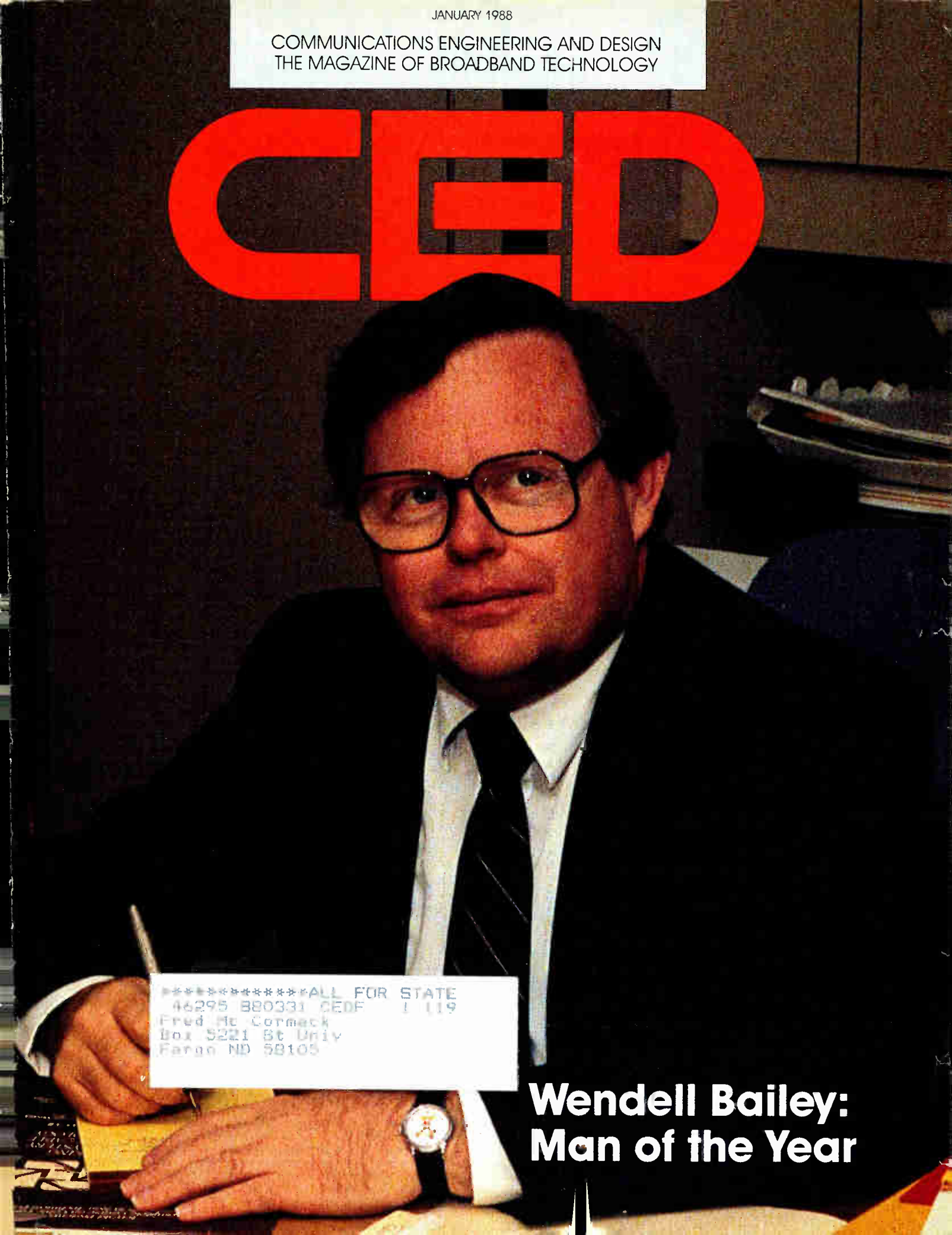


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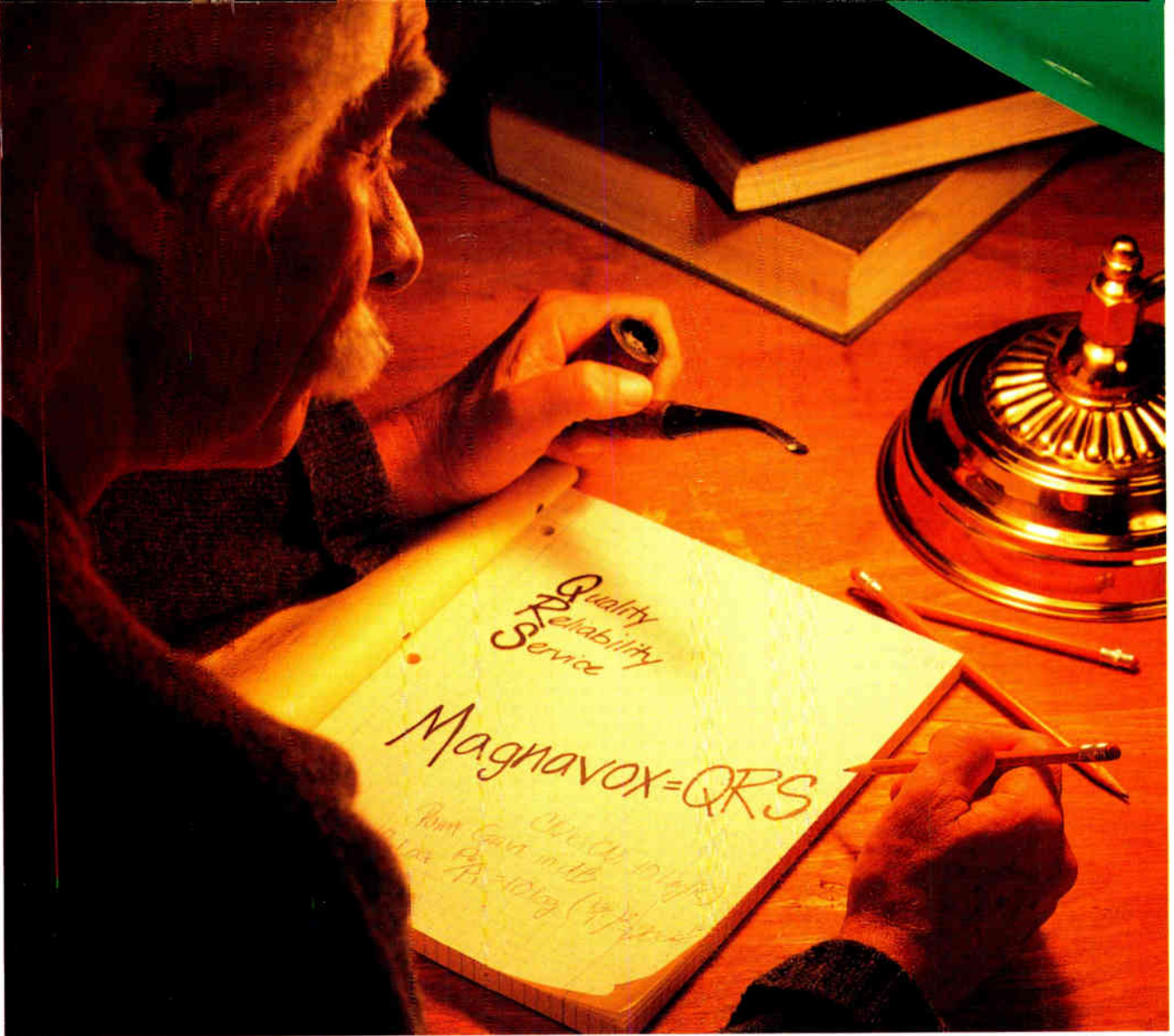
COMMUNICATIONS ENGINEERING AND DESIGN
THE MAGAZINE OF BROADBAND TECHNOLOGY

CEED

A man with dark hair and glasses, wearing a dark suit, white shirt, and dark tie, is seated at a desk. He is looking directly at the camera with a neutral expression. His hands are resting on a yellow notepad. In the background, a typewriter and stacks of papers are visible on the desk. The overall lighting is somewhat dim, typical of an office environment from that era.

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CLASSICS

Separating cross modulation distortions

16

Before this paper on the characteristics and perceptibility of cross modulation in a CATV picture was presented by Rezin Pidgeon Jr. of Scientific-Atlanta in 1983, there was little information available that distinguished between the types of distortions. Pidgeon's paper discusses, among other things, the AM and PM distortion components and the importance of each.

Man of the Year

30

There is perhaps no better spokesman and lobbyist for the cable industry's technical community than Wendell Bailey, NCTA's vice president of science and technology. His ability to decipher complex issues and explain them to lay people made him stand out as our Man of the Year.

Reliability vs. cost: what are the tradeoffs?

42

For the more than 2,100 small system operators in the U.S. who can't afford costly state-of-the-art equipment, finding reliable, yet cost-efficient means of providing quality service isn't always easy. Vendors offer advice on what works and how to go about getting it for the "right" amount of money.

BROADBAND LAN

Prospecting for LAN business

58

Traffic wasn't the best ever seen at the Autofact and Localnet shows this year, but evidence abounds that vendors are creating new and exciting products for LAN buyers looking for innovative and promising equipment.

Engineers look to the future

64

Vendors at the 1987 Western Cable Show in Anaheim were optimistic that 1988 will be a good one for business, but without a doubt the two major themes of the show centered around the latest developments in fiber optics and HDTV. A listing of new products unveiled in Anaheim is included.

DEPARTMENTS

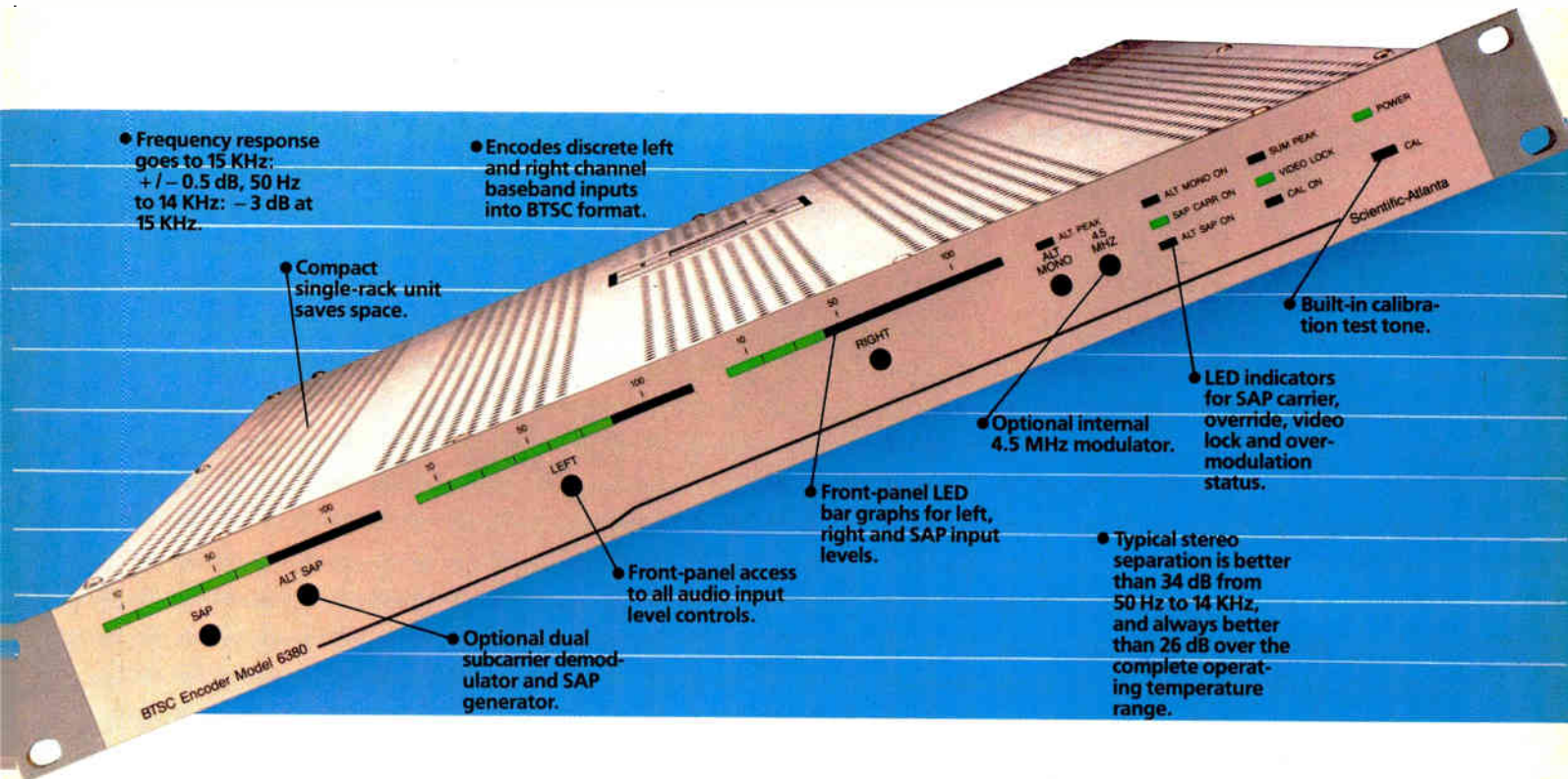
- My Turn 6**
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- From The Headend 14**
- Return Path 28**
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- Ad Index 74**

About the cover

Wendell Bailey, CED's Man of the Year for 1987, doesn't sit still for long, but the NCTA cornered him for this recent photograph.



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NTSC standards were prologue to HDTV's future

Today, we seem to be on the verge of another of those great telecommunications mileposts marking major turning points in our lifestyle. Once again, technical standards are under consideration to assure a proper match between television receivers sold to the public and the signals transmitted.

Like it or not, for better or for worse, a new generation of television standards is about to happen, this time for some form of advanced television. The professional journals, reflected to a degree in the trade press and even in the public media, are currently engaged in profound debate regarding new standards that are likely to determine the course of television technology, and perhaps even programming, for decades to come.

In Shakespeare's *The Tempest*, Antonio speaks of another such profound event:

"Whereof what's past is prologue;
what to come,
In yours and my discharge."

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

The setting of NTSC monochrome TV standards some 46 years ago, and the addition of color 11 years later, were but prologue to the development of HDTV (high definition television). It is instructive to review the past; but what is to come will be determined by an entirely different pattern of circumstances.

As early as 1862, Abbe Caselli sent a sort of "picture" by electricity through a wire from Amiens to Paris, only 18 years after Morse's telegraph line between Baltimore and Washington. On Christmas Eve, 1883, the German, Paul Nipkow, conceived the idea of optically scanning a scene, using a spiral series of holes in a rotating disc. Electronic scanning replaced the Nipkow disc in the late 1920s, but the scanning concept has remained as the basis for all television ever since.

Experimentation with color TV, like HDTV, began long before the setting of standards. In July, 1929, Dr. Herbert Ives published a paper in the *Bell Labs Record* entitled "Television in Colors." High resolution television for NASA's moon landing was described by Lawrence Lockwood *et al* in the April 1970 *Journal of the SMPTE*, at about the same time the Japanese began to develop their HDTV ideas.

Standards for monochrome TV were adopted by FCC, effective July 1, 1941, exactly as recommended by the first NTSC (National Television Systems Committee), formed for the purpose a year earlier. However, the development of commercial TV broadcasting was abruptly halted, before it could even get started, by the sudden U.S. entry into World War II on Dec. 7, 1941.

By 1946, after the wartime freeze had been lifted, long frustrated broadcasters and hungry entrepreneurs began pressing for shares in the lucrative business of supplying outlets to satisfy the pent-up demand for radio advertising time. Queues at the FCC grew so long that they had to call a halt to the filing of new radio applications while they worked down the backlog. They called it the "Temporary Expediting Procedure," TEP for short. In practical effect, it was an AM radio freeze.

