanced by placement of the jamming carrier very close to the picture carrier. Quality of the recovered signal is enhanced by the narrowness of the trap and the ability to place pre-corrected signals in the opposite sideband. Independent of this new technology but offered with it is a new packaging technique utilizing mounting to the side of the subscriber's house, providing a line of demarcation between the CATV system and the subscriber.

Acknowledgements

The authors acknowledge the considerable contributions made by L. Montreuil, D. Hoder, D. Bowen, W. Vaughn, M. Harney and S. Nusrallah. We also wish to express the support received from members of our suppliers' technical staffs, including D. Ashe, J. Andle and B. Horine. Finally, we happily acknowledge the support, ideas and incessant prodding of J. Sparkman, T. Elliot, D. Willis and others at Tele-Communications Inc. without whose ideas and help this project would not have happened.

ators express a desire for them. That time may be rapidly approaching, according to some industry observers.

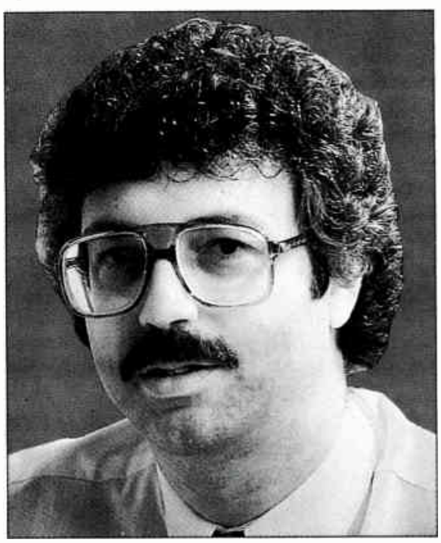
Developing an off-premise system remains a high priority at Pioneer, according to Mike Hayashi, sales engineering manager. "I still feel off-premise is ultimately the way to go, but the system, in addition to being subscriber friendly, has to be user friendly too."

The time is right

He said that flexibility will be a key feature of any system so that it can be deployed any way the operator needs it. "Dusting off old technology is not the way to do it," he added. But he also noted that the time is right for this type of technology. "There are a lot of under-the-surface activities taking place" by both vendors and MSOs regarding product testing, he said.

Although he declined to be more specific, Hayashi said Pioneer's efforts are going beyond simple interdiction as it has been defined to date. "We're looking at something using a mixture of interdiction and another approach. Interdiction alone is not good enough. The more channels that are jammed, the more the cost goes up, or jamming effectiveness is lost. And we don't want to put any restriction on its uses—we've made that mistake before."

But as excited as these vendors are, some operators and vendors remain skeptical. Spokesmen from American Lightwave Systems and Texscan, makers of Mini Hub and TRACS, respectively, said they have suspended attempts to market the products to cable operators. John Holobinko, vice president of marketing and sales at ALS, said the star-switched concept that Mini Hub was predicated on is being looked at by telcos and SMATV systems, not cable. But he does admit operators are actively looking for an



Joe Van Loan

alternative to the present situation. "People wouldn't be looking for new approaches if they were completely satisfied," he said.

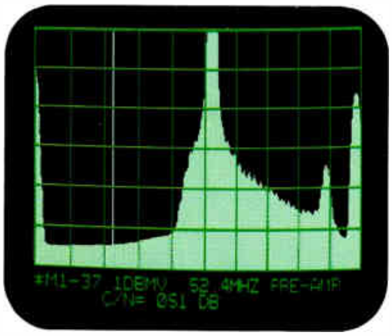
Although they may not be totally satisfied with the status quo, not all operators are enamored with present off-premise product offerings. Joe Van Loan, vice president of engineering at Viacom Cablevision, remains unexcited because there's a lack of anything new. "We gave it a good shake" and decided the technology wasn't good enough, he said.

First, with investments of upward of $100 that have to be made for every home passed, regardless of whether a subscriber lives there or not, "you've made an investment in technology that would choke a horse," said Van Loan. Secondly, interdiction systems depend upon physical security that is too easily defeated and bypassed, he added.

"There's a need for some real cleverness out there," said Van Loan. "If someone can make a device, control the price, fix it so it's truly secure and make it so you can control the channels you want to, they might have something." But in the meantime, the Viacom executive insists that electronically secure systems like EIA's MultiPort are the ultimate way to achieve friendliness.

In Dave Large's mind, however, the key issue is signal leakage. Present law says that the cable operator is responsible for all leakage, including that which comes from inside the subscriber's home. "We have a big responsibility in that home," said Gillcable's vice president of engineering. "That is the big downside to interdiction."

A secondary concern is that no matter how good it may be, any trapping system ultimately degrades a picture sent to the home. Positive traps, because they remove some of the picture information along with the jamming carrier, destroys the channel that's being watched. And negative traps degrade adjacent channels, Large said. "My brain says this is a step backward."



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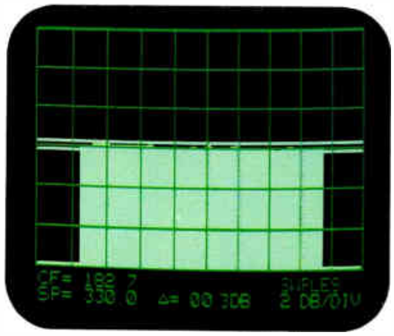

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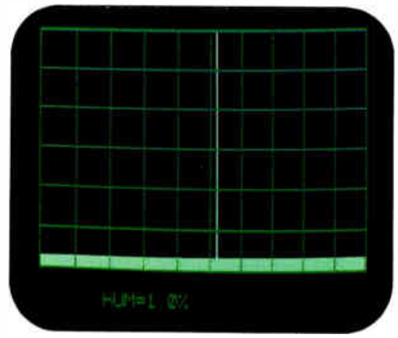

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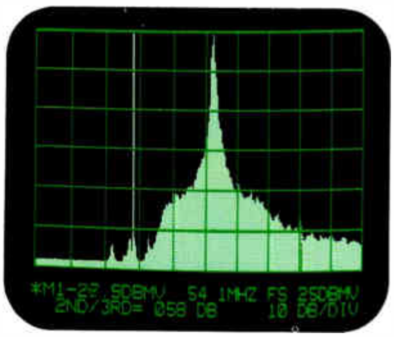

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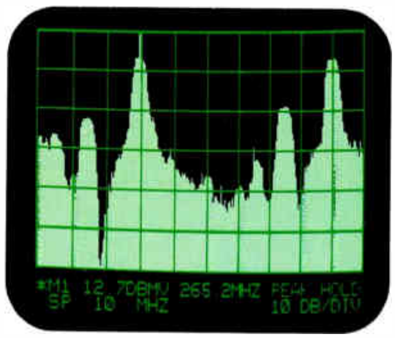

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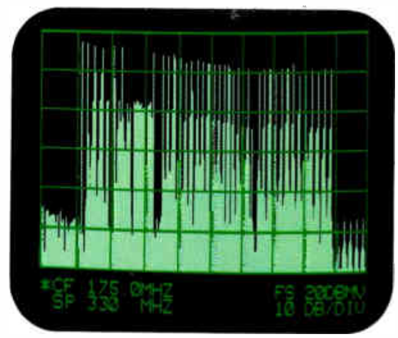

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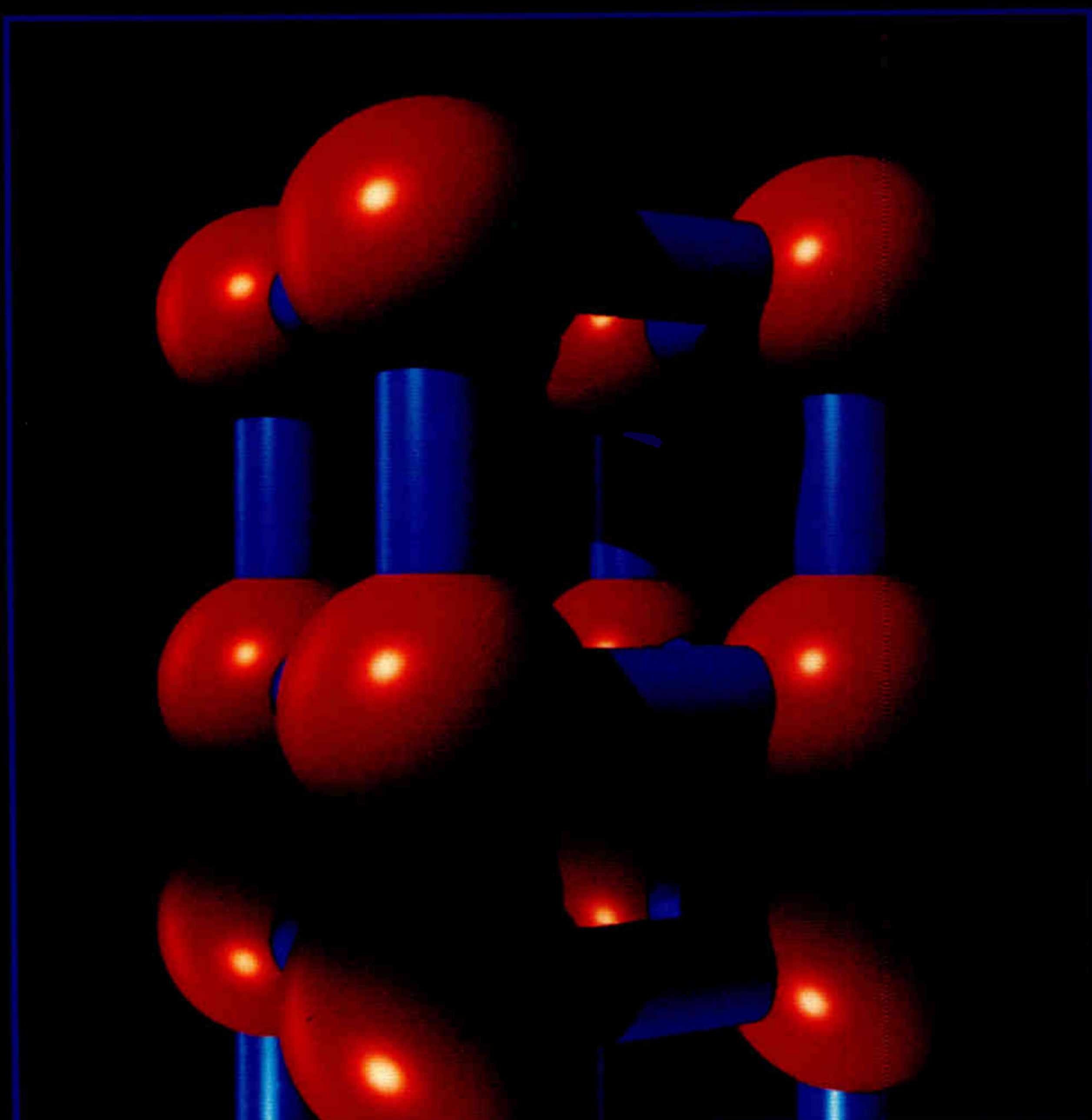
Sweep response testing



Sweep response testing

Keeping your system running at peak efficiency.