During this *de facto* radio freeze, applications skyrocketed for television

permits by those who had missed the radio boat. The demand for TV permits greatly exceeded the supply of available channels. While there were over 100 channels for AM radio (no one wanted FM anyway), the 12 channels then open for TV were quickly occupied by established radio broadcasters and networks.

Meanwhile, in 1946, in a petition that sounds strangely familiar, CBS requested authority to use two adjacent TV channels to broadcast commercially its field sequential color TV. Although this petition was soon denied, FCC did approve, in October 1950, a highly controversial 6 MHz version of the field sequential color TV system.

Thus, during the immediate post-war years, the FCC was confronted simultaneously with two enormously complex high-tech issues: (1) a soaring demand for spectrum to accommodate new TV stations; and (2) controversial standards for color TV. A new TV freeze was imposed in 1948. These two issues, and the freeze itself, stimulated so much public excitement about television that, by conventional wisdom, radio was declared dead. After all, who in the brave new world would listen to radio if they could watch television?

It was no accident that cable TV was born during this freeze. The public knew that television existed, and they wanted it. Receiver manufacturers were not frozen, and dealers wanted to sell TV sets. Known originally as Community Television, cable TV was started largely by public spirited citizens willing to share with their neighbors the fruits of their skill in finding ways to receive the few otherwise unreceivable, pre-freeze (actually pre-war) TV signals then on the air. (The name was later changed to Community Antenna TV, or CATV, for reasons of litigation; but that is another story).

Many leading engineers and broadcasters were deeply concerned about the non-compatibility of the field-sequential color TV system. Because of their concern, the old NTSC was reconvened in January 1950, for the purpose of drawing up color TV standards, with the express proviso, previously considered impossible, that they be "compatible" with the monochrome standards recommended nine

Continued on page 11

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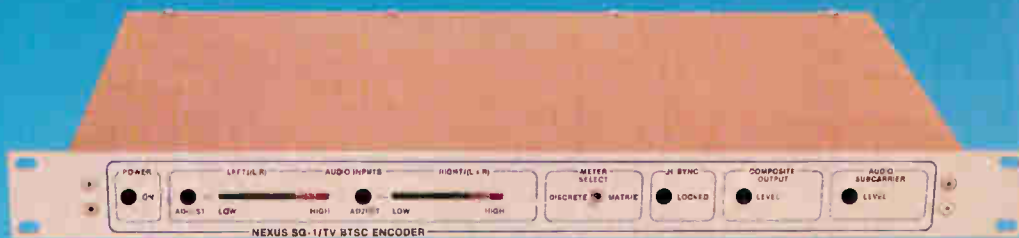
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One thing seems certain: within less than five years, we will see wide-screen TV sets in dealer's show rooms.

Continued from page 6

years earlier by the first NTSC. It is hard to comprehend why the FCC approved the non-compatible CBS/Goldmark color TV system without waiting for the recommendations of the reconvened NTSC, whose technically sound monochrome recommendations in 1941 had been so widely respected. CBS actually broadcast in color for only about five months in 1951. Nevertheless, in 1953, Dr. Peter Goldmark seconded the motion in the NTSC to recommend to the FCC the present NTSC compatible color TV standards. They were quickly adopted, in January 1954. Yet, it is worth noting that this remarkable color TV system that has served the public well for more than 30 years, did not achieve solid public acceptance until the mid-1960s, about 10 years after its formal adoption. It should also be noted that PAL and SECAM are but mutations of the basic color TV system created by the members of the second NTSC with the inspired encouragement of RCA's General Sarnoff.

The freeze ended in 1952 with the allocation of 70 brand new UHF channels to the television broadcasting service, but without adopting new standards for color TV. The 12 choice VHF channels had already been assigned mostly to established broadcasters, leaving UHF channels, generally perceived as less desirable, to johnny-come-latelys. Ed Allen, then Chief Engineer at FCC, reported that while prospective television broadcasters were "feverishly attempting to obtain scarce VHF channels," they "showed little interest in the abundantly available UHF channels." As a result, the Television Allocation Study Organization (TASO) was formed in 1956 as part of the long struggle to overcome the impact of the laws of physics that made UHF appear to be inferior.

Now, there is much activity, and some nonsense, about another quantum improvement in picture quality, with a wide screen like the movie theater, and sharper, cleaner pictures without visible scan lines or disturbing artifacts, even in large screen projections.

But, this time, we do not have the luxury of a freeze to stop motion while

we prepare for the coming revolution. Already there may be close to two-thirds of a billion TV sets in use, the world over. Within the next few years, there will assuredly be new standards for television reception by the public. The burning question is: how do we get from here to there?

Any engineer who has suffered through the international chaos resulting from the present NTSC/PAL/SECAM multi-standard for color TV fervently hopes that the next change will be to a single, universal, worldwide standard. It begins to appear that this is not to be. The abstract of a paper by Dr. Kerns Powers of the David Sarnoff Research Center, at the recent HDTV Colloquium in Ottawa addresses the present dilemma:

"The dream of a single worldwide scanning standard for television seems to be as elusive today as it was when monochrome was developed in the 1930s; and when color was added in the 1950s and 1960s. A new generation high-definition system seems to be the last chance to achieve such a standard, but time is running out.

"The desire for compatibility with existing emission systems is a deterrent to the concept of a single world standard for emission. Even for production, compatibility is an equally important issue. A single world standard for production and for international program exchange cannot be simultaneously compatible with today's production system (film at 24/25 Fps) and emission systems based on 50 and 60 Hz field rates.

"In the face of this dilemma, it is suggested that a single exchange standard might have a cost *disadvantage* over multiple frame rate exchange standards, because of the large number of high-cost standards converters required."

Thus, compatibility again becomes the key issue in getting from here to there. But now, instead of the 2 million monochrome sets in 1948, we see some

200 million TV sets in use in the U.S., mostly color, with no possibility of a freeze to stop the growth. Is it politically feasible even to consider a new transmission standard (like the Japanese 1125/60 MUSE) that could not be received on any existing TV sets? This issue can logically be argued either way; but compatibility seems to be winning.

Inextricably entwined with compatibility is the matter of spectrum management. This is a crucial issue for broadcasters. How should FCC balance the 8 to 12 MHz spectrum requirements for HDTV against cellular telephone, paging, and other land mobile requirements? Advanced or high definition TV entertainment can be distributed to the public by cable or VCR without gobbling up so much electromagnetic real estate. On the other hand, mobile communications, by definition, must be airborne. This will certainly lead to politically necessary compromises with technological perfection, to which cable and VCR need not be party. The suggestion has been made that HDTV broadcasting be confined to DBS, or to new terrestrial frequency bands at 2.5 or 12 GHz. Such a solution might well defuse the compatibility issue, since new receivers would be required anyway.

One thing seems certain: within less than five years, we will see wide-screen TV sets in dealer's show rooms, with most of the artifacts scrubbed and the scan lines no longer visible, even at close viewing distance. Whether the programming will be broadcast over the air, or distributed on cable, it will surely be available on home VCRs, using tapes from the video stores.

Postscript. For a fascinating review of NTSC activities, read the paper by Donald Fink entitled *Perspectives on Television: The Role Played by the Two NTSC's in Preparing Television Service for the American Public*; Proc. IEEE, September 1976. Much of the foregoing historical presentation was drawn from Don Fink's paper. The early history of television is summarized in another interesting paper by J. George Knapp and Julian Tebo, in the May 1978 issue of the *IEEE Communications Society Magazine*.



Making sense of alphabet soup

Well it's coming.

You can't see this many people, this much money spent on airline tickets, years of time, mountains of paper, bushels of words, reams of equations or rooms full of puzzled expressions without understanding that something big and important is approaching—high definition television. The number of players and committees that are tackling this issue are so intertwined that a road map and scorecard are needed to find out who's doing what. Perhaps I can take a moment to shed a little light on the committee structures that are working in this area.

First, the oldest committee known to be working on HDTV that includes the cable industry is the Advanced Television Systems Committee (ATSC). The ATSC was formed by the Joint Committee for Interdisciplinary Coordination (JCIC), a group made up of NCTA, NAB, EIA, IEEE and SMPTE. The JCIC gets together whenever one or more of its members feels that standards-setting activities or investigations into new technologies are going on in multiple industries and more

efficiency and better timing could be had by assigning the bulk of the work to one of the five organizations or some other outside organization with relevant competence.

At one such meeting a few years ago, the JCIC, recognizing that high definition and improved television were the subjects of debate, discussions and tests in several places, most notably SMPTE and NAB, decided that a new entity needed to be created to move the American television industry into the realm of HDTV and vastly improved TV images and sound. The ATSC was formed to do just that.

Its first executive director was Dr. Richard Green, now senior vice president for PBS. The ATSC's first chairman was E. William Henry, a former chairman of the FCC. While Henry is still its chairman, the current executive director is Dr. Robert Hopkins. The ATSC counts among its members the leading players from all fields of television in the U.S. and it does its work through three technology groups, one of which is concerned with HDTV.

While many of the cable industry members who serve on the NCTA Engineering Committee are also active in the ATSC, it was felt some time ago that the time had come for the NCTA Engineering Committee to form an HDTV subcommittee. This subcommittee's task was of such importance that Nick Hamilton-Piercy of Rogers Cablesystems was named its chairman.

That subcommittee, so far, has developed test plans for use by ATSC, provided input on the FCC's Notice of Inquiry on Advanced Television Systems and helped arrange tests of HDTV on cable outside of the ATSC. In addition, the subcommittee appointed a working group dealing with "Super-cable." This working group will look into ways and means by which cable might deliver Super-VHS or other extended quality and definition signals to cable homes. This group is chaired by Paul Perez of Recoton.

The FCC, with much fanfare, announced a high-level, blue ribbon advisory committee made up of luminaries from the world of television, broadcasting, cable and equipment manufacturing. It includes the chairmen or heads of all three major commercial networks, and the heads of PBS, ATC and

Viacom and the president of HBO. The chairman is Richard Wiley, former chairman of the FCC.

The majority of work will be done through three subcommittees; planning, chaired by Joe Flaherty of CBS; systems, chaired by Dr. Irwin Dorros of Bell Communications Research; implementation, chaired by James Tietjan of the Stanford Research Institute.

Each of the three subcommittees has two vice-chairmen. Flaherty's subcommittee (planning) has as its vice-chairmen Greg DePriest of Maximum Service Telecasters and myself, representing NCTA. Brenda Fox, NCTA's vice president for special policy projects and general counsel, serves as vice-chairman of the implementation subcommittee. Under planning, there is an extensive working group structure, with each working group having its own chairman and vice-chairman.

Several talented cable representatives serve in those working parties, including Ed Horowitz of HBO and Paul Resch of The Disney Channel. The subcommittee meetings are open to any interested party and NCTA will be encouraging anyone with an interest in seeing television develop in this country to attend any and all meetings.

The NCTA recently formed its own blue ribbon panel made up of senior executives from the cable industry. This group is chaired by Dick Roberts, president and chief executive officer of TeleCable. This committee will be doing a lot of its work through a technical advisory group chaired by myself and including senior engineering personnel from several companies.

All of this activity and smoke is not without some fire. The fact is that better television pictures are coming. These better pictures will be delivered by a variety of technologies. The cable industry must and will participate fully in all of the deliberations. Along with improved pictures comes improved sound. The task of implementing multichannel sound will, be seen as easy compared to the task of deciding on and then implementing the techniques and signals which will make up the television picture of the future. Cable has a major stake in providing the best possible pictures to those people who pay for television—our subscribers. ■

*By Wendell Bailey, Vice President
Science and Technology, NCTA*

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Reader Service Number 6

Unraveling threshold specifications

With the increase in Ku-band activity in the CATV industry in recent years, and due to Ku-band's increased susceptibility to rain fade, a renewed focus has been placed on the threshold performance of earth-station receivers. Under some circumstances of extreme rain fade, improved threshold performance in a given receiver can mean the difference between no rain outage and outages of several minutes or more. While most manufacturers are always pleased to see an interest taken by the industry in improved performance, as a buyer, you should be cognizant of the way threshold is specified, and wary of the pitfalls if you concentrate purely on the "static" threshold performance of a receiver.

Historically, the "static" FM threshold of a receiver has been defined as the point at which, in a plot of output video S/N vs. input C/N, with no modulation present on the input signal, the curve

departs from a 1:1 slope by 1 dB. In other words, above the receiver's so-called FM threshold, a 1 dB decrease in input C/N will result in a 1 dB decrease in output video S/N ratio.

However, as the input C/N ratio approaches the receiver's threshold point, the output video S/N begins to degrade rapidly due to the creation of "impulse noise" in the FM demodulator. Once this begins to occur, we can determine the receiver's static threshold by simply finding the point at which, on a S/N vs. C/N plot, the video S/N ratio has "departed" from its projected 1:1 slope, by 1 dB. Hence the term "one dB departure." This static threshold, or threshold in the absence of modulation, is the threshold performance which is typically specified by manufacturers on data sheets.

When a manufacturer states that his receiver has "an 8 dB threshold," he is claiming that the receiver's output video S/N ratio will begin to degrade very rapidly, below about 8 dB C/N, if there is no modulation present. As a buyer, the problem you will face if you concentrate solely on the static threshold performance of a receiver is that it is quite possible, and in fact somewhat common, to apply threshold extension techniques within a receiver which will greatly improve its static threshold performance, but may offer no improvement, or in some cases can actually degrade its operating or "dynamic" threshold performance.

While static "one dB departure" has been the historical choice for specification of receiver threshold performance, perhaps a more accurate indication of a receiver's actual "in-circuit" or operating threshold capability is its "dynamic threshold." Dynamic threshold is a measure of the receiver's threshold performance with modulation present. Typically, 80 IRE of a 3.58 MHz sinusoid is used as modulation to simulate full color saturation, in order to exercise the pre-detection IF filter and the FM demodulator to their fullest. After demodulation, the 3.58 MHz signal is trapped-out prior to the S/N measuring instrument. Otherwise, the measurement technique is the same as for static threshold.

Dynamic threshold is a more accurate indication of a receiver's performance because as Clayton¹ has

shown, the impulse noise in an FM system increases in amplitude, and occurs more often, as the input carrier deviates from the center of its pre-detection IF bandwidth. Therefore, if modulation is present (which by definition in an FM system causes the carrier to deviate from center frequency), impulse noise will increase, thereby causing a corresponding degradation in the threshold performance of the receiver.

In addition, if the IF filter is too narrow for the uplink's transmitted deviation, then during peaks of modulation, the frequency of the transmitted carrier could instantaneously travel beyond the bandwidth of the IF filter, which in turn would cause an instantaneous reduction in the amplitude of the carrier. If the receiver were operating near threshold, this reduction in carrier amplitude could force the receiver into "threshold" earlier by causing an increase in impulse noise at high deviations. These types of phenomenon are not discovered with a simple static threshold measurement. In fact, if you were to measure the static and dynamic threshold performance of a "typical" industry receiver, you might see anywhere from 2 to 5 dB of difference between its static and dynamic performance.

Design tradeoffs will always be made in the development of any new product. Juggling a receiver's static threshold performance against its dynamic performance is simply one of those tradeoffs. For that reason, whenever you read a data sheet, maintain a degree of skepticism. Ask a lot of questions, and perform a rigorous evaluation of the receiver's static and dynamic threshold. In addition, carefully measure its baseband video and audio performance against the manufacturer's published specifications. In the long run, you'll be glad you did. ■

1. Clayton, Lorimer, *FM Television Signal-to-Noise Ratio*, IEEE Transactions on Cable Television, Vol. CATV-1, October 1976.

Anyone with comments on or suggestions for future From the Headend columns should send them to Chris Bowick, c/o CED, 600 Grant St., Suite 600, Denver, CO 80203.

By Chris Bowick, Engineering Dept.
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Reader Service Number 7

Characteristics of cross modulation

Cross modulation (crossmod) is a type of distortion that was particularly noticeable in earlier CATV systems. It is characterized by the "windshield wiper" effect or interference appearing as frames or images slipping in the TV picture. As advances were made in amplifier performance and the number of channels increased from 12 to 62 or more, triple-beat distortion increased in relative importance. For cross modulation the distortion is closely proportional to the number of channels, whereas for triple-beat distortion, the effect increases rapidly as the number of channels increases. For wide-band systems, triple-beat distortion is the major contributor to the total distortion.

To extend the performance of newer wide-band systems phase locking came into being. This technique reduces triple-beat interference and enables system operating levels to be increased 4 to 5 dB. Thus, with phase locking the relative importance of cross modulation is increased.

This paper presents results of experiments made to measure the amount of cross modulation that is just perceptible in a TV picture. Relatively little data has been found on the subjective measurement of cross modulation, partly because of the difficulty in separating other distortions from cross modulation and observing only cross modulation. The experiment described herein generates cross modulation by direct video modulation instead of by distortion in a cascade of amplifiers. This enables cross modulation to be controlled and observed without other impairments.

Cross-modulation analysis

Amplifier distortion has been treated extensively in the literature, and distortion effects in CATV amplifiers are well understood. However, to aid in the discussions that follow, a few of the basic equations and definitions are given in the following paragraphs. This simplistic treatment is presented to show the characteristics of cross modulation and distinguish it from other

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By Rezin Pidgeon Jr.,
Scientific-Atlanta Inc.

Experiments measure amount of crossmod in a TV picture.

distortions, particularly those in which modulation sidebands occur because of modulation of carrier "beats."

If the amplifier nonlinearity is expressed by the first three terms in a power series, then

$$e_{out} = k_1 e_{in} + k_2 e_{in}^2 + k_3 e_{in}^3. \quad (1)$$

The coefficients k_1 , k_2 , and k_3 are the linear gain and second- and third-order distortion coefficients, and are real constants if we assume no phase or frequency-dependent distortion.* The input voltage is first assumed to consist of three sinusoidal voltages or carriers

$$e_{in} = A \cos W_a t + B \cos W_b t + C \cos W_c t. \quad (2)$$

The distortion produced at carrier frequency W_a is obtained by expanding (1) and collecting all terms containing W_a . Thus

$$e(W_a) = (k_1 + \frac{3}{4} k_3 A^2) A \cos W_a t + \frac{3}{2} k_3 (B^2 + C^2) A \cos W_a t. \quad (3)$$

The first term contains a distortion term $\frac{3}{4} k_3 A^2$ which represents self-compression or self-expansion (depending on the sign of k_3). This term is identically the same whether or not other signals are present and can be neglected since certainly the system must amplify a single channel faithfully. The term $\frac{3}{2} k_3 (B^2 + C^2) A \cos W_a t$ is the cross modulation component. This shows that for CW carriers the carrier at W_a is compressed or expanded by carriers at W_b and W_c regardless of their frequency. Thus, cross modulation is inherently different in origin from distortion caused by "beats" or mixing of carriers.

Only the linear and cross modulation terms are given in (3). A complete third-order expansion would give the following terms: (1) a dc term; (2) a linear term (desired component); (3) cross modulation terms; and (4) harmonics and "beat-frequency" terms (sum and difference frequencies including $2W_a \pm W_b$, $W_a \pm W_b \pm W_c$, etc.). This latter group is the major cause of distortion or interference to the TV

picture. Carrier systems that are not phase locked are limited by carrier beats, primarily composite triple beat, at higher operating levels. In phase-locked HRC systems all video-carrier beats are coherent with the picture carriers, and in this case interference is caused by the modulation present on each beat. This effect may be called "beat modulation" and is different in origin but similar in appearance to cross modulation.

The above equations are given for CW (unmodulated) carriers, but also apply for modulated carriers. The carrier amplitudes A, B and C can be video-modulated amplitudes $A(t)$, $B(t)$, and $C(t)$. Rewriting equation (3), cross modulation distortion is

$$XMOD = \frac{3}{2} k_3 (B^2(t) + C^2(t)) A(t) \cos W_a t. \quad (4)$$

Since cross modulation is proportional to the amplitude of the interfered carrier $A(t)$ cross modulation will be larger in the darker areas of the TV picture. Note also that crossmod is proportional to the amplitude squared ($B^2(t)$ or $C^2(t)$) of the interfering signals.

The above discussion relates to *ampli-*

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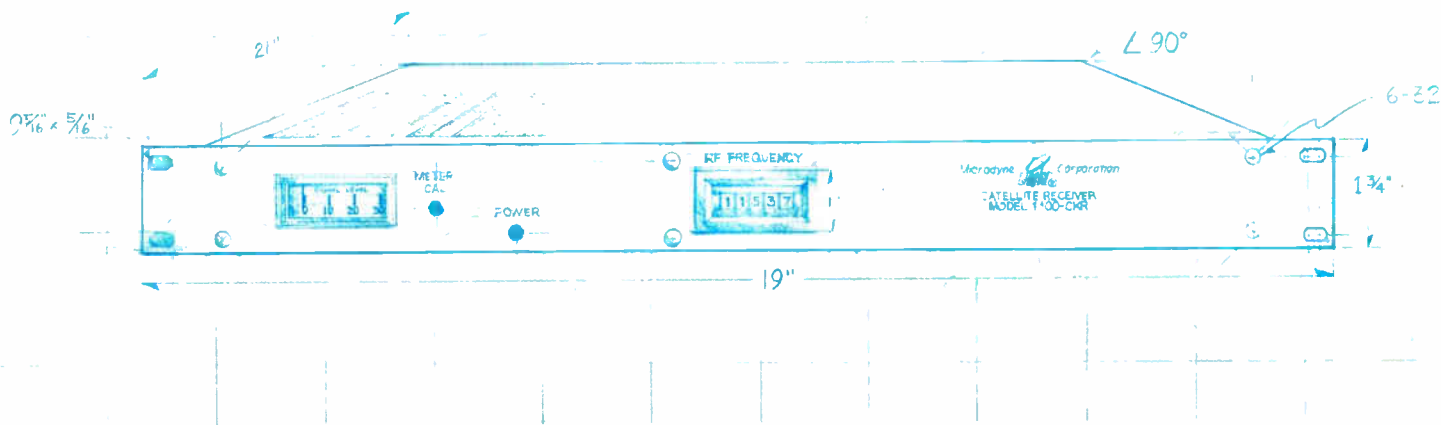
Do you know what amount of cross-modulation is just perceptible in a TV picture? Can you distinguish between the visible effects of cross-modulation and third-order triple-beat distortion? Did you know that cross-modulation resulting from many channels of non-synchronized video sources is much less visible than cross-modulation generated by a standard "NCTA" test-set?

As the author of this paper, "Characteristics & Perceptibility of Cross Modulation," puts it, "relatively little data has been found on the subjective measurement of cross-modulation, partly because of the difficulty of separating other distortions from cross-modulation and observing only cross-modulation."

This 1983 paper by Rezin Pidgeon presents a measurement methodology and results which deserve close attention.

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Reader Service Number 8

Cross modulation can be measured by different techniques and under various conditions.

tude cross modulation (amplitude modulation of the desired carrier). Cross modulation can also appear as *phase* cross modulation. Due to amplifier phase shifts and nonlinearities, amplitude modulation is converted to phase cross

modulation. In addition, at higher frequencies the nonlinear transistor junction capacities become significant contributors to phase crossmod. The presence of both amplitude and phase cross modulation has caused some con-

fusion in the measurement, specification and subjective effects of cross modulation.

Phase modulation of the TV signal becomes visible since phase crossmod results in frequency modulation, and FM is slope detected by the Nyquist filter in the TV receiver. Since the instantaneous frequency is proportional to the derivative of phase, light-dark and dark-light transitions in interfering TV pictures (particularly leading and trailing edges of sync bars) produce large frequency deviations and will be seen as lines of interference. Components above the Nyquist slope (more than 600 kHz above the picture carrier) are detected equally whether phase or amplitude modulated.

Cross-modulation measurement

Cross modulation can be measured by different techniques and under various conditions. Equipment manufacturers and system designers measure and specify cross modulation by the familiar "NCTA method." NCTA Standard 002-0267 "CATV Amplifier Distortion Characteristics" defines and specifies this measurement. In this procedure, all carriers except the one in question are square wave modulated at the horizontal line rate. The level of modulation impressed on the observed carrier is then measured, usually by tuning a spectrum analyzer to the carrier, turning the IF sweep off, and measuring the linearly detected envelope with a waveform analyzer tuned to 15.75 kHz.

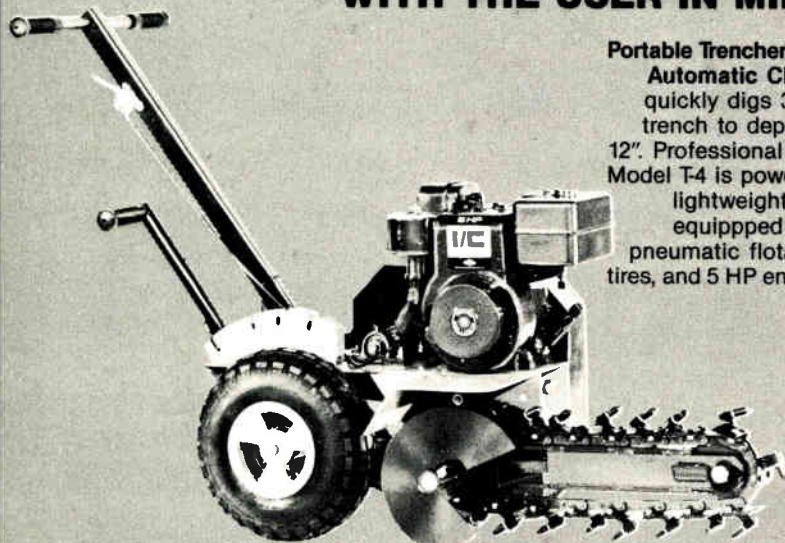
Cross modulation is also measured by measuring sideband levels with a spectrum analyzer. This technique is useful for observing interference, but results will correlate with the NCTA measurement for only amplitude modulation and if beats do not obscure the 15 kHz cross modulation sideband. Since for 100 percent square-wave modulation the first sidebands are 10 dB below the peak level, the NCTA measurement is 10 dB greater than the 15 kHz sideband level.

Note however, readings can be effected by second- and third-order carrier beats. For example, if the carrier being observed is turned off, a cluster of beats (if the carriers are not phase

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locked) will be seen centered at the carrier frequency. If all carriers are modulated, clusters of sideband due to modulation of individual beats will also be observed. These beats add noise to the carrier being measured (the carrier is not modulated by the beats), but the noise is rejected by narrow-band filtering if a wave analyzer or synchronous demodulator is used in the NCTA procedure.

Test system

The subjective measurement of cross modulation perceptibility is difficult because of the presence of other distortions. A method of observing picture degradation in the presence of composite-triple-beat noise and with or without cross modulation has been reported. This method allows crossmod to be eliminated from the observed distortion, and thus one can ascertain whether crossmod is a significant contributor to the total distortion in a particular system. However, crossmod cannot be observed with complete freedom from other distortions since they are generated by the same amplifier nonlinearities. Therefore, a method of simulating crossmod was devised and implemented. Furthermore, with this method, cross modulation can be generated by either AM or PM (or some of each). The procedure is simply to add some interfering modulation to a normal video-modulated carrier and observe the result in the TV picture. Independent video sources are used to create the interference and the measurement is then related to crossmod as measured by the NCTA procedure. Note that for the simulation to be an accurate representation, equation (4) requires that the distortion be proportional to (1) the amplitude of the interfered carrier $A(t)$, and (2) the amplitude squared of each interfering video source ($B^2(t)$, etc.). See Figures 1 and 2.

The video picture or test pattern to be observed is connected to the video IF modulator of a Scientific-Atlanta 6350 Television Modulator. The video interfering signals are coupled to individual circuits which dc restore and square each signal. The outputs of the squaring circuits are then summed and ac coupled to the modulation input of

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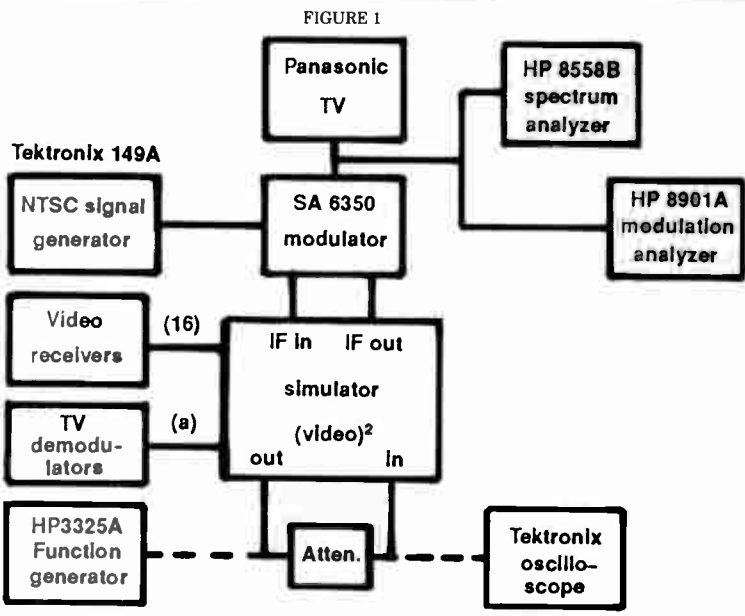
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Since cross modulation is most noticeable in a dark background, a gray flat field of 7.5 to 10 IRE was used in this experiment.



Cross modulation test set-up

an IC modulator. The RF input to the modulator is a sample of the video-modulated IF. The output of the modulator is the form

$A(t) [B^2(t) + C^2(t) + \dots N^2(t)] \cos W_{if}t$, which is the proper representation for cross modulation distortion produced by N channels. This signal is attenuated, phase shifted by the line stretcher and combined with the video-modulated signal to be observed. The line stretcher is used to adjust the phase of the cross modulation relative to the undistorted IF so as to produce AM or PM cross modulation. For amplitude crossmod, the relative phase is 180 degrees in order to produce signal compression.

The IF modulated signal is then processed by the vestigial sideband filter and upconverted to channel 4. The composite signal is then viewed on a TV receiver. The amount of cross modulation is attenuated and the measured cross modulation is correlated with observer reactions.

Test results

Cross modulation was measured for interference against a test pattern background. Observations were made when using TV programming material, but the large variations and movements in actual scenes made it difficult to determine the threshold for cross modulation visibility. Since cross modulation is most noticeable in a dark background, a gray flat field of 7.5 to 10 IRE was used in this experiment. The TV receiver was a Panasonic CT9051, and was viewed in dim lighting. The picture was clean—the carrier-to-noise ratio was greater than 55 dB. These conditions led to a measurement much more sensitive than would be obtained—if one could do so—under actual field conditions with live scenes and inherent noise and distortions.