System sweeping is a function that certifies a new build or provides a proof-of-performance for an existing system or a system being considered for purchase. However, it should not be applied only at those times. System sweeping provides the means to keep an active broadband distribution system operating at peak performance using a valid test reference and following a planned maintenance schedule.

Sweep response testing begins during a product's manufacture. Amplifiers and passive devices, including cable, have a published response bandwidth. The response bandwidth of amplifiers, splitters, directional couplers, taps, power inserters and equalizers are established by design and maintained by component and/or assembly evaluation, which in many cases is response testing. By testing, the manufacturer is able to maintain the performance parameters (technical specifications) which will be the basis for equipment evaluation and selection.

Having produced the product, the manufacturer will sweep response test various amounts of product to maintain quality control so the equipment delivered to the end-user should perform as specified. Following the manufacturer's lead, pre-installation sweep response testing is used in some systems to minimize turn-on problems. When repair is required, sweep response testing is again used to verify component quality and repair completion.

By Greg Lemon, Sales, CWY Electronics

Equipment

The equipment required for testing a broadband distribution system is the same as that used for individual component testing. A radio frequency sweep generator is used to produce RF carriers in the bandpass to be tested. This happens sequentially from the lowest to the highest frequency at a specific test level. The technical specifications are the predetermined operational parameters provided to determine the effect of any device being evaluated. Any change in these preset test parameters are the effect of the devices being tested. A receiver of some type is used to recover and display the test information. A spectrum analyzer or oscilloscope is used to recover the sweep signal and display the information for evaluation. The sweep response displayed will present a pictorial presentation of how the amplifiers, cable, directional couplers, taps and connectors are affecting the sweep signal and how these devices will affect the RF carriers on the system.

The results of this type of testing will provide information on: system flatness, i.e. peak-to-valley; defective components, i.e. corroded or loose connectors; frequency suckouts; mismatches from cable damage, passive components or connectors; improperly performing amplifiers, i.e. low gain, roll-off or improper equalization.

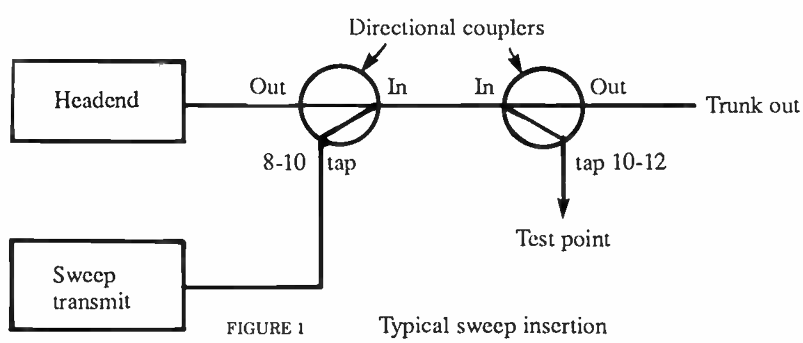


FIGURE 1 Typical sweep insertion

Test methods

There are presently four methods of sweep response testing: low-level synchronous (tracking), low-level asynchronous, high-level synchronous and processed sweep.

The low-level synchronous sweep uses a sweep insertion that is approximately 10 dB to 30 dB below the system's carriers. In this case there is almost no interference discernable by the subscriber. However, an expensive tracking analyzer is required to recover the sweep. This method produces less subscriber interference but has the disadvantage of resolution loss as the number of carriers increases and the amplifier cascade lengthens.

The low-level synchronous sweep also uses low-level sweep insertion. In this case no pilot or tracking analyzer is required to recover the sweep. A long persistance phosphor CRT, or a unit that has display storage capability, is used to display the sweep response for analysis.

The high-level synchronous method uses sweep insertion approximately 10 dB to 15 dB above the system carriers. While the resolution is superior, subscriber interference increases as a result of an increased sweep level.

The processed sweep method, also a high-level method, is a microprocessor-controlled means of digital cancellation of the TV signals, allowing the receiver to display only the sweep response. This is accomplished by transmitting synchronizing information from the transmitter to the receiver, using a pilot carrier which is modulated with information that includes: the start frequency of the sweep, the frequency span, the time the sweep will take, and (from start to stop) the time until the next sweep.

After the synchronizing information is transmitted, the transmitter sends a trigger pulse via a pilot carrier. This causes the receiver to start measuring the RF voltage on the distribution system using a broadband active detector. The detector output is sampled and each sample voltage is expressed as a digital value. Under microprocessor control, the receiver sets its sampling rate so that it samples 250 times during the sweep time. The transmitter does

Standing waves are the result of impedence mismatches located outbound from the amplifier.

not send a sweep on this pass, so the receiver is measuring the sum of the sync and video signals on the cable. The digital values are stored in the memory of the receiver's microprocessor.

One TV frame time later (33.3667 Msec.), the transmitter sends a second trigger pulse, followed this time by the sweep. The receiver again begins to sample the RF voltage, but this time as each voltage is measured the digital value from the first pass (no sweep) is retrieved from memory and converted back to a voltage. This voltage is subtracted from the detected RF voltage; the circuitry expresses the voltage difference as a digital value and stores it back in memory.

The sampling rate on the second pass is the same as on the first. Since the second trigger pulse comes exactly one frame time after the first pulse, the sync signals at any time after the pulse will be the same as on the first pass. The video signals will be nearly the same, so the total RF voltage on the cable will be about the same at any time after the pulse, except for the sweep voltage, which will stick out after the subtraction. This sweep is the only information that is now evaluated for response characteristics, signature build-up and standing waves.

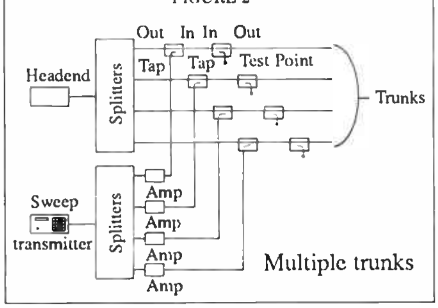
Response characteristics are the overall bandwidth characteristics that include the lower and upper roll-off points. This verifies that the device under test will pass the desired band and disregard spectrum where passage is not desired. In a cable system sweep response test, the lower and upper filter roll-off is what is of concern when two-way communication is desired. Two-way transmission will also require the distribution system to be swept in both the forward and return direction.

Signature build-up is an incremental "extra" contribution to gain in a particular portion of the operational spectrum. The signature "bumps" may be quite small per amplifier, but will grow in cascaded amplifiers. The operating manual of the amplifier or the manufacturer should be consulted for corrective procedures in decreasing the signature build-up.

Standing waves are the result of impedence mismatches located outbound from the amplifier. This includes housings, connectors, directional coupling devices, and taps and splices that are in front of the signal.

Previously, a distribution system was set up using a signal level meter and one or two RF carriers for reference. One carrier was at the lower end of the passband and the other was at the upper end. This technique is adequate with short cascades and 12-channel systems, but proves inadequate when cascades grow and channel capacity increases. This single-carrier set-up method will not show frequency suckouts, inband noise, filter roll-off, improper equalization or information about the area of the spectrum where

FIGURE 2



no carriers are present. Sweep response testing provides a means to align and verify the amplifier's performance. It also provides a pictorial of the effect of the cable and other components on the sweep signal over the entire system's bandwidth.

Various means of sweep signal insertion are used. In a headend with a single output, we can use a set-up similar to Figure 1. This same set-up may be used for multiple trunk outputs as long the desired sweep level can be maintained after splitting, as in Figure 2. When the output of the test equipment is insufficient to perform as required, a post amplifier after the RF sweep generator may be required prior to insertion of the sweep signal into the system. The primary concern is to maintain test values that will give meaningful results when displayed. If the inserted sweep values are unknown or carelessly coupled into the system, the results are nearly meaningless because there is no point of reference from which to determine useful information.

This will verify the test equipment's operation because no components are between the sweep generator and the receiver. By setting the sweep bandwidth and the RF output level parameters at the required insertion values, the test equipment's performance is verified. Performance verification will be different for various types of equipment and the manufacturer's equipment manual must be consulted for proper set-up. It is therefore the operator's responsibility to carefully read the equipment manual to determine all set-up requirements and become familiar with the specific test equipment.

The insertion test point and the recovery test point should also be swept for flatness to determine what effect these devices will have on the response of the inserted sweep signal. Remember, the system's flatness will be no better than the flatness established at the insertion point. From the insertion point forward, the sweep response test signal can only be degraded in quality. It is this effect of the cable, amplifiers and passive devices through which the signal must travel that will be displayed.

Conclusion

Sweep response testing is used by manufacturers for component evaluation, module alignment and final assembly certification. Sweep response testing is used by cable companies for pre-installations checks of equipment, post construction set-up, proof-of-performance acceptance and the bench repair of failed equipment. Many cable companies also sweep test their distribution system in a continuous effort to maintain the system's peak operational performance and avoid unscheduled maintenance when possible. In the above efforts and all future applications of sweep response testing, the most important point to consider is to have a valid reference from which to draw valid test results.

References

For a list of references used with this article, contact Linda J. Johnson, *CED*, 600 Grant St., Ste. 600, Denver, CO 80203, (303) 860-0111.

Signal analysis meters

Signal level meters (also known as field strength, field intensity or signal analysis meters) are important and widely used diagnostic tools that monitor broadband network signal levels. Originally developed for the CATV market, SLMs are tuned radio frequency voltmeters and basically measure voltage applied to their terminals. In addition to calibration in voltage, many SLMs are also calibrated in dBmV. They're available in simple installer versions that are relatively inexpensive and measure high and low channel carriers. More complex and expensive models can measure hum modulation and carrier-to-noise ratios. A few contain integral signal generators as well. That's a handy feature when used on a LAN because, compared to more traditional CATV video applications, carriers will tend to show up in bursts rather than continuously.

Other features some meters contain are ohmmeters, hardened or waterproofed housings, automatic power-off circuits to conserve batteries, battery chargers, built-in temperature calibrators, 300 MHz to 890 MHz tuning range, autoranging, spectrum analyzer interfaces, rack mount versions with built-in spectrum analyzer displays, two-year warranties, video or audio level readings in dBmV, audio monitors, modems or built-in CRT monitors.