Data is presented as a function of the number of video sources: 1, 2, 4, 6, 12, 18 and 24. These were independent sources; eight from local broadcast stations and 16 from satellite receivers. For each measurement, the flat field was first viewed with strong interference, and then the cross modulation was reduced until it was barely visible. The measurements thus obtained were

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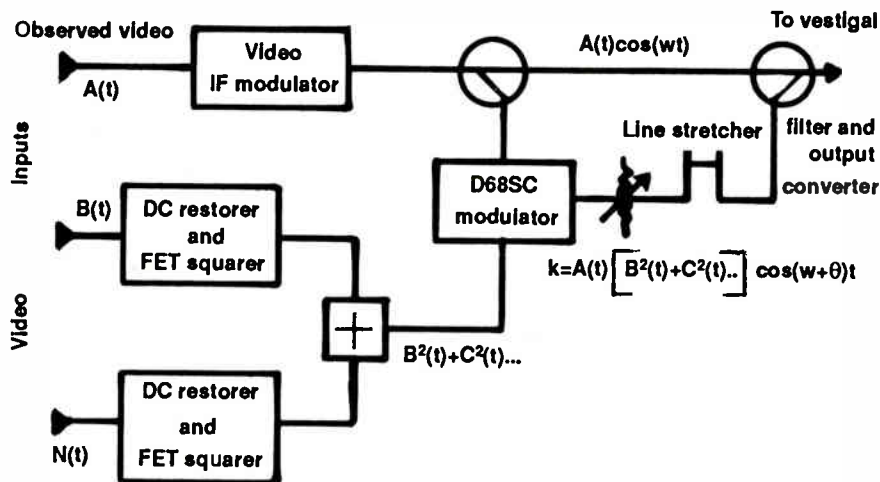
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Although the NCTA method is specifically for AM, it is meaningful to express phase cross modulation in the same terms.

FIGURE 2



Cross modulation simulator

related to the NCTA measurement by substituting a 1V peak-to-peak 15.75 kHz square wave for each video source and measuring sideband levels on a spectrum analyzer. Adding 10 dB to the 15 kHz sideband levels gives the NCTA measurement.

The same procedure was used for both amplitude and phase cross modulation. Although the NCTA method is specifically for AM, it is meaningful to express phase cross modulation in the same terms by converting the measured PM to the equivalent AM. (For pure AM or low mod. index PM, as is the case here, one cannot distinguish between the two from a spectrum analyzer display). Thus, for phase cross modulation, the 15 kHz sidebands were determined and 10 dB added to give the equivalent NCTA number.

Results of the experiment are shown in Figure 3. For a single interfering channel the data averaged -50 dB for AM and -43 dB for PM. Cross modulation from a window test pattern aver-

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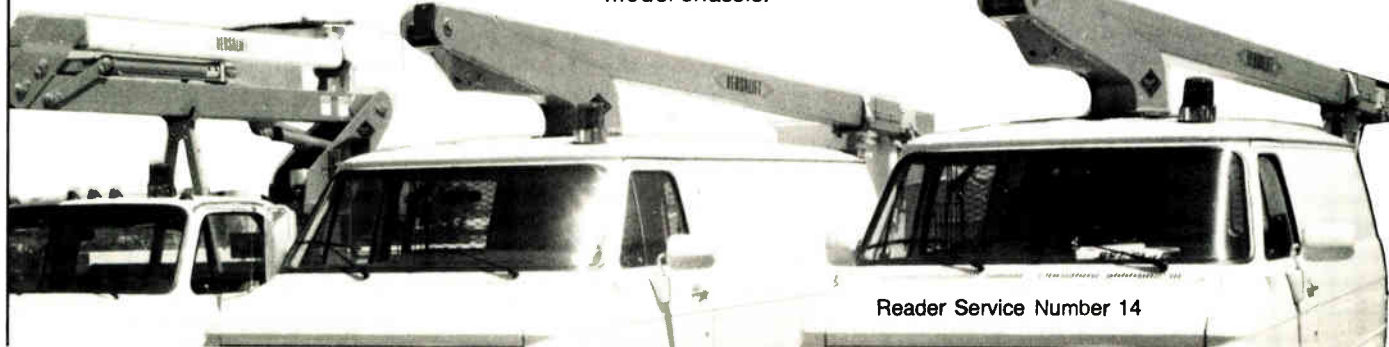


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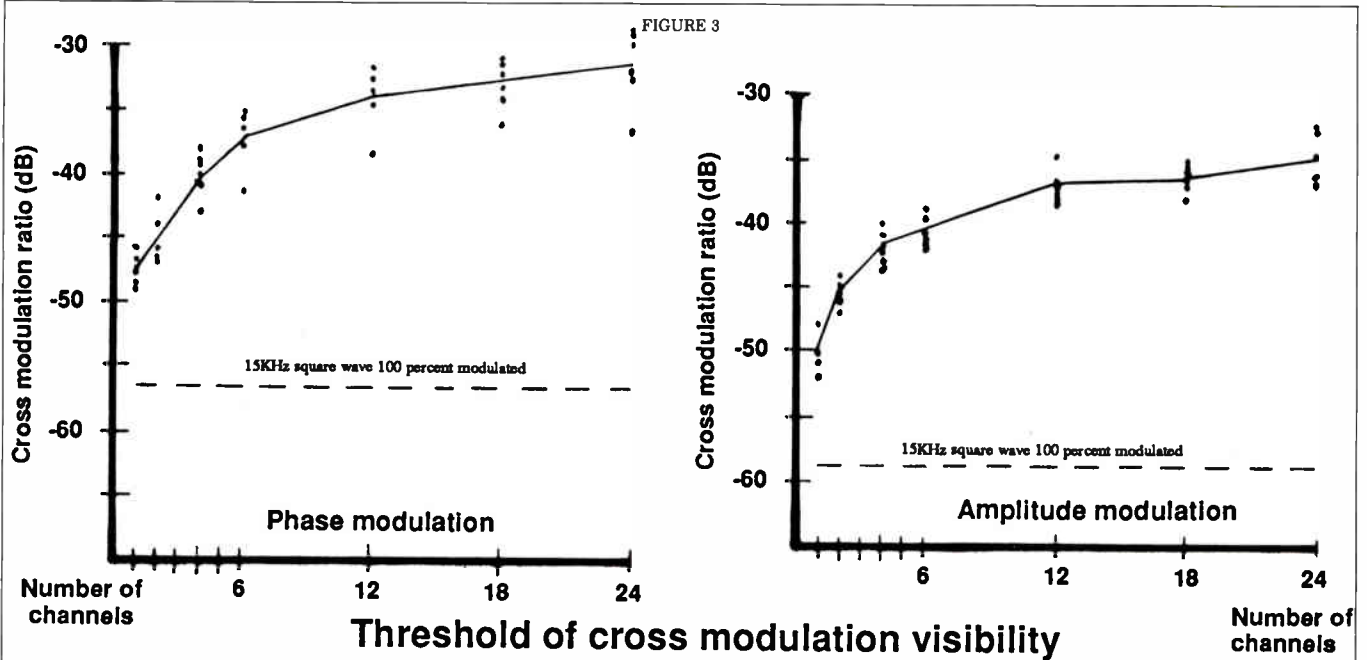
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The threshold level of cross modulation derived in this experiment is high compared to standards in general use in the CATV industry.



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aged -51 dB for AM and -44.5 dB for PM. For 15.734 kHz square-wave interference (equivalent to 100 percent modulation) the threshold was -59 dB for AM and -52 dB for PM. Thus, 100 percent square-wave modulation was more discernable by 7 to 8 dB.

As the number of video sources increased, the difference in amplitude between square-wave sources and the composite of the video waveforms increased. For a large number of video sources, the signals combine in a somewhat random manner resulting in substantially lower peak energy than for synchronous modulation. For 24 video sources, the measured cross modulation threshold averaged -35 dB for AM and -26 dB for PM. The difference between 100 percent synchronous square-wave modulation and video modulation is 24 dB in AM cross modulation perceptibility.

The threshold level of cross modulation derived in this experiment is high compared to standards in general use

in the CATV industry. From the data in Figure 3 we would expect a present-day channel loading of 52 to 62 channels to have a visibility threshold of about -32 to -34 dB in a picture free of noise and other distortion. It is generally agreed that triple-beat distortion is just perceptible for a CTB ratio of -46 to -48 dB** in systems not phase locked. For HRC phase-locked systems, operating levels can be increased 4 to 5 dB, resulting in a CTB threshold of approximately -38 dB. Thus, a cross modulation threshold of -33 dB is 5 dB higher than the CTB threshold. Amplifier cross modulation ratios are usually within a few dB of each other at their worst channels. For example, for the TRW CA5000 hybrid operating at 46 dBmV, 6 dB tilt, and 52 channel loading, the CTB is -67.6 dB at 400 MHz and cross modulation (predominately AM) is -68.6 dB at 54 MHz; CTB is higher by 1 dB. Since these are both third-order distortions the same difference should exist at higher operating

levels: if the CTB ratio is increased to -38 dB, cross modulation should be -39 dB. From this we conclude that triple-beat distortion in a phase-locked system is 6 dB higher than cross modulation distortion. ■

* A more rigorous treatment is obtained by a Volterra series expansion. With the power series expansion it is assumed that the output signal depends only on the input signal at the same instant of time. The Volterra series expansion treats the case of frequency-dependent nonlinear characteristics. Similar results are obtained for cross modulation except for changes in magnitude and phase of the distortion components.

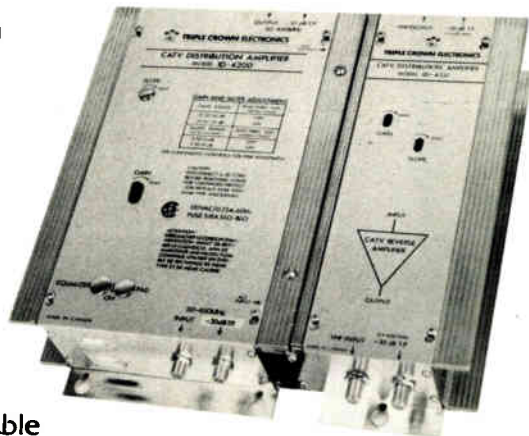
** This is the ratio that is measured if video-modulated carriers that produce just visible distortion are replaced with CW carriers at the same peak level, and the CTB ratio measured by the NCTA method. For CW beats the ratio usually quoted varies from -51 to -57 dB.

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Taking exception

I feel exception must be taken with several of the points made by Chris Bowick in his November article, "Headend audio loudness control." As the satellite engineering manager for CBN Cable Network, it is my responsibility to monitor audio levels and quality and interface with the cable system technicians and their customers when problems arise.

I know of no cable programmer which does not use some form of peak control. The satellite owners publish audio level (deviation) standards which uplinkers are required to meet. To uplinkers the trade-offs relate to audio headroom, noise floor, response and distortion. If you scan any of the "cable birds," scrambled or not, the audio levels will all be within 3 or 4 dB of each other. These levels will obviously vary within a program when monitored over the short-term, but do not vary appreciably from program to program, as Mr. Bowick implies.

The only exception to the above is the variation in perceived loudness between standard programming and commercial spots. We have noticed an even larger variation in the levels between programming and the locally generated avail audio. Obviously, the programmer has no control over either of these.

We oppose additional processing as a decrease in quality results for every device added to a signal chain, even when the device is properly calibrated and maintained. If installed and ignored, or improperly calibrated, the results can be very distracting to the listener.

While a misadjusted audio channel may be a major inconvenience to a system causing a few viewer complaints, an uplink will be inundated with phone calls if the same thing happens to it. It pays the master control/earth station combination to carefully monitor its audio levels.

What we at CBN Cable find frustrating is the lack of test equipment and training made available to CATV system technicians, as many technicians often relate to us. Some are forced to try to measure audio levels with a common VOM or worse, the famous

"that sounds about right at that setting" comment, or still worse, "We keep the modulator levels at the factory preset levels, whatever they are." Until technicians are educated at near state-of-the-art levels in the increasingly complex audio field, and are given the proper test equipment to work with, I see no resolution to the problem discussed by Mr. Bowick.

For our in-house 450 MHz mid-split system, we monitor all audio levels both audibly and quantitatively using the "five-minute rule." If a channel (off-air, off-satellite or generated in-house) fails to reach or over-deviates by 1 or 2 dB of our test tone levels as measured by a standard VU meter during the monitoring period, we look at possible adjustment. This method is easy, takes into account subjective loudness variations and yields very small channel-to-channel variation.

I have no reason to quarrel with anyone in the cable industry, but feel that Mr. Bowick's comments paint a less than fair image of cable programmers in general and uplink operators in particular.

*Neal S. Albertson
Manager, satellite communications
technical support division, CBN*

Coax inadequate to stop leaks

I was surprised that no linkage was made between "Has fiber's day finally arrived?" and "Your leakage detector..." in the October 1987 issue of *CED* (page 91). It seems to me that the ultimate solution to leakage from CATV systems is the replacement of the coaxial cable distribution systems with systems using fiber optics.

The Canadian Radio Relay League Inc. is a nationwide non-profit organization representing more than 5,500 Canadian amateur radio operators. Since "Your leakage detector..." referred to using radio amateurs to assist in tracking down leaks, and since I think it's fair to say that the cable industry is more mature in this country, I thought I'd make a few comments.

First, I'd like to support the use of amateurs as a means of tracking leaks. I'm sure that cable operators genuinely interested in keeping their systems tight will receive the support of local amateurs.

However, it is interesting to note that the lowest level leak considered in "Your leakage detector..." (graph on p. 91) is 50 uV/m. This is an enormous signal to any spectrum user! Even a simple paging receiver is typically specified to operate in a field strength of only 5 uV/m or less. And the paging receiver has no external antenna. Just think of what those levels will do to a mobile or base station receiver used for ordinary FM voice communications!

Radio amateurs use their VHF/UHF spectrum for a variety of purposes, including voice communications employing ordinary FM modulation. But many of our applications are even more sensitive. These include packet radio, satellites and weak-signal communications using single-sideband suppressed-carrier and Morse Code emissions. Some amateurs have even managed to communicate by bouncing their signals off the moon! It is obvious that communications using these techniques are susceptible to any unwanted emissions from cable systems.

Many CATV engineers I have spoken to have suggested that their systems are essentially tight, except for a few leaks. Unfortunately, this contention is not supported in practice. Cable systems seem to leak everywhere with signals strong enough to potentially interfere with even a paging receiver. There are also many stronger leaks sprinkled through the systems. I believe that this is why base stations having high antenna systems can be so badly clobbered by essentially an infinite number of smaller leaks, and a number of larger ones, from any surrounding CATV system.

All spectrum users have serious concerns about radiation from cable systems. These fears are well justified. And I fear that today's coaxial cable distribution technology cannot adequately protect us.

*Raymond W. Perrin, VE3FN
CRRL director, Ontario*

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Reader Service Number 20

The engineer's man in Washington

By all rights, engineers should hate politicians.

After all, politicians often end up telling engineers that their designs cannot be used because some outside or peripheral interest group finds it a threat to their well-being. In fact, that's happened a lot in the past year or so.

It's no wonder, then, that given the task of naming the one person who has had the most impact on the cable TV technical community over the last 12 months that Wendell Bailey's name quickly rose to the top. But it's also highly ironic because Bailey is perhaps the quintessential politician.

When Wendell, chairman of the board of CED's consulting board of engineers, formed a committee consisting of Jim Chiddix, vice president of engineering and technology at ATC; Walt Ciciora, vice president of new technologies at ATC; and Bill Riker, executive vice president of the SCTE (and last year's Man of the Year) to decide 1987's Man of the Year for CED, he had no idea he'd be the one they would choose.

But to the members of the committee he seemed the obvious choice. With battles over A/B switches, signal leakage, multichannel sound, high definition television, scrambling and a host of others going on everyday in Washington, Bailey's lobbying skills on behalf of the cable industry have been of paramount importance.

It's Bailey's job as vice president of science and technology at the National Cable Television Association to decipher the meaning of technical issues and articulate the cable industry's stance to the press, politicians and government agencies that try to muddy the waters with unnecessary regulations.

"We thought of a lot of people who had contributed to the technical end of the industry during the year, but no one stood above anybody else," says Riker. "But it seemed Wendell had orche-

Bailey's efforts gain him Man of the Year honors.

strated what everyone else had done. He was the bandleader for all the people who did the work this year."

Riker says it's Wendell's ability to motivate people who already have paying jobs to do just a little bit more that sets him apart from most people.

"I've got 3,800 members (in the SCTE) now and more than 200 people involved in our chapters who are all volunteers," says Riker. "I've learned the true importance of being able to motivate people, especially when they've got other jobs to do. I learned a lot from Wendell when I worked as his director of engineering."

Perhaps the key to Wendell's ability to motivate others lies in the fact that he is an intensely motivated and self-confident person. "He's fast, you have

to run to keep up with him," says Ciciora, who sits side-by-side with Wendell at the NCTA Engineering Committee meetings. "You have to work hard to hold his attention because his mind is going at seven different things at once."

Bailey began his professional career in 1966 at AT&T, where he worked on private line and data circuits for large customers. The other thing he did was go to AT&T's schools. In fact, whenever a slot came open in one of the classes, he told his boss he wanted to fill it. "I got a lot of very nice training that way," he says.

In 1973, Control Data Corp. offered Wendell employment as a manager of telecommunications. He was all set to take the job when then-fledgling MCI offered him a position as a junior circuit engineer. Although the Control Data job offered more money, Wendell saw the opportunity for advancement if MCI really caught on and decided that was where he would go.

Well, MCI did "catch on." By virtue of the fact Bailey was perhaps one of the first 150 employees hired by the telecommunications firm, he advanced quickly up the ladder. His outstanding people skills were recognized and he was eventually named to the corporate staff as a supervisor in the microwave engineering department.

MCI "was an exciting place to work," recalls Wendell because of the esprit de corps between the employees there. He remembers making decisions on the run more often than not just to stay ahead of those who wanted to see MCI out of business.

Looking back on it now, Wendell says it was the tremendous mental pressure that led to his taking a job with the NCTA in early 1981. At the time, though, he wanted nothing to do with a trade association and knew absolutely nothing about cable television.

"A headhunter called me one day and asked if I knew of anybody who would be



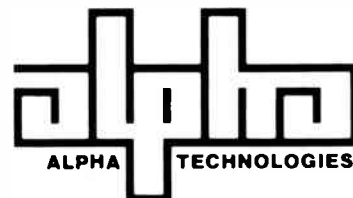
Wendell Bailey

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From all of us at
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NCTA remained convinced he was the man for the job and made the formal offer.

suitable for the job," Wendell remembers. He gave out a couple names and thought nothing else about it. Several days later the headhunter called back and asked if he'd be interested in being the next vice president of science and technology.

"I told them, 'No.' " he says. But he was eventually talked into meeting with Tom Wheeler (then-president of NCTA) and later met Frank Bias, who was at that time vice president of science and technology at Viacom and also chairman of the NCTA Engineering Committee. That was the turning point, Wendell realizes now.

But at the time, Wendell was still unconvinced. He enjoyed his job at MCI and really didn't want to leave. "Because I didn't really want the job (at NCTA), I think I was probably a lot blunter and more frank with Frank than a candidate for the job would've been."

NCTA remained convinced he was the man for the job and made the



Bill Riker

formal offer. Wendell said he'd take the weekend to think about it.

Over the weekend he discussed it with his wife Denise and came to the conclusion he'd decline the offer. But

when the phone rang at 8:30 a.m. Monday, he heard himself say, "Yes."

"My mind was telling me I needed a break," he says now. MCI was a "very invigorating and exhausting place to work. Every day was like mental guerrilla warfare."

By leaving MCI he may have unloaded one set of pressures, but new ones took over at NCTA. His first day at NCTA was highlighted by the usual Monday morning department head meeting, where VHF drop-ins were the topic of discussion. Wendell was asked what the NCTA's position was. He replied, "Mr. Wheeler, I have no idea what those are...but I'll find out and let you know." Later in the day, he went to the FCC to discuss the issue. "That's what you call hitting the road on your feet," Wendell says.

It's his ability to strip away the hyperbole and grasp the importance of technical issues and evaluate their ramifications on the industry as a whole that is possibly Bailey's most

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Women in Cable
Zenith Cable Products

His value to the industry is also noticed by those outside the engineering community.

important attribute, say those who work with and for him.

"Wendell is a unique individual who combines technical ability with wonderful skills at dealing with non-technical folks," says Ciciora. "As we go into the future, with things like HDTV coming, we'll require more people who have those kinds of skills. He's been extremely valuable as an interface between the technical and non-technical worlds."

"Wendell has been our tireless champion in Washington on a whole range of things and he's an effective voice for the industry in general," says Chiddix. "He's been very effective in articulating the industry's point of view to the press, Congress and others. The last few years have been a period where cable has made great strides in the regulatory arena and the NCTA in general has done a great job. Wendell has been a big part of that."

Riker agrees. "He's able to talk to non-technical people and discuss high-



Walt Ciciora

tech issues and bring them to a level people can understand. He's able to persuade them toward the cable industry's point of view. That's something I was immediately impressed with when

I went to work for him."


Andrew Setos, senior vice president of engineering and operations at Viacom Networks Group, adds his own accolades. "Wendell is one of the cable industry's secret weapons. He is extremely knowledgeable and savvy and is one of the ultimate problem solvers that the industry has. That's not to mention the fact he's a heck of a nice guy, very funny and a joy to work with."

His value to the industry is also noticed by those outside the engineering community. "Wendell is NCTA's Benjamin Franklin; there isn't much in any field he doesn't know about," says Jim Mooney, president of NCTA. "One of Wendell's greatest strengths, aside from his facility for explaining complex technical matters in lay language, is his ability to recruit company participation in industry projects. This reflects the respect he has earned in the engineering community and is a very valuable asset for NCTA."

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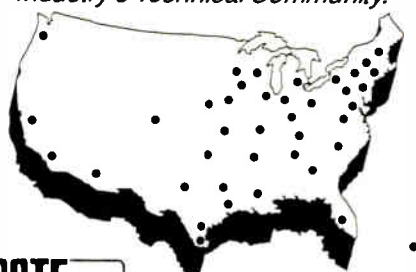
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Reader Service Number 27

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Although Wendell gets the credit, he says it's not simply a one-man show.

Even though he gives most of the credit to Bias, it's been under Wendell's guidance that the engineering committee has grown to become arguably the most influential and knowledgeable collective technical voice around.

When Bailey first came to NCTA, the committee consisted of just 16 members and the topics it tackled included teletext and "cable-ready." Bailey saw the potential for vigorous discussion with a larger group and began to invite more people. The group, which meets every other month, now regularly has 50 or 60 attendees representing MSOs, programmers and manufacturers who work with a camaraderie that transcends competitive pressures.

"That committee is clearly the joy of my job at NCTA," says Wendell. "It is an unbelievable group. The range of fluencies that each of these people have is really an amazing thing. I would put this group up against any other that I've ever met. Nothing slips by this



Jim Chiddix

group."

He credits the committee's foresight and diligence for resolving issues like consumer compatibility ("MultiPort was started before VCRs became real

popular," he says), signal leakage ("I think we stood a big, big chance to lose rights to frequencies"), multichannel television sound ("We insisted that companding had to be done or it would never work over cable") and exploring new technologies like HDTV ("We had a subcommittee working on it before management became concerned about its impact").

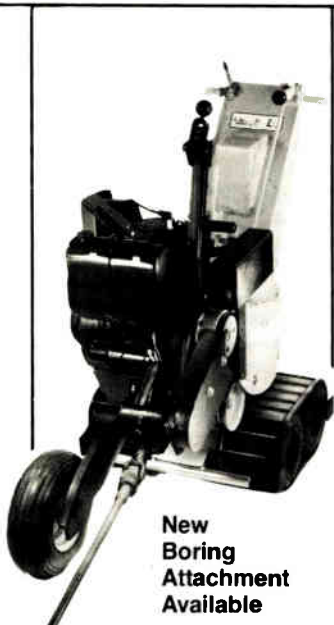
Although Wendell gets the credit, he says it's not simply a one-man show. Bailey credits his staff of Brian James, Katherine Rutkowski and Sabine Lavaud for the overall success of his department and keeping the engineering committee organized.

With so much of his time devoted to bringing better images to consumers, saving MSOs millions of dollars on A/B switches or convincing the FAA to let cable share spectrum, Wendell's highlight film would be jammed with successes. But it's Wendell's personal life that gives him his greatest satisfaction. He's been married to Denise, "an

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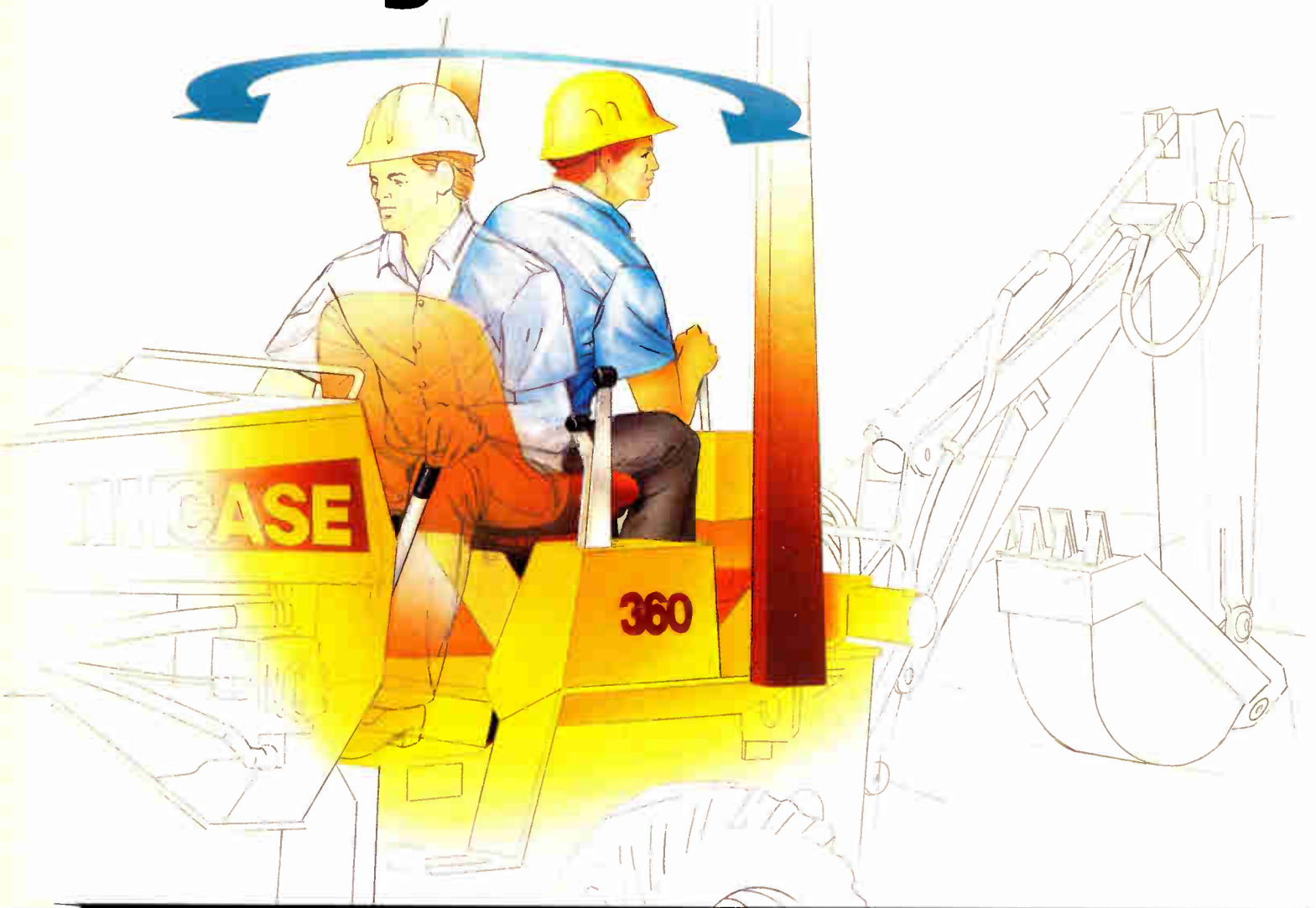
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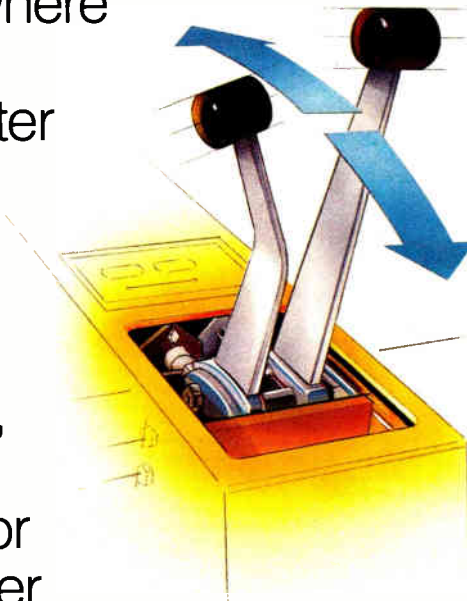


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'The easy path is the one that leads to telco ownership; the hard one leads to independence.'

incredibly smart and professional woman," for 20 years and together they have raised "a smart and beautiful daughter," he says.

And it isn't all work and no play for the 41-year-old Bailey. His jovial personality makes him a lot of friends and he loves a good joke. "I still feel like I'm 17 inside," he says in an attempt to explain why he loves to ski some of the more challenging Rocky Mountain slopes.

But his real love is flying, a passion he shares with Brian James, director of engineering at NCTA, who is also a pilot.

"Both my parents were pilots and I remember it was something I've wanted to do all my life," he says. That desire went unfulfilled until a few years ago when Denise and daughter Jennifer Leigh arranged for Wendell to join the FAA flying club and learn the craft.

It wasn't long before he was elected to the board and then chosen as the club's president, an office he has held

for the past three years. "Flying is every bit as enjoyable as I always thought it would be," he says.

Hidden in his philosophy toward flying is the key combination of emotions that sums up his approach to life. "Flying is a complex activity, but it can be extraordinarily fun and exhilarating. When you're flying, you're putting yourself in a situation that demands your attention all the time. It doesn't allow for relaxed, casual participation, but it's an immensely enjoyable thing to do."

That blend of seriousness and fun is perhaps what Wendell is all about. When he's focused on lobbying the FCC or Congress about an issue of importance to the industry, he won't give up until the fight is over. But at the same time he never loses his humor. "This is a fun job, but it's hard work," he says. "But if you can't have fun at this, you ought to go off and do something else."

Would he? He doesn't completely rule out the idea that he may one day

leave NCTA, but it would have to be for something equally as challenging. "I'm happy at NCTA. If my career stayed here I wouldn't complain," he says. "As technology changes and evolves, my little department gets new and exciting things to talk about and work with all the time. That helps guard against complacency because almost every day I come in here and I'm sure there's something I don't understand that has happened overnight."

Despite the number of potential competitors looming on the horizon of the future, Wendell remains optimistic that cable will be around for some time to come. "The industry has its long-term future in its own hands," he says. "The easy path is the one that leads to telco ownership; the hard one leads to independence. I believe the talent and resources are there to take the hard path."

And most people believe he's part of the talent.

—Roger Brown

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Equipment for small system operators

John Giudice owns Broadband Technology, which has the franchise for Lyons, Colo., a hamlet of some 460 passings tucked away on the two-lane highway linking Boulder and Estes Park, Colo. Broadband has 309 basic subs, 7.5 miles of plant and is hidden behind some mountains that make off-air signal reception pretty poor. So penetration for the 20-channel system built at 330 MHz hovers at about 66 percent. Still, margins are pretty thin and there's not a lot of room for big engineering budgets or lavish staff.

Unusual? Hardly. More than 2,173 U.S. cable systems have fewer than 1,000 subscribers.

Small system operators like Giudice usually must (and perhaps should) trade some types of features against price when buying equipment for their systems. But what small operators—especially those in rural areas serving remote locations—shouldn't sacrifice is reliability, many vendors say. Giudice definitely agrees.