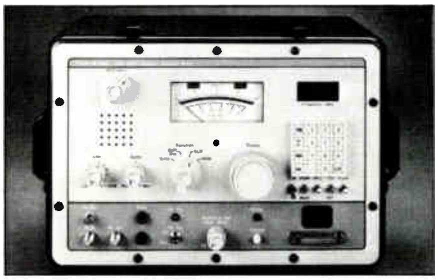
Watching system levels is important because bit error rates will increase if the levels are out of tolerance. Low signal levels will increase noise effects; high levels will increase distortion.

SLMs also can be used with dipole antennas to measure and locate system leaks and with a signal source and terminators to test passive component isolation, insertion loss or tap loss.

There are some differences between broadband CATV networks and LANs that affect SLMs and other test gear. The size and complexity of the network, length of cascades, availability of on-site technical personnel, priority attached to certain network legs and cost considerations will dictate the precise equipment package that's appropriate for each network.

In some ways, LANs are more complex. CATV, for example, uses a single signal format (NTSC, AM and FM) and the receiving device is a TV set. A LAN, on the other hand, might use any of 50 different modulation schemes and data bandwidths. Also, there's the matter of active return. "You really have limited control over the amplitude of the return path and output levels so you can't readily use return energy as the reference for SLM measurements," Wavetek Indiana's Terry Bush, technical support specialist, says. That's one reason Wavetek recently introduced the LAN 450D Network Analysis Meter, an SLM with a built-in, phaselocked RF signal generator.

There's an SLM for almost every conceivable situation.



Wavetek's new LAN 450D

SLMs for LANs

On the other hand, LANs frequently are much easier to maintain than CATV networks. So LANs may not require all the test equipment a CATV operator might have on hand. For example, third order distortion and cross modulation aren't typically problems in LANs unless the networks are heavily loaded or using very long amplifier cascades, Bush says. Another factor to keep in mind is personnel. "Some operators won't have trained staff on-site to do system sweeps." LAN size also can make a difference. "A smaller network using only a single amplifier might be able to get by with a loop loss meter (LAN 450D) and occasional spectrum analysis to see what's on the net that you didn't put there," Bush says. Another advantage of the LAN 450D is the reaction time it affords. It's a one-piece device and doesn't require heavy technical background to interpret or use. And that's important when system down time is expensive.

"It might be more cost effective for a LAN user to buy a leakage detector than to run a sweep," Bush says. "I've seen some plants that have been running for five years and have never had a sweep run." Larger LANs, on the other hand, will require sweeps—especially if serious cascades (10 amps, for example) are used. The type of data being run also makes a difference. Some sweep techniques (high level sweeps among them) necessarily create a lot of interference. CSMA/CD (carrier sense multiple access with collision detection) systems are "a natural for interfering sweeps," Bush says. Interfering sweeps usually will run transparently on a CSMA/CD system because they're set up to sense collisions and automatically retransmit. Token ring systems, by way of contrast, can't tolerate interfering sweeps to the same degree. A "sweepless sweep" or low level synchronous sweep works better with token ring nets.

Bush recommends a minimum level of leakage detection testing and equipment for LANs, because the levels run are much lower than is typical for CATV networks. Ingress is probably a bigger problem than egress, especially co-channel interference caused by TV transmissions in the VHF bands. Loading schemes used by LANs tend to be more random than is typical in CATV and that tends to compensate for composite beat problems on LANs. Relative group delay, on the other hand, might be a bigger problem for LANs than for CATV.

Building products for broadband LANs is changing Wavetek's engineering philosophy a bit. In the past, test accuracy was among the most important design goals. And while that's still important, in a LAN environment, reaction time has grown in importance. Wavetek wants equipment that's easy to set up and easy to operate; to get tests done faster and to save labor. "Overall, our concept is to reduce the amount of overhead required to maintain a network, not focus exclusively on just test results," Bush says.

Calibration checks

Calibration checks are important

If any two words can sum up Texscan Instruments' approach to the SLM market, those words are 'portable' and 'rugged.'

since level readings between similar meters might vary by a few dB even when all are set to the same specifications. Also, if the meters will be used at widely varying temperatures (other than room temperature for example), they should be calibrated at high and low temperatures so error correction is possible. Sadelco's spectrum calibrator can be used to make calibration checks. The SC 450 calibrator generates a white noise signal containing all frequencies between 4.5 MHz and 450 MHz, all at the same amplitude. It compensates for the different IF bandwidths meters have by generating a narrow-band, crystal-controlled signal with accuracy ±0.25 dB.

Wavetek's MC-50-400 Tunable Meter Calibrator also can be used to tune SLMs over the 4 to 400 MHz range with an accuracy of ±0.25 dB. Wavetek additionally has the AutoBite automated signal testing system that monitors each carrier on a system, measures levels, checks for modulation and hum modulation, measures temperature, stores and analyzes the data. Using an IBM PC software package, a PC or compatible controller and remote SAM meters with RS-232 ports, AutoBite can poll 24 remote sites, 70 channels at 10 automatic testing times.

Texscan Instrument's new Spectrum II meter

Texscan Instruments

If any two words can sum up Texscan Instruments' approach to the SLM market, those words are "portable" and "rugged." The company recently revamped its SLM line with two new models that offer the best warranty available in the industry: two years on every SLM. The basic design philosophy was to engineer toughness into the device, recognizing that in CATV settings, the meter will literally be thrown into the back of a utility van and be carried up and down telephone poles. Also, some of the design engineers at Texscan have backgrounds in the consumer electronics industry, and

The SAM III is programmed to select any frequency within 0.1 MHz across the band.

there the philosophy is that devices "have to be right and have to last a long time," says Gary Gerhold, company vice president and general manager.

In fact, Texscan's product reliability is up by a factor of three over the past three years. The company goal is less than a 5 percent return rate on shipped instruments. In the high-volume consumer electronics industry, manufacturers shoot for a 1 percent return rate. Texscan's corporate philosophy is simple: be a world-class manufacturer of portable, rugged test equipment.

Texscan also does a lot of custom work. In fact, the company resembles a big engineering model shop more than a high-volume production run manufacturer. "Every customer has some unique needs and we have to respond to those needs," Gerhold says. In fact, lots are often so small that traditional statistical process control procedures aren't possible. Instead, every SLM that goes out the door has been individually tested. Later this year, vibration and shock test equipment will be installed at Texscan's plant to find latent mechanical problems in SLMs and all other portable devices made by the company. Also, RF modules are quite a bit more complex than digital boards, so more testing is necessary. "Every time you slap a case onto a device the capacitance and resistance changes," Gerhold points out.

Texscan's new SLM line features the Spectrum II, a two-button device that measures a single high channel and a single low channel on a broadband network. The handheld device is about the size of Sony Walkman and is accurate to within 1 dB. Using automatic power-off circuits, the single rechargeable 9-volt battery will last over eight hours. Low channels read are 3 (61.25 MHz) and 4 (67.25 MHz). High channels read are 36 (295.25 MHz) and 37 (301.23 MHz).

The Spectrum 600 covers the 5 MHz to 600 MHz frequency range in six bands and can measure from -35 dBmV to +60 dBmV with accuracy of ±0.75 dB to 450 MHz; ±1.0 dB from 450 MHz to 600 MHz. It uses a NiCad rechargeable battery and contains a built-in charger. It weighs 8.5 lbs. and is drop tested to mil spec. Previous models had a plastic case.

The Spectrum 700 weighs 13 lbs. and covers the 5 MHz to 600 MHz bands. It operates from zero to 130 degrees Fahrenheit. An audio monitoring feature is included. The unit has an aluminum case, internal charger and NiCad battery, padded weatherproof carrying bag. An audible tone indicating power on sounds at five-minute intervals. For more information, circle Reader Service number **75**.

An SLM for every need

Wavetek Indiana has a complete line of SLMs that range from simple installers meters to microprocessor-controlled rack mount versions. The newest addition to the family is the LAN 450D Network Analysis Meter that incorporates a phaselocked RF signal generator for stand-alone loop loss measurements from any point on the network. It measures data carrier levels, C/N and hum modulation. The LAN 450D can transmit and receive frequencies between 5 MHz and 450 MHz. Translator offsets can be stored in non-volatile RAM.

The low-priced DT-9 installer's meter is tuned to channels 2 and 13, but can be custom-ordered for other channels in the sub-, mid- or super-bands. Accuracy is ±2 dB and an ohmmeter is included.

The SAM Jr. covers the 10 MHz to 450 MHz range, has an audio speaker, RF attenuator switches, front panel calibration and an ABS plastic case. It's waterproof and weighs 5 lbs. Accuracy is ±0.75 dB.

The SAM I can be coupled with an oscilloscope to function as a spectrum analyzer, measures hum and voltage and is available in 300 MHz, 450 MHz or UHF versions. An internal calibrator allows accuracy within 0.25 dB and temperature calibration from the front panel. Frequency tuning is simplified by the five-band dial. The accompanying instruction manual fits into the SAM storage compartment.

The SAM III is a microprocessor-controlled meter with pre-programmed storage of standard and HRC channels (both video and audio carriers). All channels can be called up by channel designation (2 to 60) and format (standard or HRC). A "Next" button automatically tunes up one channel. The SAM III also is programmed to select any frequency within 0.1 MHz across the band. An internal calibrator allows temperature compensation ±0.25 dB. Hum modulation, voltage, and C/N tests are standard. A spectrum analyzer interface allows SAM III use with a standard X-Y display scope. Frequency range is 4 MHz to 450 MHz standard with optional UHF coverage. Remote control capability is provided by the integral RS-232 interface.

The SAM IIIE 600 has the same capabilities as the SAM III but covers

The Wavetek SAM IIIE 600

The SAM RACC is a rack-mounted 450 MHz meter designed specifically for remote automated testing.

frequencies to 600 MHz.

The SAM IV DX is a rack-mounted headend meter with a built-in display for spectrum analysis. The meter tunes to 60 standard or HRC channels (video and audio) or to any frequency (in 0.1 MHz increments) across the 4 MHz to 450 MHz range. A "Next higher" channel tuning function is standard. The SAM IV DX is compatible with the RT-1 remote terminal and RT-IV Automated Test System. An RS-232 port allows remote operation. Signal level measurements, hum, temperature or battery status can be interrogated remotely. An auto-answer modem operating at 300 bps, internal calibrator and enhanced peak detector (used to enhance mesurements on carriers using sync suppression scrambling) are included.