He's designed his system using some-what more costly but decidedly more reliable equipment. He says his system is "overbuilt" with Standard Communications receivers and Catel modulators and signal processors. Why? To cut his maintenance and operations costs. Simply, he's found that paying more upfront means savings later.

In particular, Giudice avoids trouble calls relating to headend and distribution gear. "Aside from sweeping the system twice a year we don't have to do much," Giudice says. That also means he saves on labor costs. "Basically, we only send techs out to do installs and disconnects."

But can reliable, high-quality equipment be had at a price small systems can afford? Definitely. It's now possible to buy signal processors, modulators and receivers that offer basic performance comparable to higher-priced full-featured units but at less cost. That'll keep costs under control for the headend portion of the plant. Of course,

Industry vendors offer tips.

there's still the distribution plant to take care of, but here as well, more economical equipment is available.

Link budgets

Start with the headend. What specs have to be met for the signal link between receiver and combiner? Standard Communications offers a few guidelines. First, Standard assumes that pictures delivered at the end of line must, at least, match pictures

chrominance to luminance gain inequality all would degrade beyond the VCR/off-air reference, says Standard's Warren Davis.

So what does that mean? Differential gain, expressed as a percent of maximum gain, is the change in amplitude of a chrominance subcarrier superimposed on a luminance signal, occurring between the sending and receiving ends of a device as the luminance signal varies from blanking level to white level.

Differential phase, expressed in degrees of phase change, is the change in phase of a chrominance subcarrier superimposed on a luminance subcarrier, occurring between the sending

and receiving ends of a device as the luminance signal varies from blanking level to white level.

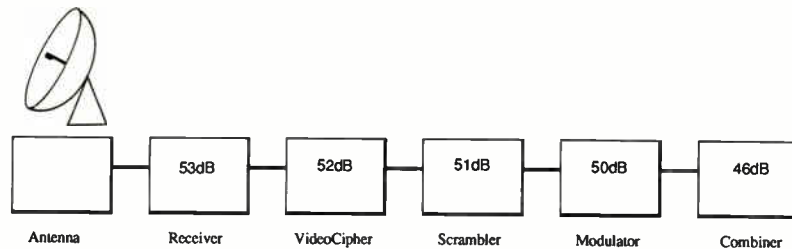
Chrominance to luminance gain inequality is the difference in amplitude between the color and luminance carriers after they have passed between the sending and receiving ends of a device.

What do these artifacts do to pictures? Differential gain causes washed out, dull, or brighter than normal colors. At higher distortion levels, pictures turn fluorescent, Davis says.

Differential phase causes incorrect color hues, such as yellows that are greenish or facial tones that are pinkish or bluish green. At higher distortion levels, pictures will look like the hue control had been misadjusted, Davis says.

The point: those receiver specs buyers sometimes skip over—especially when they're asking about price—do make a difference. And given that operators cannot affect the receive EIRP level, VideoCipher, scrambler or combiner portions of the signal path at the headend, more attention needs to be put on the elements buyers can control: receivers and modulators, Davis says.

So what's being given up as customers trade down in price? Cosmetics, chassis quality, the ability to phase-lock



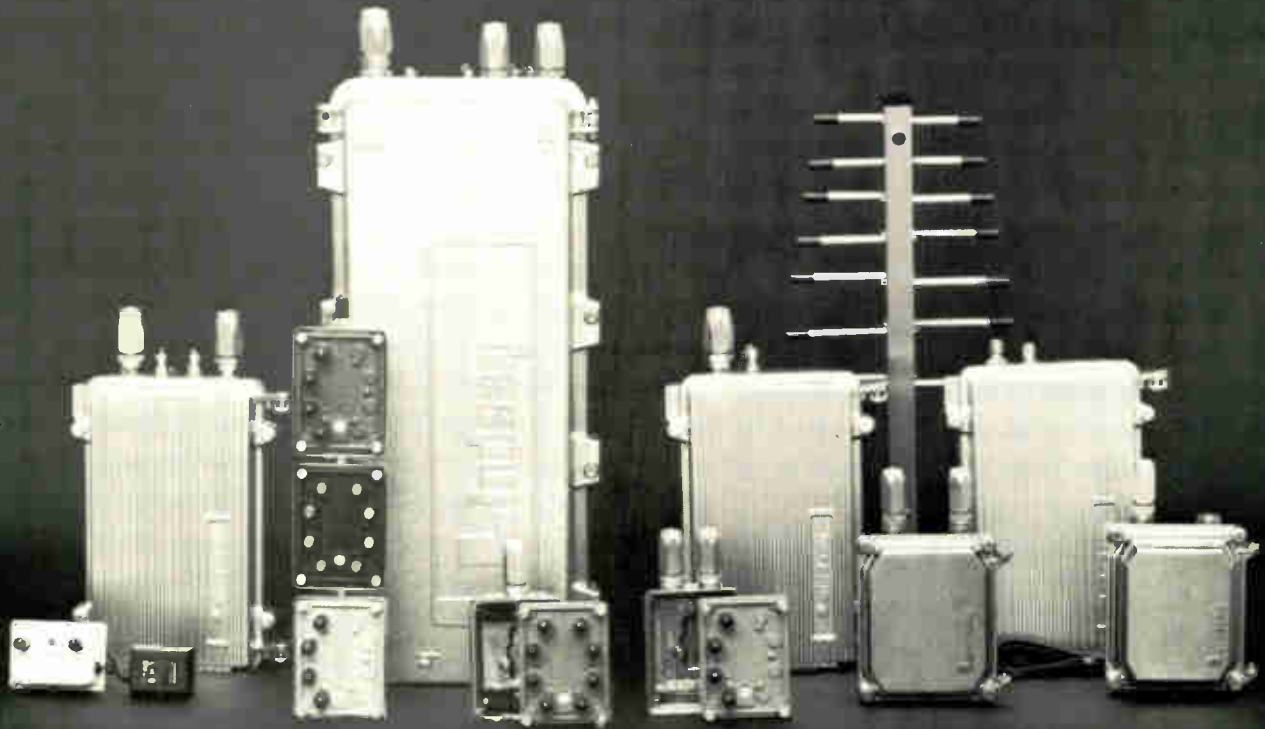
Link budget analysis for S/N

Standard Communications assumes end-of-line performance for CATV must equal over-the-air or VCR S/N. That's 53dB. If the receiver takes S/N to 53dB, S/N out of the combiner is only 46dB. And that's before S/N degrades further through the distribution plant.

available over-the-air or from standard VCRs. Assume S/N of 53 dB for the reference signal (off-air or VCR). Assume that a perfect test bench signal would deliver 67 dB and that virtually all circuits in the link are perfectly linear. S/N in the receiver would take system S/N to 53 dB. After going through a VideoCipher unit S/N would be 52 dB. Assuming a scrambling system is used, S/N goes to 51 dB. Out of the modulator S/N would be 50 dB. After the combiner S/N would stand at 46 dB. And that's just leaving the headend. Further degradation would occur at each active stage of the distribution plant.

Obviously, there's a problem. VCR or typical off-air S/N is assumed to be 53 dB. And Standard assumes the signal coming out of the combiner using some typical lower-cost receivers would already be 46 dB. Other components of signal quality such as differential gain, differential phase and

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Reader Service Number 36

To complicate matters, the industry doesn't have common standards of measurement for performance.

signals, RFI protection and shielding, video sync pulse performance, vertical interval timing, protection from spurious signals and a degree of flexibility. Typically, the ability to adjust RF output is sacrificed, as is the ability to put in filters for TI. Video clamping can get tricky and the IF filters might not be the 70 MHz standard most high quality receivers use. More important, S/N degrades and there's likely to be more drift.

To complicate matters, the industry doesn't have common standards of measurement for performance. Consider threshold performance, for example. If measured by looking at an unmodulated carrier, it isn't the same thing as threshold performance looking at color bars. The first is a measurement of static threshold; the second a measure of dynamic threshold. Which measurement is given on a spec sheet isn't always noted, Davis says. Is it important which test is used? Certainly. Dynamic range will always be

less than static range. If, for example, dynamic range isn't 13 dB or better "you start getting impulse noise. You also lose fade margin," says Davis.

If you really want to be safe, you always can look at the specs Scientific-Atlanta is quoting. S-A consistently gives the most conservative number when a range is involved—and that's almost always the case. Not all companies will do that. Some will quote an average figure. Others might give a higher figure that is obtainable on some units from some production runs, but possibly not from 85 percent of units from 85 percent of production runs on 85 percent of all channels.

So how much does a receiver cost that will do the job technically? "Over \$800 and you're buying features, not basic performance," Davis says. Between \$400 and \$500 to \$600 is where the smaller operator probably can find good, reliable equipment without paying for "bells and whistles."

Something else buyers ought to be

looking at is the quality and quantity of documentation provided with the processors, modulators and receivers. How good are the manuals? How long is the warranty? What limitations and exceptions are made to warranted items? What's the turn-around time on repairs?

Other smaller, but telling points: does the power supply have adequate heat sinks? Are the resistors flame-proof? Are the boards made of PC quality material? Are the screws made of good quality metals? Are the switches rugged and securely mounted? Are the units stable over temperature ranges?

A typical link

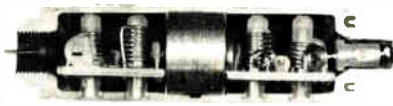
Here's a typical link analysis Standard Communications would make for a customer. Assume a receive site located around Los Angeles, Calif. Assume a 10-foot reflector, a receiver costing about \$500, a modulator costing about \$500, an LNBC costing about

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Standard will soon be rolling out new receiver products that will offer surprising performance for the price.

\$150, no scrambling system and a VideoCipher unit in place. Assume antenna gain of 39.5 dB, antenna noise of 28 dB, cable loss of 10 dB, LNBC gain of 60 dB, LNBC noise temperature of 65 dB, receiver noise temperature of 13 dB, receiver bandwidth of 27 MHz, video deviation of 10.75 MHz and video bandwidth of 4.2 MHz. Assume system noise is 101.8 degrees, system G/T is 19.4 degrees, C/N is 12.7 dB, S/N is 50 dB and audio S/N is 60.56 dB. Assume EIRP of 35 dB and antenna to LNBC loss of 0.1 dB. Assume there's no scrambling required but a VideoCipher unit is. Looking just at S/N, the best S/N that can be delivered to the home, assuming a perfect distribution plant, is 45 dB. That's barely acceptable and allows no margin at all for degradation from any single source or combination of sources.

Recall that VCR and off-air broadcast S/N is assumed to be 53 dB. You get the point. Skimp on the receiver and modulator and be ready for trouble.

Made for small systems

Here are some of your options. Scientific-Atlanta, for example, makes modulators like the Model 9220 with specifications comparable to the higher-priced 6350 and 6330 models. Are there trade-offs? Of course. Some of the switching options and phaselock features are given up. And there are some differences in specs for differential phase and output level, for example. If a frequency agile modulator is desired, the Model 9260 is a lower cost device designed for adjacent channel operation. The 9220 modulates signals in the 54 MHz to 300 MHz range and complies with FCC offset rules. The Model 9260 FAM outputs 50 dB signals over the 54 MHz to 300 MHz range and also incorporates FCC aeronautical band offsets. The Model 6330 modulator produces 60 dB output for frequencies between 54 MHz and 300 MHz.

In signal processors, the Model 6150 is typically the choice for a large

system. The Model 6130, however, is more commonly recommended for the small system. Again, it's less expensive because it gives up the modular design and some features found on the 6150.

In receivers, try the Model 9640, which offers two standard C-band 24-channel formats, eight pre-programmed Ku-band formats, and a 32-channel programmable format for non-standard C-band or Ku-band spacings.

Standard will soon be rolling out new receiver products that will offer surprising performance for the price. Today, small systems might consider the Agile 24PC or Agile 40 C/K.

Look north for equipment as well. Some of the Canadian suppliers like Triple Crown and Nexus Engineering, for example, are used to supplying excruciatingly small hamlets scattered across Canada's sparsely-populated north lands. Those systems simply have to work without any maintenance because there is no on-site technical workforce. Also, because of the tiny subscriber bases, headend and distribution system costs also have to be pared to the bone. How tiny? Triple Crown is putting in 80 headends for clusters of as few as 70 subs.

There's no magic to it. Triple Crown's Channelizer, for example, is a pre-racked headend with receivers, demodulators and modulators that can be supplied with pre-authorized and burned-in VideoCipher decoders, passives and power bars. All channel blocks are interchangeable and all the receivers are frequency agile.

All the amplifiers and combiners are 300 MHz or 450 MHz devices so the entire headend can be spared with one unchannelized modulator module, one unchannelized processor and one receiver. All modulators and processors are SAW filtered. Combiners and post amps can be spared from stocks of regular amps and taps. The equipment is designed to be stable because "you just can't send a tech out there all the time to fix it," says the company's Brian Ward. Signal out of the post-amp is usually 45 dB Ward says.

Set up? "Typically you get a subscriber at the end of the cascade and have them watch TV to check the signal quality or you use a simple SLM." One advantage to buying this type of pre-packaged headend is that

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the operator doesn't need a spectrum analyzer to set up the headend.

A pre-packaged headend often is a good choice for smaller operators who can't afford the test equipment usually required to set up the equipment. Blonder Tongue, John Weeks, Nexus, Cadco and Qintar, among others, can supply such a plug-and-go headend.

Qintar estimates that a complete 12-channel headend, including four VHF and four UHF-converted-to-VHF channels plus four satellite channels, costs as little as \$5,500 (VideoCipher units not included). A typical 24-channel headend with seven off-airs and 17 satellite channels costs as little as \$11,000.

Different philosophies

Design philosophies for headend equipment vary quite a bit. S-A and Standard have taken one approach. Nexus Engineering has taken another. Take, for example, the Nexus approach to building modulators. How can the company possibly build high quality products and still sell them at less cost?

Simply by looking for basic performance and rigorously pruning away "bells and whistles." Consider frequency agility, for example. Nexus doesn't build FAMs. The company doesn't think modulators need to be re-channelized very often and has decided to skip the additional circuitry and cost. Less complex, more reliable.

How about power supplies? The typical modulator, demodulator or signal processor available to the industry uses internal power supplies. They generate internal heat, which can cause drift and shortened component life. The result, Nexus says, is reduced reliability. So Nexus uses external power supplies. Less heat, less drift, less circuit cooking, more reliability.

Output level? The company's Series 1 products, designed for large systems, output is 54 dB instead of the 60 dB many other manufacturers use. The Series 5 line, more commonly used in private cable settings, outputs 35 dB. The rationale? It's more economical to run the modulators at less output level, combine the signals at lower levels and then amplify them together using a post amplifier.

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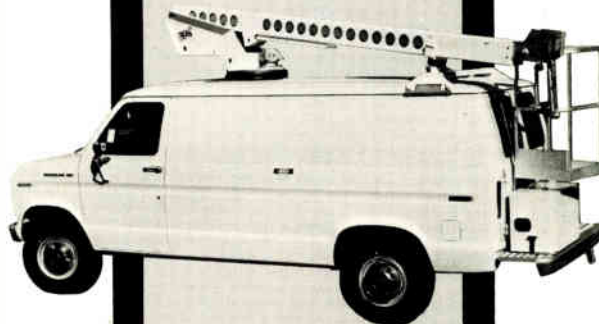
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So the issue is whether an operator wants to put FAMs side-by-side. Many vendors say no.

Similarly, the company has argued that SAW filtering and heterodyne processing weren't necessarily better than on-channel processing and bandpass filtering. That's still true for the Series 5 line of processors, modula-

tors and demodulators. But the Series 1 line of processors, modulators, demodulators and a BTSC generator, intended for larger systems, uses both SAW filtering and heterodyne processing.

FAM or fixed frequency?

Frequency agility is the subject of debate among design engineers today. Obviously, a fixed frequency modulator can filter out all bands except the passband of interest. An agile modulator, on the other hand, has to pass a wide range of frequencies. As a result, the out-of-band noise floor for a fixed frequency modulator is 70 dB or so. On an agile device, where filtering isn't possible, the noise adds on a power basis when FAMs are used side-by-side. The result, of course, is a less-than-clean signal coming out of the modulator bank.

So the issue is whether an operator wants to put FAMs side-by-side. Many vendors say no. Use the agiles for sparing but use the fixed-frequency units as primaries. "Most agile units are going to sit on-channel" says S-A's Ken Cannon, applications engineer.

Standard, in fact, has pulled its FAM off the market until it can do a better job with out-of-band noise.

Bill Smith of Cadco favors SAW rather than bandpass technology for modulators because of the reduced maintenance. "If I was building a real small system I'd use 45 dB SAW-filtered modulators and processors, amplified combiners and line extenders for the distribution plant. For a system of 5,000 subs or so I'd go with processors and modulators that put out 60 dB and space my amps at 1,700 feet. I'd do everything with an eye to low maintenance costs and reliability. You shouldn't have to check the equipment every 30 days." He also wouldn't, for cost reasons, recommend 100 percent use of frequency agile modulators and processors. "They're more complex and I don't think channelizations are going to change that much. On the other hand, FAMs are great for sparing." Cadco sells a 45 dB output FAM; model 260.

ISS Engineering, on the other hand, recommends the use of agile equipment entirely. Why? So that only three products are required to build a headend: a single model of modulator, demodulator and receiver. Sparing also is simplified. ISS also cautions operators against buying equipment with non-standard IF frequencies.

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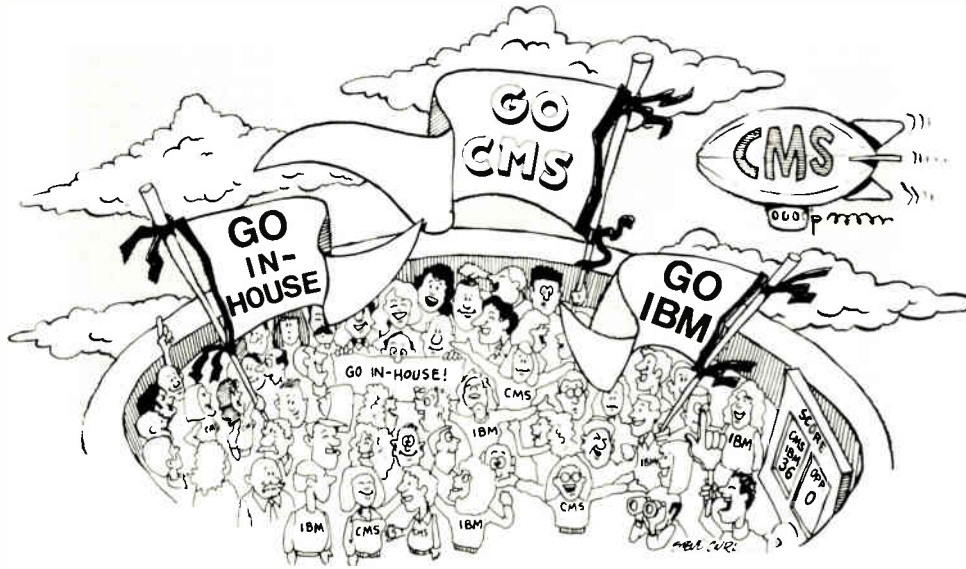
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Occasionally, converters are going to go on the fritz and need repair. That's when a converter repair house comes into play.

New from Jerrold

General Instrument's Jerrold Division has introduced a satellite receiver and modulator that are "priced well below even the so-called popularly priced CATV receivers and modulators," says Ed Leahy, company ad manager. The S412R receiver is C/Ku-band switchable with 950 MHz to 1450 MHz block conversion input. It uses digitally synthesized video and audio tuning with frequency counting compensation for LNB drift. It accepts narrow band or wide band audio subcarriers from 5.0 to 8.5 MHz in 10 kHz steps in discrete, matrix or multiplex formats. It also is VideoCipher II compatible.



Jerrold's S300M FAM

The new frequency agile S300M modulator is agile to 300 MHz. Channel selection, IRC/HRC and FCC offsets all are switchable from the front panel. The unit is one and three-quarters inches high and is BTSC compatible (it accepts both baseband and 4.5 MHz subcarrier input). All spurious outputs are 60 dB or more down from video level in-band. Out-of-band S/N is specified at 67 dB. The S300M also outputs 60 dB RF level so no post-amplifiers are required. Separate video and audio IF loop-through is supported.

Pico Macom recommends that small operators use the CR-1000 receiver, M45 modulator, SP60 signal processor, the SP60-U for converting UHF signals to VHF; and the CHC-16 16-channel combining network. The company offers extended warranties and manufacturer-direct pricing as well.

R.L. Drake's compact ESR1240 receiver sells for \$389 and hooks up to all descrambling equipment now on the market. The company's VM2410 frequency agile modulator outputs 57 dB and typically costs about \$700.

Distribution gear

Distribution gear is another place money can be saved. Some vendors

Continued on page 54

More money saving tips

Small operators desiring full-motion video ad insertion capabilities can choose from systems made by Texscan MSI, Ad Systems, Monroe Electronics, Tele-Engineering, Falcone and Channelmatic, among others. Get character and graphic generator packages from Abiqua International, Texscan MSI and Compu-Cable Systems. Compu-Cable's generators, for example, start at \$350 and move up to \$7,000. Texscan's SpectraGraph Series MGG-2 digitizes and stores NTSC video images or audio messages. The images can be edited with the system's graphics and text software.

The Ad-Cue Jr. by Tele-Engineering is a sequential access system costing about \$2,090 for a one-channel or two-channel system and \$3,335 for a three-channel or four-channel system.

Ad Systems makes the Ad Lieutenant, a system supporting four channels but using only one VCR. It sells for \$3,495. Ad Systems also makes the Automated Break Compiler, a system for editing the actual commercial tapes. It costs \$6,995.

The 3000 R-14 commercial insertion unit made by Monroe Electronics offers single-channel ad insertion for \$2,495. It also can be configured for two-channel operation.

Adams Russell recommends that the smaller operator look at the Arvis 6000 or Grid systems. The Arvis 6000 randomly accesses over 100 spots of 30 seconds length on a one-hour tape.

Telecommunication Products Corp. sells the BASUS sequential controller working with a single VCR. Spots are played in the order they occur on the tape. The controller sells for \$1,220.

Texscan suggests the Cross Channel Promoter for smaller systems. Available in four-channel or two-channel versions, each model controls one tape deck and inserts spots on a "first come, first served" basis. The trade-off is logging or verification ability: there is none. On the other hand, no CPU or terminal and no printer are required.

The ComSertter-191 monitors a single channel and controls one VCR. It's slightly more sophisticated and offers a "random sequential" access: spots

run sequentially but the start of a series can be anyplace on the tape.

Looking for stereo? Keeping in mind that there are two formats being sold to CATV operators (BTSC as well as FM System's non-standard stereo format), for the first six months of 1988 members of the National Cable TV Cooperative will be able to buy the FMT633S stereo modulator for \$695. To set up and test the encoders, FM Systems recommends the ADM-1 audio deviation meter.

Converters

One way to save money on converter purchases is to buy reconditioned boxes from vendors such as Brad Cable Electronics. The company carries equipment made by Jerrold, Oak, Hamlin, Pioneer, Scientific-Atlanta, Zenith, RCA, Magnavox and Sylvania, among others.

If you're looking for reconditioned equipment in the states of Indiana, Michigan, Ohio, Illinois or Wisconsin, Great Lakes Cable TV Services resells equipment for 10 to 75 percent of original wholesale price.

If, on the other hand, you're in the market for new converters, Pioneer recommends the low-cost, 36-channel BC-2000 for systems running up to 300 MHz.

Occasionally, converters are going to go on the fritz and need repair. That's when a converter repair house like PTS/Katek comes into play. Most orders of 100 units or less can be returned within two weeks and all repaired converters come with a six-month limited warranty. The company also will sell reconditioned boxes if you're looking for them.

Intrastellar Electronics offer a two-week turn-around time for converters it is repairing, and likewise can sell reconditioned boxes.

Distribution houses

Smaller supply houses often can offer more support to a small operator. TVC Supply Co., for example, empha-

Continued on page 52

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MFC recommends positive trapping as a security system and for much the same reason TCI uses them.

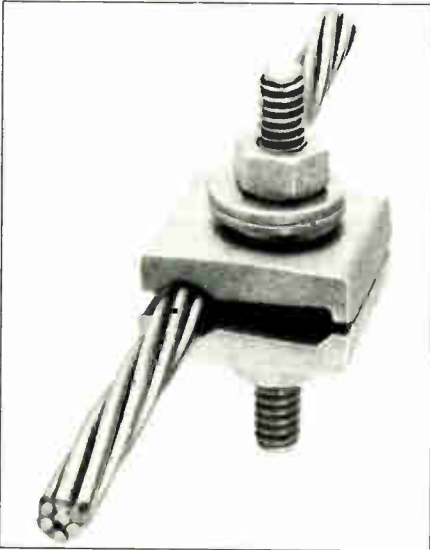
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sizes its staff of sales engineers.

Cable Services Co. also can design, construct and engineer a build, rebuild or upgrade in addition to providing CATV hardware. There is no minimum dollar amount for an order and no standard package of equipment an operator must buy.

The Head End specializes in used equipment ranging from modulators to headends. So does Com-Tek, based in Hayward, Calif. and Sedalia, Mo.

Idea/onics sells a low-cost emergency alert system that overrides up to 64 channels.



Diamond Comm.'s lashing clamp

When choosing cable supports, lashing clamps, and drive rings, Diamond Communication Products cautions against choosing solely on price. "An unusually low price is the first warning sign that short cuts were taken in the manufacturing process," the company says.

Telecrafter Products specializes in drop hardware and recommends its universal cable markers for drop identification and the RB-2 clip gun, which minimizes the chance of damage to the drop cable as it is fastened.

Billing systems

Creative Management Systems offers operators of systems from 2,000 to 10,000 subscribers the System 1 in-house management and billing system,

running on an IBM System/36 computer. The System 1 supports addressable and PPV ordering systems. CMS also offers a national printing and mailing service for its clients.

First Data Resources designed its Cablestar management and billing

ators, since it is priced as much as 25 percent below other comparable racks. It can be shipped by UPS and has accessories such as a rolling base, equipment shelves, blank panels, patch panels and a support bracket for rack-mount devices.



Microwave Filter's Positrap System

system for operators of systems smaller than 20,000 subs. The software runs on IBM PCs and compatibles.

CableTEK's CableMAX system is designed for systems of 15,000 subs or less and also runs on IBM PCs and compatibles. A trouble-call screen allows recording of information about the problem a subscriber has (ghosts, snow, no sound or no video). A four-line comment field can be filled with notes that will print on the actual work order for system techs.

Computer Utilities of the Ozarks sells the Cable/I system running on IBM PCs and compatibles and can be used by systems as small as 1,000 subs. An average cost for a 3,000-subscriber system on 60-month lease would be about 7 cents a sub, the company estimates. What an operator is looking at is monthly costs of about \$155 for the leased software and hardware and \$55 maintenance.

CableData's choice for the small operator is the On/Line Shared System because it saves the expense of computer system ownership.

Signal security

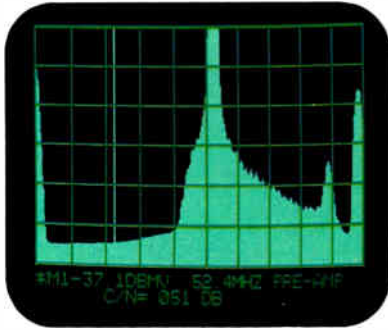
To deter theft, Midwest CATV recommends the "Labelock," a color-coded tag that identifies subscriber status and provides evidence of tampering, since it must be destroyed to be removed. The RR72 equipment rack also is recommended for small oper-

Pico Products recommends negative and positive traps for pay security. If pay channel penetration is greater than 35 percent, Pico says to go with negative traps. If pay channel penetration is less than 35 percent, it's cheaper to go with positive traps. The Pico Six-Pack can secure as many as six pay channels from two to 36 with less than 1 dB insertion loss through six daisy chained traps. The Six-Pack requires no subscriber or system power and costs about \$15 a subscriber. Traps can be installed by non-technical personnel and come with a two-year warranty.

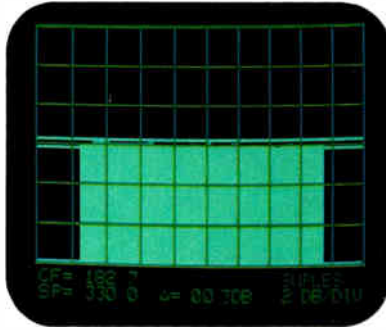
Microwave Filter and Intercept, among others, also will custom design filters for special applications.

MFC recommends positive trapping as a security system, and for much the same reason TCI uses them. It costs less to secure a pay service under conditions of low penetration using a positive rather than a negative technology. Basically, the operator has a choice of "pay to deny service" (negative trap on all drops except for pays) or "pay to provide service" (positive trap on those drops taking a pay service). Since the cost of a single-channel trap—positive or negative—is the same, the economics obviously work in favor of positive technology under low-take conditions. Conversely, high-take pays are more economically secured by negative trap technology.

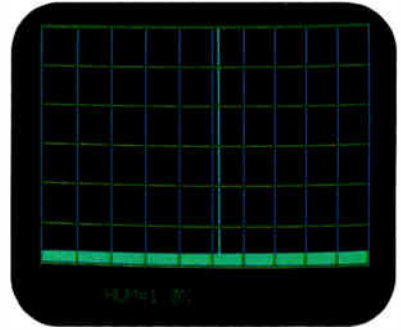
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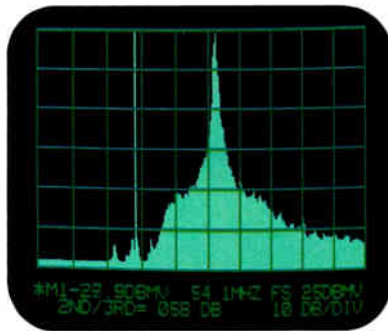
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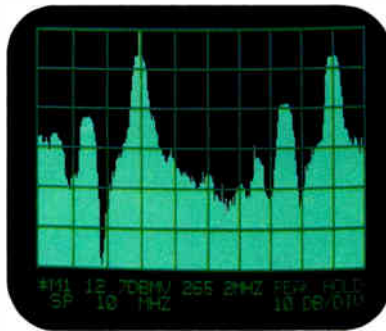
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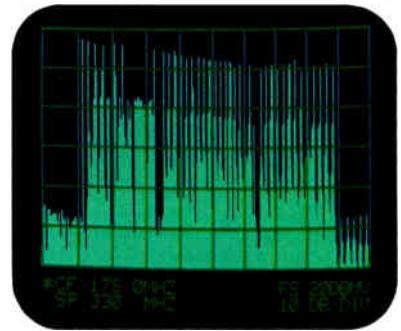
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Introductory price \$9995.

WAVETEK®

In essence, the concept is to take trunk quality hybrids and put them into a distribution amp.

Continued from page 50

make very low cost trunk amplifiers that look more like LEs or distribution amps, for example. Other vendors have developed LE-type products that can be run more than two to a cascade. In general, the goal is to simplify—and thereby reduce the cost of—the amps. Although more popular in Canada than in the United States, tapped trunk design also can be used to reduce distribution plant costs. C-COR Electronics, for example, has amplifiers specifically designed for low cost but high performance applications in rural or other areas of low customer density.

In essence, the concept is to take trunk quality hybrids and put them into a distribution amp. The 300 MHz MT-500 Series "mini-trunks" come in 22 and 32 dB gains and incorporate a passive distribution output on the housing that takes either an 8 dB or 12 dB directional coupler.