The SAM RACC is a rack-mounted 450 MHz meter designed specifically for remote automated testing and includes a auto-answer modem running at 300 bps, calibrator and enhanced peak detector. The RT-1 is a hand held terminal used for direct or remote testing of SAMs with an RS-232 interface. Circle Reader Service number **76**.

Sadelco

Englewood, N.J.-based Sadelco Inc. has a line of meters ranging from installer's to sophisticated 900 MHz devices with X-Y plotter terminals, composite video jacks, attenuators (10, 20 dB steps), internal calibrators, automatic shut-off, hum tests, S/N tests, voltage tests and low battery warning indicators.

The Sadelette is a hand held bar graph display meter available in two-channel versions for any channels or pilot carriers up to 300 MHz. It's designed for CATV converters.

The Model 733B installer's meter offers resolution ±2 dB and monitors the 54 to 216 MHz band. It weighs 5 lbs., has a built-in speaker and is powered by four 9-volt batteries. The Model 733C covers the 54 MHz to 450 MHz band, has automatic shut-off, a speaker and is accurate ±1.5 dB. A MK III low frequency adaptor is available for measurements between 4.5 MHz and 45 MHz.

The Model 719D weighs 7 lbs., reads in dBmV from 54 MHz to 216 MHz and 470 MHz to 812 MHz. The MK III adaptor is available for the 4.5 MHz to 45 MHz band. Accuracy is ±2 dB in the VHF bands, ±3 dB in the UHF bands. The 719D can be powered by batteries or AC.

The model 7450 covers the 54 MHz to 450 MHz band with accuracy of ±1.5 dB, has two 20 dB pads, an audio monitor, automatic shut-off and can be powered by NiCad, carbon-zinc or alkaline batteries. The MK III adaptor also is available for the 7450.

The FS 3D-VS is calibrated in dBmV with continuous coverage from 54 MHz to 540 MHz (the MK III adaptor will cover the 4.5 MHz to 54 MHz band). The 7 lb. meter has accuracy of ±1 dB in the 54 MHz to 450 MHz bands at 75 degrees Fahrenheit. An audio monitor, recorder jack, video jack for oscilloscope, 20 dB and 10 dB attenuators and automatic shut-off cicuit are standard.

The FS 3D-VU meter tunes the 54 to 216 MHz and 470 to 812 MHz bands. The MK III adaptor is used for 4.5 MHz to 45 MHz coverage. Accuracy is ±1 dB in the VHF bands, ±2 dB in the UHF bands. An audio monitor, X-Y recorder jack, oscilloscope jack, automatic shut-off circuit and 20 dB and 10 dB attenuators are standard.

The models Super 600 (4.5 MHz to 600 MHz) and Super 900 (4.5 to 890 MHz) are top-of-the-line meters with ±0.5 dB accuracy (Super 600) and ±1 dB accuracy (Super 900). S/N, hum modulation, voltage, and ohm measurements are standard. Audio output, X-Y recorder jacks, NiCad batteries, video output jacks and readouts in dB millivolt or dB microvolt are standard.

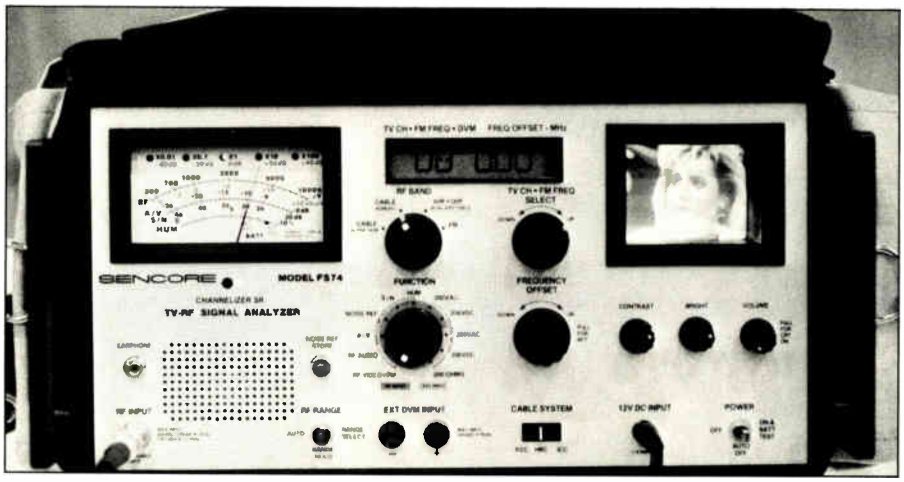
The meter readout has a 20 dB range with 1 dB markings. A calibrator is built-in. The Super 600/900 weigh 10 lbs. with case and batteries. Accessories include case, test leads, headphones, charger and AC adaptor, cigarette lighter charging cord, 12 rechargeable NiCad cells and manual. Circle Reader Service number **77**.

Comsonics

ComSonics Inc. sells the "Window," a 5 MHz to 550 MHz meter operating from -10 to 120 degrees Fahrenheit with accuracy of 0.5 dB at room temperature. A calibrator is built-in. The portable unit weighs 11.5 lbs. and

Sencore is a well-known name in TV test instrumentation and has introduced two SLMs for the broadband industry.

is powered by 12-volt sealed gel cell batteries operating for about six hours. On power-up, the screen shows a display of all video signals. From there the user selects a desired frequency to monitor. The screen then shows a detailed profile including channel, frequency, video level in dBmV and audio level in dBmV. S/N and hum readings also are standard. Circle reader service number **78**.



The new model FS74 "Channelizer Sr." from Sencore automatically returns HRC and IRC offset.

Sencore

Sencore is a well-known name in TV test instrumentation and now has introduced two SLMs for the broadband industry. The FS73 "Channelizer Jr." is a digitally tuned meter covering the FM, VHF, UHF sub-band, mid-band, hyper-band channels in standard, HRC or IRC formats. Automatic fine tuning allows the FS73 to tune all channels, whether standard or shifted, while a readout shows how far the carrier is from the assigned frequency with 1 kHz resolution. The FS73 also can be manually tuned in 50 kHz steps. An autoranging attenuator provides fast measurements over the entire input range of 5 microvolts to 1 volt with 1 dB accuracy.

The FS73 measures audio and video carrier levels, dB difference between audio and video carriers ±2 dB, hum modulation (60 and 120 Hz) and S/N (on any in-use channel). The FS73 hum test doesn't require an unmodulated carrier and can be used on any in-use channel. Audio output, IEEE 488 bus output capability (requires a Sencore IB72 interface) and automatic power-down are standard. Operating range is from -4 degrees to 104 degrees Fahrenheit. Power is 12-volt DC and the unit weighs 10.2 lbs. RF level accuracy is ±1 dB over VHF, sub-, mid-, super-and hyper-band; ±3 dB on UHF.

The S/N noise test requires storage of a reference noise signal. Two references can be used: noise on an unused channel or noise measured during the vertical blanking interval of an in-use channel. Most SLM S/N references are based on unused channels. But vertical blanking interval measurements, where possible, can provide a better indication of individual channel S/N. Amplifiers generally contribute a uniform amount of noise throughout the spectrum. Signal processors, however, tend to contribute noise only within a narrow bandwidth.

The model FS74 "Channelizer Sr." offers even more interesting features. Like the FS73, the FS74 uses a digital tuner to lock on to all frequencies typically used on a broadband network (FM, VHF, UHF, sub-, mid-, super- and hyper-band) with 0.1 MHz accuracy and a flat 5 microvolt sensitivity and 1 dB level across all bands. Automatic fine tuning finds any frequencies offset from standard. Manual tuning in 50 kHz steps also is possible. An autoranging attenuator allows fast and automatic level measurements over the entire range of input signal levels. Like the FS73, the FS74 also measures video and audio carriers and displays the dB difference between the carrier levels. The S/N measurements can be done on any in-use channel. Hum measurements also are automatic. Autoranged volt and ohmmeters are built-in.

An interesting and unique feature is a built-in three-inch CRT monitor with 3.5 MHz bandwidth that can be used to visually test for interference, ghosting or other video signal impairments that might not show up on the quantitative tests. The monitor is adjustable for brightness and contrast and derives sync digitally so no user adjustments are required.

Audio output, IEEE 488 bus interface capability (a Sencore IB72 interface is required) and automatic power-off features are standard. The FS74 weighs 13.5 lbs. and is powered by 12-volt DC. For more information circle reader service number **79**.

Matrix Test Equipment

Three signal strength and distortion meters are made by Matrix Test Equipment. The Model R-12 automatically measures cross-modulation, composite triple beat, discrete second and third order. The signal strength meter gives readings in dBmV while distortion is displayed linearly in dB. The R-12 operates over the 5 MHz to 500 MHz range standard. Frequencies to 1,000 MHz can be special ordered.

The AR-12 has IEEE 488 bus remote control ability, standard commutative filter processor, and automatically measures cross-modulation, composite triple beat, discrete second and third order distortion with resolution of 0.5 dB. The AR-12 operates over the 5 MHz to 500 MHz frequency range standard and 1,000 MHz can be special ordered.

The Model R-75 has the testing features of the AR-12 but adds test capability for composite second order and carrier-to-noise. The R-75 reads power in dBmV and can make CTB, CSO and C/N measurements on channels where no carriers are running. In addition to supporting the IEEE 488 bus interface, the R-75 also supports the RS-232 interface. Circle reader service number **80**.

—Gary Kim

Broadband modem market in flux

The broadband RF modem vendor base is in a state of major transition. Several traditional players have already phased down their operations and a few others will probably put their own nameplates on boxes manufactured by somebody else. One of the newest players is **ISC Datacom**, a subsidiary of International Signal & Control Group PLC, a multinational company specializing in military, defense, aerospace and telecommunications businesses. ISC Datacom is a broadband RF modem company led by familiar names: Chuck Frank, vice president of sales, and Ken Crandall, senior principal engineer, both of whom were principal figures at Zeta Laboratories. Zeta has justly earned a reputation for quality and ISC Datacom should do as well or better.

ISC Datacom's first two products are the Model 1019 RF Modem and the Model 1056 RF Modem. The 1019 runs up to 19.2 Kbps, is protocol transparent, uses QPSK modulation for spectral efficiency and can run as many as 2,650 data channels spaced at 25 kHz (66 MHz total bandwidth). Features include forward error correction (nine-bit error bursts for all data rates except 19.2 Kbps), built-in BERT, remote loopback, switch selectable single and dual cable interfaces, local and remote control of frequency, power, format and diagnostics.

The Model 1019 runs synchronously at 1200, 2400, 4800, 9600 and 19,200 bps; asynchronously from 0 to 1200, 2400, 4800, 9600 and 19,200 bps. The eight-pound modem can be rack-mounted and has a dynamic range of -20 dBmV to +20 dBmV. Transmit and receive frequency pairs run from 5.75 to 396 MHz.

Allen-Bradley's new modem.

The Model 1056 runs at 56 Kbps, is protocol transparent and uses 100 kHz spacing (66 MHz total bandwidth) for a total of 662 data channels. Its other features are the same as the Model 1019 except that the Model 1056 can be configured in either full or half-duplex.

In quantities of nine or less, transmitting at less than 732 MHz, the 1019 costs $1,695. For transmit frequencies between 72 and 384 MHz, boxes cost $1,870.

In quantities of nine of less, transmitting at less than 72 MHz, the Model 1056 costs $2,190. For transmit frequencies between 72 and 384 MHz, the box costs $2,365. For details circle Reader Service number 81.

Allen-Bradley, the Rockwell International-owned factory automation com-

Manufacturing Automation Protocol connection prices have just fallen 40 percent.

pany, has a new 19.2 Kbps frequency agile aysnchronous modem designed for point-to-point and point-to-multipoint applications. The firm also has introduced a line of VistaLAN/3 products that are compatible with Ethernet. For details circle Reader Service number 82.

LanTel Corp., the Norcross, Ga.-based supplier of broadband voice and

Ken Cooper

data modems, has a new Model 840 single-line trunk modem that links to any standard PBX system or telco Central Office line. It also can be used to create a voice bridge between two physically separate broadband networks. Getting outside consists of the familiar "dial 9" routine used by standard PBX systems. The 840 and its companion product, the Model 810 (which connects to a single-line, tone-type telephone) are programmable in 50 kHz increments. Single-unit Model 840s sell for $1,425. For details circle Reader Service number 83.

Digital Equipment Corp. now is reselling **Chipcom Corp.**'s entire line of "Ethernet over broadband" LAN products in the Far East, Central and South America, the Caribbean, Australia, New Zealand and Canada. For details on Chipcom's product line circle Reader Service number 84.

Ken Cooper is the new director of sales for Fairchild Data Corp., the Scottsdale, Ariz. manufacturer of broadband modems.

MAP (Manufacturing Automation Protocol) connection prices have just fallen 40 percent to less than $450 per port. **Concord Communications**, which specializes in MAP networks, says the per-port connection is that low on its 10 Mbps Terminal Server with 12 ports. The unit sells for $5,250 and is available 30 days ARO. For details circle Reader Service number **85**.

Bridge Communications, the prolific LAN gateway and bridge manufacturer, has a new CB/1 5 Mbps bridge connecting different broadband LANs, extending the reach of a single Bridge broadband network (to 15 miles). The CB/1 supports six channel pairs and multiple CB/1 units can be used to support all six Bridge network channel pairs.

The company also has a new two-port communications server designed for unobtrusive placement of one or two terminals on a broadband network. A college dormitory room or data-entry terminal point are examples of where it might be used. The server has the same footprint as Bridge's RFM/5 modem. The CS/50 is priced at $1,495 and is available 30 days ARO.

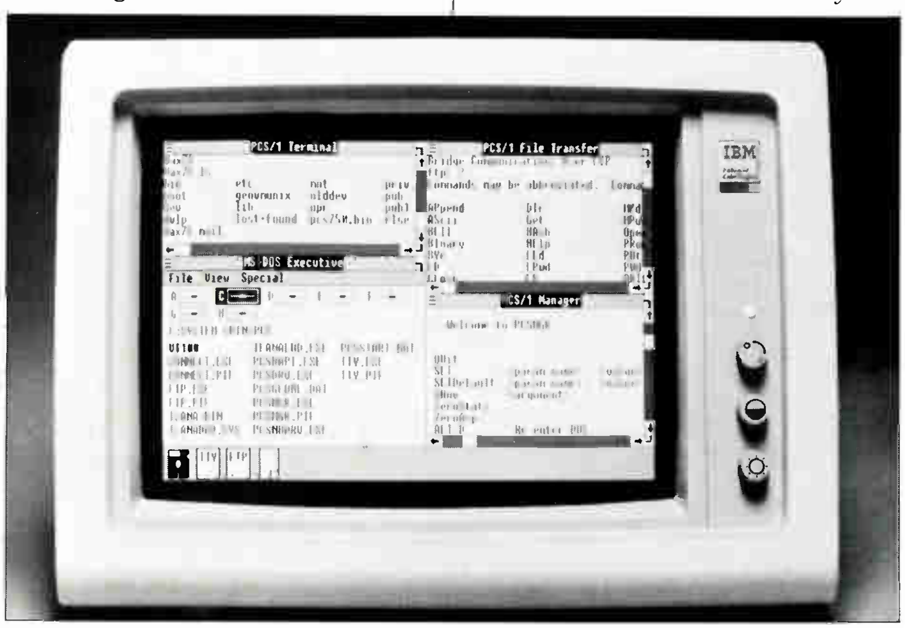
Also new is a PCS/1 communications server with NETBIOS interface for connecting IBM PCs or 3270 hosts to Bridge's 5 Mbps broadband network. The PCS/1 runs the TCP/IP (Transmission Control Protocol/Internet Protocol) favored by the Defense Department and costs $1,195. It's available 30 days ARO. For details circle Reader Service number **86**.

General Electric Fanuc Automation North America has introduced six interface and modem boards that allow its Series Six Plus programmable controllers connection to MAP carrierband networks. They're priced at $3,150. For details circle Reader Service number **87**.

LANEX (formerly Kee Inc.) has a new model PC588 IBM PC interface to its broadband LAN. The PC588 costs $695 and is available now. For details circle Reader Service number **88**.

Cadco, the Garland, Texas-based manufacturer of CATV headend electronics, has several modulators and translators suitable for LAN use. The 250B modulator outputs channels T7 through YY (5 to 440 MHz). The 350 modulator outputs frequencies from 54 MHz to 440 MHz. Cadco's frequency translator converts almost any 6 MHz band to any other frequency, up or down, from 6 MHz to 440 MHz, including 156.25 and 192.25 offsets. For details circle Reader Service number **89**.

—Gary Kim



Bridge Communications' PCS/1 personal communications server.

Design principles for broadband LANs

Some tips on designing a system.

Designing a broadband LAN is an awful lot like designing a small two-way cable TV network, although data applications may require improved C/N and peak-to-valley while one-way video probably requires better distortion performance, in particular composite triple beat. Both networks are specified with reference to the 6 MHz video carrier level. And in LAN as well as CATV applications, the transmit level from each active device is typically set at 56 dBmV in the forward path; 10 dBmV in the return path. Each outlet, or drop, would typically receive 6 dBmV of signal.

Peak-to-valley response over any given 6 MHz channel should be 1 dB or less, with total system peak-to-valley of 3 to 3.5 dB or so. System C/N should run between 42 and 45 dB—closer to 45 in the forward path. Hum modulation should be held to between 2 percent and 3 percent; carrier-to-second order at -60 dB; carrier-to-composite triple beat at -51 to -53 dB. Egress should conform to FCC rules.

A common suggestion is to run data carrier levels about 13 dB below video when 300 kHz data channels are used; 18 dB below video when 96 kHz data channels are used. There's a simple reason. "You want the amplifier to see a channel power loading equivalent to a video signal when using multiple narrow band signals," says General Instrument (Jerrold Division) Applications Engineer Helmut Hess.

Push-pull amplifiers ought to work in most situations. Feedforward might be overkill in many situations, since amplifier cascades are generally much smaller in a LAN than a CATV plant. On the question of bandwidth, Jerrold's Hess prefers 450 MHz. "The added distortion products, slope changes and channel loading are the problem. You might lower signal levels, but then you're running the risk of C/N problems," he suggests.

And while harmonically related carriers (HRC) or incrementally related carriers (IRC) reduce beat products in a CATV system, Hess questions their application for LANs, because "in most cases you don't have enough video channels or a long enough cascade to see the improvement."

On mid-split systems, there seems some disagreement among designers on where the lower edge of the forward bandpass ought to be. Sometimes it's specified at 162 MHz. Other times it's set at 168 or 174 MHz. Amplifier filter roll-off seems to be the cause of the disagreement.

Small LANs—those requiring only two amplifiers or less, in cascade—might be able to use line extenders exclusively. But as in CATV, any cascade longer than that requires trunk and distribution gear.

—By Gary Kim

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C-band or Ku-band: The debate rages on

Survey of engineers finds no consensus.

Few issues have polarized the engineering community more than the present debate over the need to switch from C-band delivered programming to Ku-band delivery. In the June issue of CED, *position papers from HBO and Viacom spelled out what those two companies believed were the major issues surrounding the controversy. In its paper, HBO argued for a move to Ku, citing facts like: C-band birds are approaching the end of their design lives, the cost and availability of capacity, the features and capabilities of new spacecraft and changing market forces. Viacom countered with a three-pronged argument based on performance, protection and price considerations.*

What follows is our own survey of several engineers representing leading MSOs. Not surprisingly, opinions on the subject are broad-based and issue-oriented. Everyone contacted agreed that resolution of the issue is important and acknowledged that rain fade is a fact of life with Ku technology. Beyond that, however, we found no basis for a consensus on what to do next.

Tom Elliot

Tom Elliot, director of research and development, Tele-Communications Inc.: Firmly entrenched in the C-band camp, Elliot questions the need to change technologies, given the huge amount of capital the industry already has tied up in C-band equipment.

"We're committed to C-band technology because we have such a massive installed base and it's doing a hell of a good job for us," says Elliot. "We as an industry have a tremendous investment in C-band and we're not interested in obsoleting it. Right now we transmit data via Ku-band, so I'm speaking from experience, and we have problems."

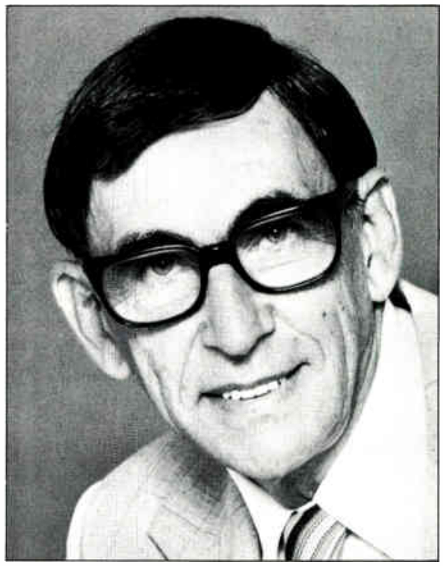
Elliot is also concerned about the business implications of a move to Ku-band that would allow programmers to market product direct-to-home. "If the same transponder is used to feed both homes and cable operators, CATV is effectively underwriting DBS. From our perspective, if you're going to fund something, you need to figure a way to participate in it."

Jim Chiddix, vice president of engineering and technology, American Television and Communications: It's not surprising that the view at ATC is pro-Ku given that the company is owned by Time Inc., the same company that owns HBO. But Chiddix's argument isn't as one-sided as it could be.

"Technically, it's a tossup," admits Chiddix, "the issues, to me, are more political and strategic." He admits that rain will diminish signal performance, but believes that can be overcome by larger receive dishes; terrestrial interference can affect C-band transmissions, but has largely been overcome, he notes; and smaller Ku dishes will be more convenient, but that is of little consequence, Chiddix says.

Instead, Chiddix builds his argument around the very notion others hesitate to even whisper about: DBS. "We must recognize that satellite delivery (of programming) to the home is out there anyway and we need to be prepared to deliver video in whatever way it works for the customer. It's naive to believe that satellite delivery isn't going to happen if we don't support Ku-band satellites—I can't buy that assumption. I don't want to be left out of the direct satellite delivery business as it develops."

Roy Ehman, vice president, engineering, Storer Communications: "I'm one of those people on the fence. I understand the merits of both but I think we're being led to something—



Roy Ehman

DBS possibly. We're using 4.7-meter dishes at one of our broadcast stations for Ku network feeds and last year we had two minutes of outage. Ku-band would be better for SMATV, certainly, and does provide TI immunity that could be helpful in a number of situations."

Frank Ragone, vice president of engineering, Comcast: Comcast has installed one Ku service in one of its systems and is "carefully watching what goes on in the real world," says Ragone. "So far, the performance of the one receiver isn't too satisfactory, but we don't want to blow the whistle yet until we're sure we're doing everything right."

Pat McDonough, chief engineer, United Cable Television: "I think it's a technical toss-up. Business-wise, though, we've got so much C-band equipment out there we can't scrap them. We have three to five earth stations at most of our headends and we just aren't going to change them out. We do like the smaller reflectors Ku technology allows, though. We plan to put in a couple of dishes, evaluate and test them. In any case it'll take some time to master the technology. It sure took some time to learn C-band."

Joe Van Loan, vice president of

Everyone agrees that downlink sites will be affected by rain but Van Loan suspects uplink sites will too.

engineering, Viacom Cablevision: The official company line at Viacom is to remain committed to C-band. But, like Chiddix, Van Loan sees the merits of both technologies and remains open-minded.

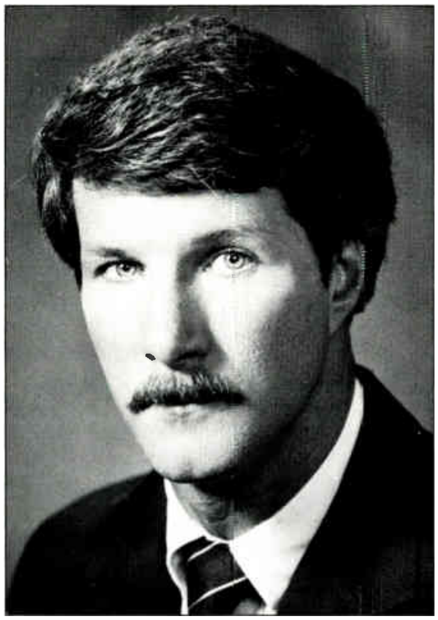
"I still give it (Ku technology) room," says Van Loan. "We're going to go ahead and put them up and look and see. I suspect, however, that time will show it's just borderline—that if the problems with rain were any worse we probably couldn't use Ku-band. We'll find out, I think we need to. But my gut feeling is that when we're all done Ku-band will be a marginal situation for us."

Van Loan notes that broadcast affiliates often back up their Ku earth stations with a second earth station several miles away so that if one is affected by rain, the feed can be switched to the back-up, which is most likely not being rained on at the same time. "But a cable operator who is using five earth stations and 30 channels can't go down the road 10 miles and do that. So, where the network affiliates with a single channel have opportunity for space diversity, the cable people really won't have—and that might be the thing that cooks Ku's goose."

Everyone agrees that downlink sites will be affected by rain but Van Loan suspects uplink sites will too, forcing programmers to construct an alternate uplink facility. "I think if one snuffles around enough, he'll find it's almost essential to do that," says Van Loan. "That could hurt the small programmer" because they may not be able to afford it, he notes.

Bob Luff, vice president of technology, Jones Intercable: "There's no question in my mind that C-band is superior in a cable TV environment to Ku," says Luff. "We're selling service and quality, so why walk away from a system that's highly reliable, almost unaffected by rain and which we have years of experience with?"

Luff is also concerned about the economic impact on a cable operator caused by a shift to Ku. "With C-band, we have experience and training all the way down to the technician level, spare parts, interchangeability of equipment and test equipment already in place. I know of places served by Ku satellites that are experiencing 30 minutes of continuous outages during heavy rains and 10- to 15-minute outages are quite common."



Bob Luff

By going to Ku, which is "incredibly more difficult to align," notes Luff, cable operators increase the chances of irritating their subscribers, when the emphasis should be on reducing that chance. And concerning DBS, says Luff: "I like competition because it makes us better, but why do we want to play right into our competitor's hands? That just doesn't make any sense. We have surplus transponder space on C-band. So we haven't even eaten all that's on our plate and somebody else is shoving another menu at us that we don't even like."

Dave Large, vice president of engineering, Gillcable: "There are ups and downs to both, technically," says Large. "I happen to have a tremendous TI problem here so I'm looking forward to seeing if I get better pictures of that Ku-band dish. If I do, I'll use it for my primary feed."

Large realizes that Ku may hasten DBS' entrance in the U.S., but remains undaunted. "I think DBS is coming and I think HBO is not blind to that fact and it's to their advantage to get aligned to Ku."

Brian James, director of engineering, National Cable Television Association: "Rain outages is what I think about for systems using Ku-band technology. Without question, operators using Ku have noticed outages. But the question is, what caused the outages? I don't think we're sure yet whether it's really rain attenuation or boresights that are off-peak slightly. When the weather's good, an off-peak boresight won't be noticeable. Heavy rain's another story. TI protection and ability to use smaller reflectors is an advantage for Ku and there's not that much difference in the electronics. What's best 10 years from now is the issue. C-band could get to be a bigger problem if more telcos convert their microwave links from analog to digital because that puts more power out there and it's harder to trap out."

The cable industry needs to keep an open mind about Ku technology, says one vice president of engineering who preferred anonymity. "Rain fade is a big issue, but in the early days of C-band technology, there were concerns that Farraday Rotation would take us off the air. But it never happened," he says.

Despite Ku-band proponents' arguments that rain fade is offset by C-band's sun outages, this VP notes that sun outages are entirely predictable and occur during hours when there are fewer people viewing. "Sun outages can be planned for. If you take that same body of time and disperse it throughout the year, then you wind up with a much different problem. So the key question is, 'How will service to the subscribers be hurt, or helped, by this transmission method?'

"But we have to scope all the issues out. Let's examine it carefully and operate both bands if we have to. We don't know if those people who have had problems have followed the correct procedure. HBO put us on the satellite to begin with. It was the right thing to do at the time. Maybe this is the right thing to do now.

"When we lack the vision to go into something new, we've gotten ourselves into the classic 'maturing trap' where we're satisfied with the status quo. We have to watch out for that. When that disease sets in, we have to inject the cure. Complacency is dangerous."

—Roger Brown and Gary Kim

A 550 MHz system from the ground up

Pre-construction planning a must.

US Cable Corp. recently constructed a 550-MHz, two-way active system in Paterson, N.J. In addition to the normal delivery of cable TV channels, the system was required to carry data signals both downstream and upstream to traffic controllers throughout the city. The traffic control system is a polling type system, sending a data carrier at 153 MHz downstream and a return carrier at 15 MHz upstream.

To meet the challenge, US Cable Corp. constructed a state-of-the-art, single trunk, single feeder, sub-split system utilizing Jerrold's JX-3000 series amplifier. This 550 MHz amplifier was equipped with a Feedforward, auto gain and auto slope trunk module, Power Doubling bridger module, station by-pass, trunk and power pack redundant modules at every station. In addition, pole-mounted standby power supplies were installed throughout the system. The following are considerations and concerns that were addressed prior to and during the construction of this system.

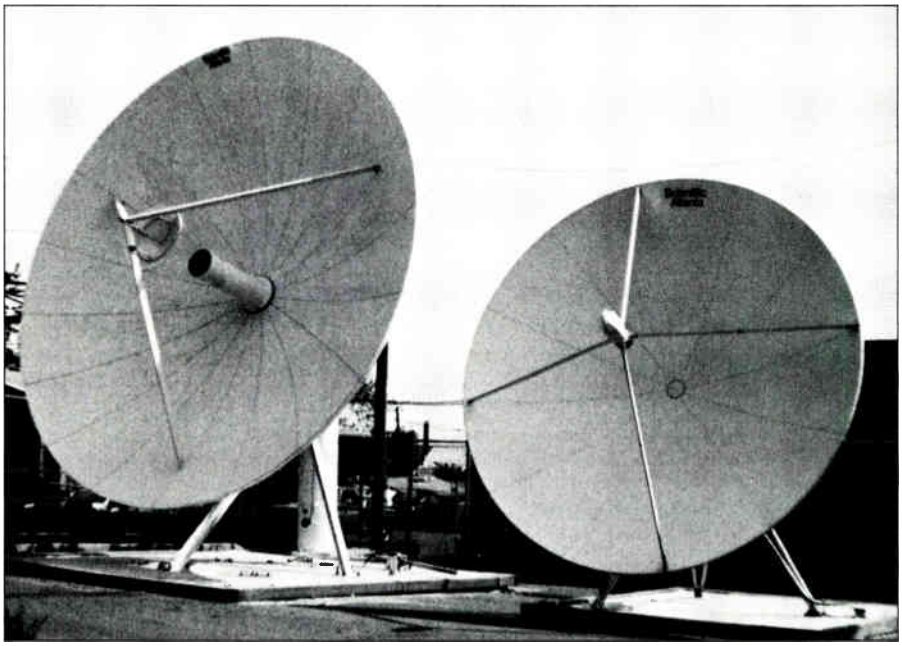
The headend

The headend site was pre-selected by the City of Paterson, with the assistance of consultants, prior to the franchise being granted. Its location is in the southwest section of the city and was found to be electrically quiet, relative to its surroundings. The reason for this pre-selected location was to insure co-existence with the traffic operation department and computer.

An on-site TVRO satellite survey indicated that terrestrial interference was present on various transponders received from Galaxy I at a signal strength from 6 dB to 12 dB below the level of the desired TVRO carriers. The solution to reduce or eliminate this interference was to either select a TI fence and/or barrier to utilize a TVRO satellite dish which could discriminate, sufficiently, the TI from the desired carriers. The latter was chosen, using a Scientific-Atlanta 7-meter satellite dish, which lowered all TI to at least 12 dB below the desired carriers, eliminating any visual TI.

The modulator and processor units selected were to be completely BTSC stereo compatible. Scientific-Atlanta 6350 modulators and 6150 processors were chosen and racked up for 77 channel capacity with 54 channels active from day one. Fourteen satellite channels were selected to have BTSC encoded audio and the S-A 6380 BTSC encoders were utilized with excellent results. All the headend racks sit on a raised computer floor, which eliminates unsightly wiring and/or ducts.

The channel lineup was set to a -12.5 kHz IRC offset and since an active two-way system was to be installed, with concern given to potential ingress, special Viewsonics passive combiners with RF shielding of greater than 110 dB were installed. The minus offset was selected so that a 22.5 kHz difference would be maintained with most off-air channels, should they cause ingress interference. Channels 5 and 6 were set on a proper IRC assignment, allowing maximum protection from composite second order (CSO) distortion.



The headend was wired to allow video and audio flexibility through the use of a Trompter video/audio patch panels. A frequency agile modulator gives an even greater flexibility with its inputs available on the patch panels and is also available as a redundant modulator. A standby power generator and line-regulating transformers were added to supply standby power, line protection and regulation.

TABLE 1

	Input	Slope	Output
Trunk	12 dBmV	6 dB	38 dBmV
Bridger	—	9 dB	48 dBmV
P.D. L.E.	21 dBmV	9 dB	*45 dBmV
Q.P. L.E.	21 dBmV	9 dB	*48 dBmV

* Derated by 3 dB for two amplifiers in cascade.

Distribution system

The distribution system selected was Jerrold's JX-3000 series amplifiers. This series of equipment was configured as feedforward trunk, power

When establishing operating levels, one must consider the "compression point" of the equipment used.

doubling bridger and line extender amplifiers with Quadra Power line extenders used at some locations where higher output levels were desired. Use of the quadra power line extenders reduced overall actives in the feeder system while maintaining performance.

The entire distribution system was configured as a sub-split, single trunk, single feeder system with active trunk return, and scattered active return feeder where required. The Jerrold equipment was selected for the following reasons:

- reliability
- redundancy
- station by-pass
- operating performance.

In the author's opinion, reliability and redundancy are, in a CATV system, synonymous. The JX-3000 electronics fit perfectly in the Paterson distribution system design concept. Redundant trunk return and power pack modules were installed at all trunk station locations. The feedforward trunk module is, in itself, a form of redundancy and complements the fully redundant station. Bridger redundancy was not selected since it was felt that bridger module failure was of lesser concern and would only affect a localized area.

Station by-pass was also an important ingredient. Since the traffic control system data carriers and 153 MHz downstream and 15 MHz upstream can operate, if need be, in a poor C/N environment, station by-pass would insure signal continuation in the event of a module or power failure. Further, during normal maintenance work that may require a module change, station by-pass insures passage of the data carriers.

The primary reason for selecting the JX-3000 amplifier for the Paterson cable system was its performance. Environmental chamber tests, for 77 channel loading, indicated that the JX-3000 amplifier, configured as feedforward trunk, power doubling bridger and power doubling and quadra power line extenders, exhibited excellent results in terms of composite triple beat (CTB) and CSO. It was determined that a major contributor to this performance was the selection of "hand-picked" preamplifier chips in the trunk module. These chips were manufactured by PHI and exhibited a low noise figure with minimum contribution to distortion.

Based on these test results, US Cable set operating levels and end-of-system design specifications which Jerrold agreed to meet. These parameters, which determined operating levels for 77 channel loading, are shown in Table 1.

Compression point

When establishing operating levels, one must consider the "compression point" of the equipment used. If this point is exceeded, distortion performance can no longer be predicted and the familiar 2-for-1 change in distortion will be exchanged for the unknown.

Compression point can be calculated and shown that in 550 MHz standard or feedforward hybrid chips, compression occurs at about 50 dBmV, with 77 channel loading, without sloped outputs. A 9 dB slope will raise the compression point to about 54.5 dBmV. The use of parallel hybrids will raise the compression point another 3 dB and quadra power yet another 3 dB.

TABLE 2

Distortion Parameters

* C/N = (58 - 10 Log N) dB + 61 dB (BR) + 61 dB (LE)
* CTB = (-84 + 20 Log N) dB + (-62) dB (BR) + (-65) dB (LE)
* XM = (-84 + 20 Log N) dB + (-64) dB (BR) + (-66) dB (LE)
* 2nd = (-86 + 12 Log N) dB + (-72) dB (BR) + (-73) dB (LE)
* CSO = (-75 + 12 Log N) dB + (-62) dB (BR) + (-64) dB (LE)
* P/V = (NT + NF) /10 + 2 dB

Where N and NT equal the number of trunk amplifiers; NF equals the number of feeder amplifiers; BR equals bridger amplifier; LE equals line extender amplifier; + equals the power sum; and + equals the voltage sum.

With this observation, one will quickly realize that parallel and quadra power hybrids should be used primarily in the distribution and standard or feedforward chips in the trunk. Also note that the compression point is raised still higher in the real world when carriers are randomly modulated by TV sync.

Distortion parameters

Cascade limitations were set and based on the perceptible intermodulation limit curve ("W" curve), as shown in Table 2. This curve dictates that CSO be no worse than -52 dB and that CTB be no worse than -57 dB below visual carrier. If an incremental or harmonic carrier plan is utilized, a conservative, subjective visual improvement of about 6 dB can be expected in CTB distortion. This, then, would set the system limitation so that CSO shall be no worse than -52 dB and CTB no worse than -51 dB.

It should also be noted that special consideration must be given to tap output levels. Sufficient tap levels must overcome converter and/or subscriber terminal equipment noise figure, maximum drop cable length and drop passive attenuations.

Further, consideration must be given to the "cable-like" attenuation characteristics affecting design selection of fixed attenuators and equalizers at amplifier stations. It's best to know the equipment by conducting sweep tests to determine actual characteristics and use these results in the design specifications.

When parameter limitations are reached, through the use of the above formulas, the maximum trunk amplifier cascade calculated becomes about 19 or 20, with CTB still the limiting factor. Temperature swings should require that the designer allow degradation to the calculated parameters. However, if actual channel loading is less than maximum, and if modulated carriers operate with random sync, sufficient headroom exists.

The usual care in handling coaxial cable still exists in 550-MHz systems. Additional concerns however, as to how equipment is spliced, the connector type selected, the use of housing-to-housing connectors to eliminate cable jumpers and the placement of passives, relative to actives, has an even greater effect on system response than narrower passband systems.

Obviously, with the use of Feedforward, Power Doubling and Quadra Power electronics, power consumption

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CORE has a macro feature with the capability of performing as many as 259 commands.

three source/power keys. Keys are grouped by color for the various functions they serve.

Universal Remote Systems

Unicom (for Universal Infrared Communicator) from URS has been fully preprogrammed to operate any infrared-controlled device built since 1981. Sporting 42 keys, the unit can control both audio and video products as well as any other application controlled by infrared commands.

A special macro function key allows several different functions to be performed at the stroke of a single key. And the unit cannot be obsoleted because it can be field reprogrammed via any IBM PC XT compatible fulfillment station with a serial communications port.

Various color-coded key overlays are available depending upon how each key is programmed to work. According to Hal Bjorklund, president of URS, the remotes will be marketed exclusively to MSOs. The unit will sell for $79. Circle Reader Service number 53.

CL9

This new start-up company offers the CORE (Controller of Remote Electronics) learning remote through retail outlets only. The unit has just 17 keys (plus 12 more programming keys located in a hidden compartment) but utilizes two microprocessors and a real-time clock to allow unattended, programmed recording of events.

CORE can control any video or audio product as well as appliances and security systems controlled by infrared. It too has a macro feature, with the capability of performing as many as 259 commands by pushing a single button. The units, which retail for $199, are being marketed to the upscale consumer, according to company spokesmen.

In addition to these previously mentioned manufacturers, vendors like Scientific-Atlanta, Magnavox and Onkyo have jumped into the fray. Magnavox's STAR universal remote is preprogrammed to work with Magnavox TVs, 32 brands of VCRs and 16 cable converters. This learning remote will be offered for $100 as a standalone unit. Onkyo's Unifier RC-AV1 can learn the functions of audio and video products.

—Roger Brown

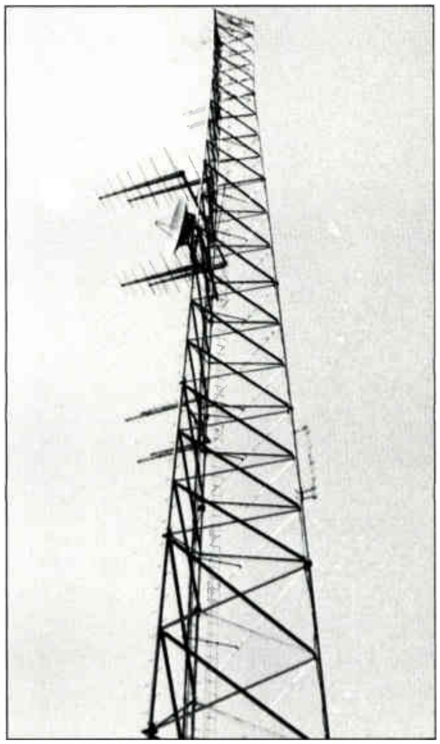
Continued from page 69

becomes a major concern. Urban system design dictated that about 0.5 to one power supplies per system mile is required. US Cable system design specifications helped to reduce this number slightly. Use of 18 amp. dual-cable power supplies, with back-to-back power inserters, at 80 percent loading, aided in reducing the number to 0.45 units per mile.

Other statistics one must be ready for in a 550-MHz urban build include: one trunk amplifier per system mile; five to six line extender amplifiers per system mile; and 55 taps per system mile, with 50 percent or greater being eight-way taps.

Set-up and sweep

Sweep alignment controls in 550-MHz trunk modules are numerous with little or no controls in feeder amplifiers. Setting the 550-MHz trunk module requires greater care than reduced bandwidth electronic modules. Calan manufactures a non-interfering 550 MHz field sweep system. Presently, this is the only 550 MHz non-interfering sweep system available to the cable industry that the author is aware of. Although this field sweep system operates well, I recommend keeping field amplifier adjustments to a minimum. A technique recommended is to bench align the trunk module flat and restrict field alignment to the equalizer board with care taken to properly select equalizers to compensate for the cable-like attenuation of passives. Another technique is to bench align with actual cable the passive equivalents to field conditions, restricting field alignment to the equalizer board. These techniques have insured meeting the required response.



Urban systems containing 550 MHz equipment are being constructed today with excellent results. Care and consideration must, however, be given to equipment selection, system design, cascade limitations, system reach, construction methods and sweep alignment techniques. Similar problems in the past were overcome by the cable industry and today, throughout the country, urban builds at 550 MHz are beginning operation.

Acknowledgements

The following people are acknowledged for their assistance: Bob Young, General Instrument; John Ridely, General Instrument; P.J. Otten, Systems Performance Engineering Inc.; and Steven Biro, Biro Engineering.

By Steve Raimondi, Director of Engineering, US Cable Corp.

Improved video quality signals heat is on for cable operators

Now that strikingly better video pictures have become available via Super VHS tape machines and improved video monitor/receivers and HDTV seems to be just around the next bend in the road, leading cable engineers are prevailing upon the need to improve signal quality to subscribers. Better signal-to-noise ratios, shorter cascades, better electronics, fewer outages and new architectures are being introduced or contemplated to keep cable competitive with the new benchmarks videotape has established.

But hang on to your hat because cable isn't the only one attempting to improve signal quality. The issue was ever-present at this year's NAB convention in Dallas. Broadcasters spent a lot of time listening in technical seminars on proper antenna deployment (and discussing new antenna design techniques), the status of BTSC stereo and Surround Sound, and a renewed commitment to have more bandwidth allocated so that HDTV can be delivered via terrestrial means.

What this all means is that everyone is scurrying to look better in the eyes of the viewer because it's in everyone's best interest. No one wants to squander an opportunity by failing to respond to the new, quality-oriented trends. So cable operators, if you haven't noticed from the other references to better video in this issue of *CED*, it is important to transform this interest in better pictures into a higher number of subscribers.

New products to be announced include a lot of satellite receive gear. From **Microdyne** comes the 1100-CKR satellite video receiver for C-band or Ku-band applications. The unit takes 1.75 inches of vertical rack space, and its 950 MHz to 1450 MHz frequency range allows the use of low-cost LNCs. Features include frequency tuning in 1 MHz steps via the front panel and a 30 MHz IF filter with optional filters ranging from 18 MHz to 40 MHz. TI traps are also optional. Reader Service number **90**.

Meanwhile, **Pico Products** now offers its full-featured HR-1000 stereo remote control receiver in both C- and Ku-band applications. A frequency select switch and fine tuning control have been added to the back of the unit. By using the A/B switch, viewers can watch either C- or Ku-band delivered programming. A transponder conversion chart is included to assist users with Ku-band transponder selection. The HR-1000 is an integral component part of Pico's new mid-line TVRO system, which also includes the Dual Ten C/Ku-band 10-foot black mesh antenna, Concentric 4/12 dual band feed system, low noise temperature LNBs, the PAC-1000K acuator/controller and various accessories. A low-cost system consists of the same antenna and feed system but uses the Little MAC electronics package featuring the HR-100 receiver and the MAC-100K antenna positioning system. Reader Service number **91**.

A series of satellite receivers and control cards has been developed by **ISS Engineering**. The plug-in PC-SAT cards can be plugged into an IBM or compatible PC's bus. Model RX-1 allows for standard NTSC audio and video TV reception. The RX-2 is an audio receive only receiver with a built-in Wegener Panda I audio expander. RX-3 is an FSK data receiver that demodulates the information being sent and places it on the computer's bus for display, storage, formatting or other manipulation. The units can be run standalone or in another OEM piece of equipment without an IBM computer by using the ISS SC-1 Controller Card. This allows tuning with rotary dip switches or an RS-232 serial port. The synthesizer steps in 200 kHz increments for video; 1 kHz for audio and data subcarriers. Reader Service number **92**.

A new microwave radio operating in the 17.7 to 19.7 GHz band has been developed by **M/A-COM MAC**. The MA-18CC is a solid-state FM microwave communication system designed for broadcast and high definition TV applications. It meets EIA standard RS-250B for short-haul transmission and can carry one video and up to three audio subcarriers up to 15 miles. It features field-tunable RF frequencies, built-in diagnostic alarms and options including LNA, narrow-band IF, multiplexing capabilities and hot-standby protection. Reader Service number **93**.

AVCOM has developed a portable spectrum analyzer for satellite communications. The PSA-35A offers a standard center frequency band calibrated from 1250 MHz to 1750 MHz and a switch selectable 2 dB per division or 10 dB per division sensitivity function. It also offers frequency coverages of 10 MHz to 1750 MHz and 3.7 to 4.2 GHz. It features a built-in DC block, calibrated signal amplitude display and rechargeable internal battery with built-in charger. Cost is $1,965. Reader Service number **94**.

A new RGB to NTSC composite video encoder is being offered by **Communications Specialties**. The ENC-3 unit can be used anytime standard analog RGB with sync-on-green signals need to be converted to a standard NTSC composite signal, such as in CAD/CAM, image processing, and general PC applications. Color burst is locked to sync to minimize dot or chroma crawl. It has its power supply, 9-pin DIN female input and BNC female output connectors. Price is $395. Reader Service number **95**.

Corrections

In the June issue, a production error inadvertently caused Merit Communications and Pico to be grouped together in the Advertiser's Index. In the Who's Who in Broadband story, Dinsmore Communications should have been listed as being headquartered in Portsmouth, N.H.

In the July issue, a production error resulted in the omission of a table of information from My Turn. Also, the center impedence of the dipole should have been listed as 73.1 ohms. And finally, the photo in In the News should have listed those pictured to be: from left to right, David Keller, Steven Rose, James Chiddix and James Bonfiglio. We regret any inconveniences these errors may have caused.

—Roger Brown

Continued from page 32

Washington:

Miles	Newbuild aerial	Newbuild underground
0-20	20	17
21-50	3	2
51-100	2	2
100+	0	0

Miles	Rebuild aerial	Rebuild underground
0-20	12	5
21-50	2	0
51-100	0	0
100+	0	0

Channel Upgrades
# of systems = 9
10-34 channels = 4
35-37 channels = 1
40-47 channels = 0
50-56 channels = 1
60-80 channels = 0

Currently addressable systems
# of systems = 15/# of subs = 132,125

Systems going addressable in 1987
# of systems = 3
Anticipated new subs = 30,000

Pay-per-view
# of systems now offering PPV = 3
Additional systems to offer PPV in 1987 = 1
Additional systems to offer PPV in 1988 = 4

Wyoming:

Miles	Newbuild aerial	Newbuild underground
0-20	2	4
21-50	0	0
51-100	0	0
100+	0	0

Miles	Rebuild aerial	Rebuild underground
0-20	0	1
21-50	0	0
51-100	0	0
100+	1	1

Channel Upgrades
# of systems = 6
10-34 channels = 3
35-37 channels = 3
40-47 channels = 0
50-56 channels = 0
60-80 channels = 0

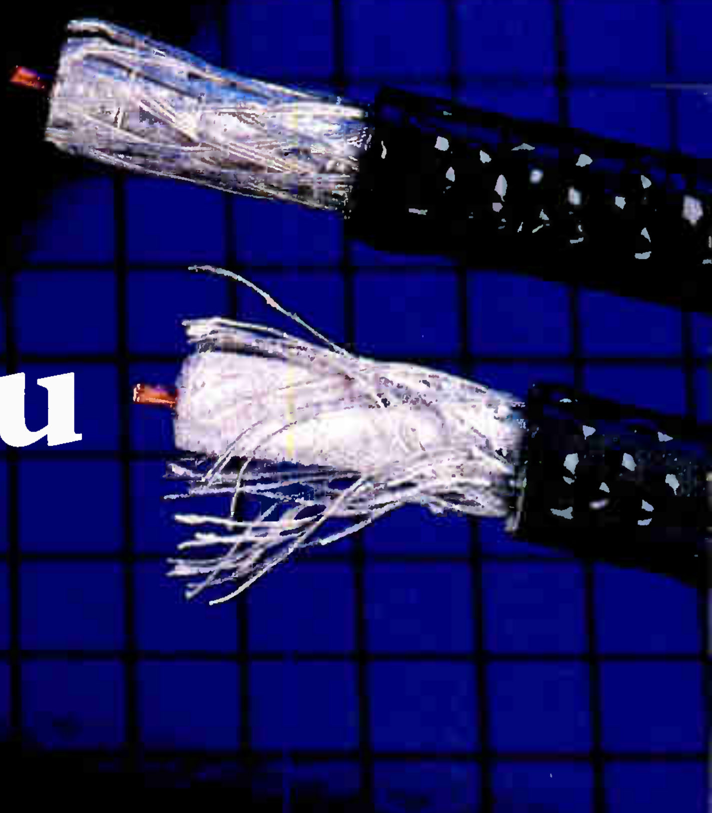
Currently addressable systems
# of systems = 5/# of subs = 7,250

Systems going addressable in 1987
# of systems = 1
Anticipated new subs = UKN

Pay-per-view
# of systems now offering PPV = 2
Additional systems to offer PPV in 1987 = 1
Additional systems to offer PPV in 1988 = 0

Advertisers' Index

Buy the Solution. Before You Have the Problem.

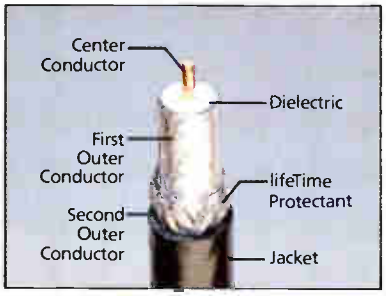


The Problem

Moisture is a major concern for today's cable system operators. It is the leading cause of damaging corrosion, resulting in premature cable failure and signal leakage, ultimately causing poor reception and increased customer dissatisfaction. The end result—rising maintenance costs and frequent replacement.

The Solution

Times Fiber Communications has the answer to these problems. Tested and proven, T4 Drop Cable with exclusive lifeTime™ protectant offers maximum protection far superior than the corrosion resistance of ordinary drop cable. Its total cable protection extends cable life and reduces signal leakage, flashing and customer outages. The end result—lower maintenance and replacement costs.



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