The D-500 Series distribution amplifier is a 43 dB high gain station designed for remote bridger applications and active feeder designs.

The 330 MHz E-417 Series line extender has 27 dB of gain. All three types of amplifiers are covered by a three-year warranty.

Brand new from C-COR is the Model E-539 LE using parallel hybrid technique and offering higher output without additional distortion. Available with one- or two-port outputs, the bottom line is that fewer LEs are required when using the E-539.

Triple Crown has a line of 300 MHz trunk amplifiers, the LA series, running with 26, 30 or 15 dB gains and costing as little as \$66. The matching DL series distribution amps offer 27 dB gain. Several of the models can be configured either as trunk or distribution amplifiers. The DX 300 is Triple Crown's LE, offering 14 dB gain.

Lindsay Specialty Products has two products specially designed for rural systems: the Model 990 Trunk Bridger Amplifier and the Model 100, a versatile amplifier that can be used as a trunk, distribution or line extender amplifier.

The 990 is a 450 MHz amplifier featuring a small housing (which reduces cost), separate RFI and rubber gaskets (for greater reliability), two

Continued from page 52

Wondering what to do with wrecked-out cable? Great Lakes Cable TV Services is a rep for Midwest Cable Services, which will pick up wreck-out cable if a minimum of 10 miles is available. Resource Recovery Systems, based in Houston and San Antonio, Texas, also will pay operators for, and haul away, scrap cable.

For operators wanting addressability, Oak Communications suggests the Sigma PC System, a lower-cost system using an IBM PC or clone and Sigma encoders and decoders. The Sigma PC is compatible with older TC35/TC56 addressable converters as well, so boxes can be mixed.

Construction tools

Smaller firms doing their own aerial construction may want to look at the new Model S (500M) pull-type lasher made by CSE Technologies. Weighing 19 lbs., the Model S can be operated by a single individual and lashes cables from drop wire up to 1 15/16 inches. Also new: a non-metallic lashing wire made of Kevlar fiber. It's about twice as strong as standard 0.045-inch stainless steel lashing wire but weighs about one-third as much. It does cost more than steel wire. On the other hand it's twice as resistant to breakage than steel wire and resists UV breakdown and corrosion.

Jensen's cable tie installation kit contains 200 ties and tie tool at a four-kit cost of about one aluminum tie tool.

Western Electronic Products makes the \$53.95 CX-1 cable stripper, a tool originally developed by NASA that prepares a coaxial cable in 10 seconds.

General Cable's Telsta division says the time it takes to place and remove a 28-foot extension ladder, climb and descend a telephone pole, position and stow the lift is 15 minutes, on average. Using an aerial lift, the identical operations take an average of 5.25 minutes. Of course, the capital cost for a van with lift is \$12,700 or so higher. But Telsta says that averaged over the 10-year expected life of both vehicles, the annual difference between a plain van and a lift-equipped van is \$1,920 a year. That assumes initial purchase cost of \$12,300 for a van; \$25,000 for a

van plus lift; annual maintenance costs of \$2,000 for the van and \$3,000 for the van-plus-lift; and salvage value of \$1,000 for the van and \$4,500 for the van-plus-lift.

If underground plant is in the picture, operators have a couple choices: cable-in-conduit made by vendors like Integral Corp.; armored and flooded cables designed for direct burial made by all the major cable manufacturers; or Cable Guard, Comm/Scope's new product that offers the flexibility of standard jacketed cable and the protection of armored cable. If you're burying the cable yourself, Line-Ward's L-1 or L-2 self-propelled vibrating plow can be operated by a single person.

When installing drop cable, the first step requires a suspension method. Sachs Canada recommends the use of an SC-02 drop clamp and SC-03 span clamp because of their superior corrosion and heat sheath breakdown resistance. To ensure proper grounding of drops, the firm recommends the SC-13 grounding strap because they're UL-approved and the SC-22 grounding connector because it costs less than half of what a traditional split bolt runs.

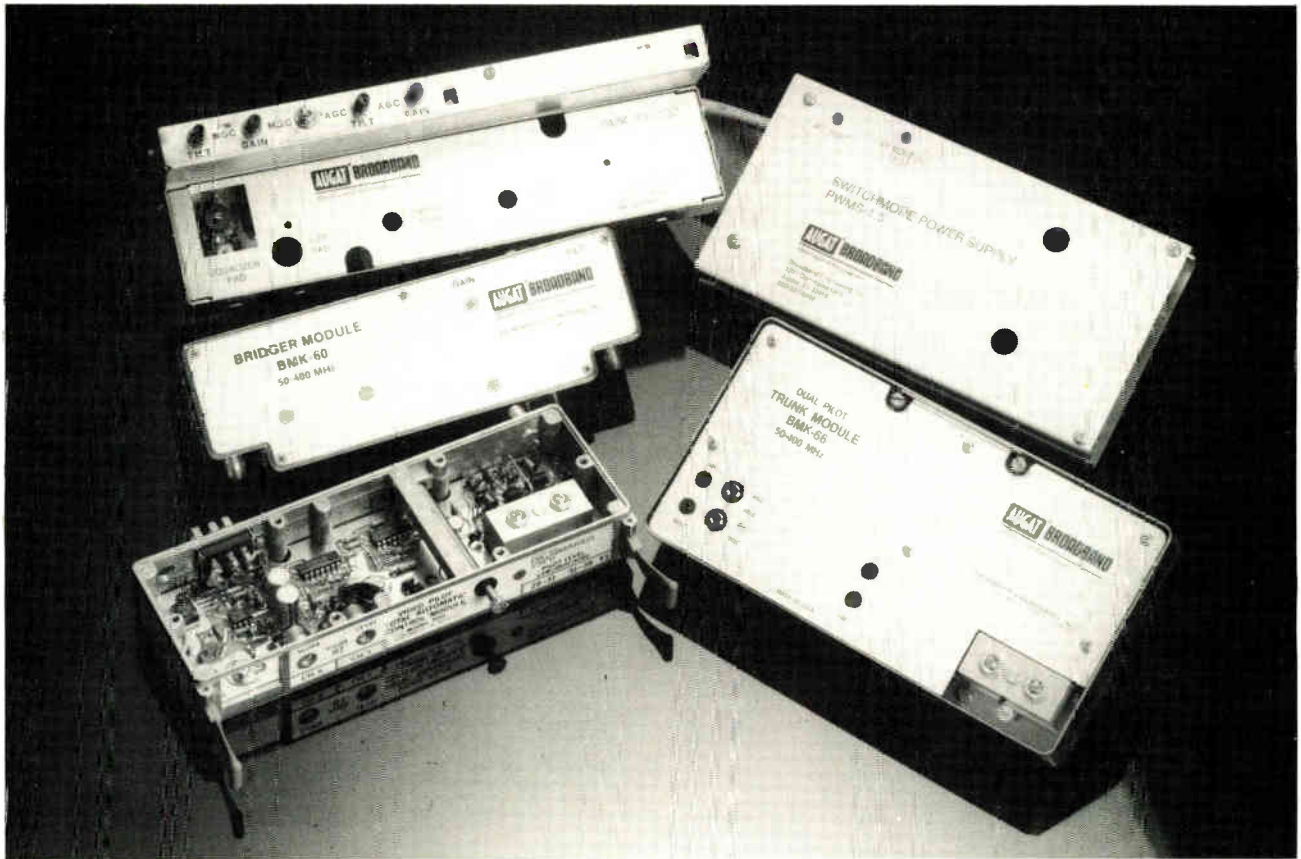
If enclosures are required for aerial plant or MDU sites, Reliable Electric recommends its heavy gauge, galvanized boxes because they're designed to resist corrosion.

Before construction can begin, however, correct system maps are required. Cable System Survey Co. does as-built maps which are bound into 11 by 17-inch binders. Signal level and powering information also is included on each map.

If a system design is required, ComNet Engineering has a new PC-based design package selling for \$1,495 complete. The program won't produce CAD drawings and distortion products aren't calculated. Also, linking of the feeder system to trunk has to be done manually. Other than that, the program eliminates the need for calculations. The program selects tap values, calculates RF levels, pad and tilt requirements as well as DC loop loss.

A.D.S./Linex sells a PC-based CAD program that automates drafting tasks. It sells for \$20,000.

—Gary Kim



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To save money, some operators use reconditioned line gear including trunk and line extender amplifiers and power supplies.

bridger ports, a switching mode 30 to 60V power supply to reduce power consumption, a modular design to reduce maintenance stock, an AGSC module that tracks video carriers (so no pilot carriers are required), plug-in directional couplers or splitters, triple surge protection and field-adjustable 300 MHz or 450 MHz pivot points (allows 300 MHz or 450 MHz operation). The result is a trunk bridger at about half the price of comparable trunk bridgers.

The 100 series can be configured as a 300, 400, 450 or 550 MHz amplifier. Set up as a trunk amp, the 100 Series uses a plug-in thermal control module or dual-pilot AGSC station about every fifth amplifier. In such applications it is usually run at 30 to 35 dB gain with input of 10 dB or so. Configured as a distribution or bridger amplifier, the 100 Series uses the LFA 130 module with output of 33 dB (without equalizer). Set up as a line extender, the Series 100 uses the LFA 120 module, which accepts 19 dB input and produces 21 dB output (without equalizer). For lower gain situations, the LFA 115 or LFA 110 modules can be used for 11.5 or 17.2 dB gains.

To save money, some operators use reconditioned line gear including trunk and line extender amplifiers and power supplies. John Weeks Enterprises, for example, buys surplus equipment (typically from operators doing rebuilds) and reconditions them for resale.

Line equipment repairs may occasionally be necessary. Quality RF Services offers a one-day turn-around on all repairs at no additional charge. The firm also stocks an extensive supply of amplifier modules and components (especially upgrade modules) and can ship the same day for all items ordered before 3 p.m. Eastern Standard Time.

Tapped trunk design

System design also can be optimized for rural systems with low subscriber densities. Known as "tapped trunk," the idea is to combine conventional concepts of trunk and feeder plant using a transmission level that is commonly halfway between trunk levels and higher gain feeder legs. Subscriber drops are literally tapped directly off the trunk cable. Using tapped trunk design reduces the amount of cable

used in the plant, causes less loss and therefore reduces the number of amplifiers required. As a general rule, cascades as long as 40 deep, supporting 150 passives in series, are possible at 300 MHz. "Tapped trunk" got something of a bad name—and deservedly so—when used with the old pressure taps. That's not a problem today.

William Grant of the Rural Electrification Association has done lots of work on rural system design and offers some guidelines for a tapped trunk design. He assumes that a 220 MHz system with an end-of-system C/N of 40 dB and cross modulation of -50 dB might be acceptable in some communities. He also assumes amplifiers accepting 8 dB input and 40 dB output can be used, each operating at 59 dB C/N and -82 dB cross modulation. With tap density at five a mile, system loading of 21 channels and system length of 15 miles, amplifiers can be spaced at 26 dB (about 2,385 feet apart). A 15-mile cascade would work out to 34 amplifiers. That would give end-of-line C/N of 43.7 dB and cross modulation of 51.4 dB. He assumes 1.4 dB of insertion loss per tap and 2.5 taps in each cable segment.

Test equipment

Without question, smaller systems will have smaller budgets for test equipment and smaller technical workforces. In fact, small system techs may be responsible for everything from headend operation to subscriber installs. Wavetek's view is that the small system technician, responsible for a wide range of tasks, ought to have available a versatile, easy-to-use testing device that does a variety of jobs. Assume that only one piece of test equipment is affordable to a single technician responsible for maintaining three systems. Which piece does the most work for the money available?

The Model 1882 Sweepless Sweep, says Steve Windle, Wavetek senior applications engineer. Why? Because it can do tests of signal level, C/N, hum and cross modulation, second and third order composite distortion as well as a non-interfering sweep requiring no transmitter. Measurement results are indicated right on the display. The 1882 sells for about \$9,995.



Wavetek's 1882 sweepless sweep

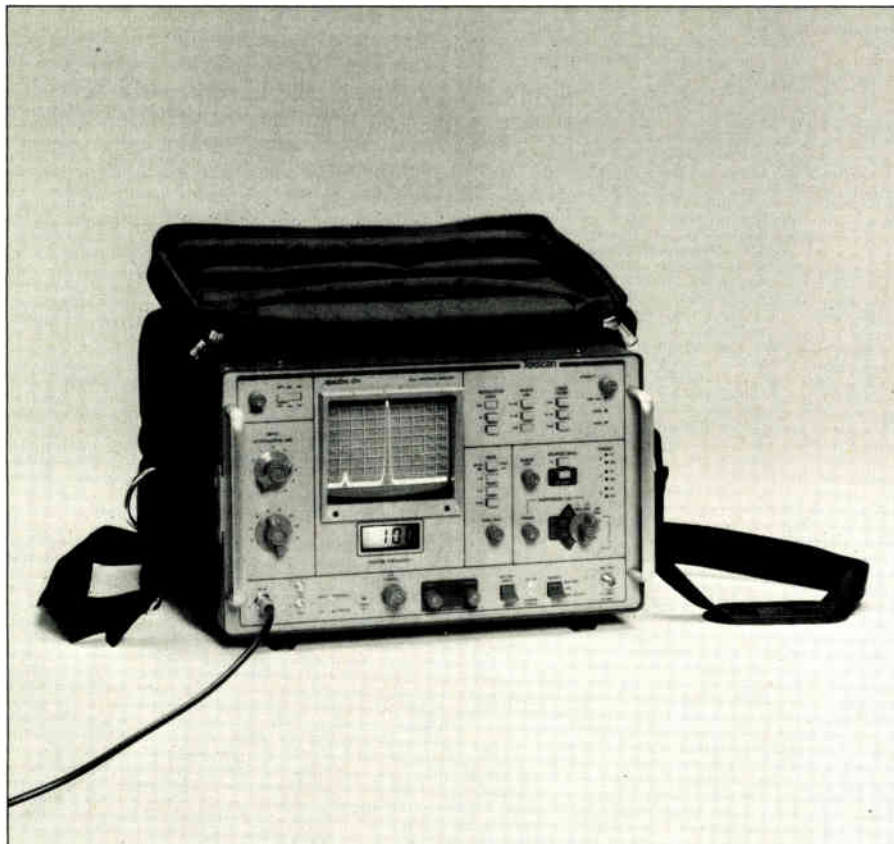
The signal level meter of choice would be the SAM III, Windle says. "It's quick, since it has channel video and audio signal frequencies stored in ROM and can be tuned at the press of a key." The SAM III measures signal level, C/N, hum and AC-DC voltages. Output to an ordinary X-Y oscilloscope also is possible. It is available to 450 MHz with optional UHF and goes to 600 MHz (SAM IIIE). Prices start at \$2,575.

"If speed isn't essential, however, a SAM I can be used," Windle says. "It has all the SAM III features except it isn't digital. Analog tuning can slow you down some, but the accuracy and measurement capability is the same." The SAM I comes in 300, 450 or 450 plus UHF versions, starting at \$1,685.

Leakage monitoring, always important, is going to be more important with the FCC's new Cumulative Leakage Index rules taking effect in 1990. For leakage detection, Wavetek recommends the CR-6 because it requires no headend transmitter. It scans six video frequencies and emits a tone varying in pitch depending on the strength of the received signal. It sells for \$400.

Texscan Instruments especially recommends the Spectre 1075 Spectrum Analyzer and 9552 T and R Sweep System for smaller operators. The Spectre 1075 is useful because it does most of the measurements required to maintain a CATV system. For \$4,995, the operator can measure visual and

Alpha Technologies suggests using a low-cost battery backup system at the headend instead of a generator system.



Texscan's Spectre 1075 spectrum analyzer

aural signal levels, C/N, all types of beat problems, cross and hum modulation, ingress and leakage. The Spectre 1075 also can be used to set headend levels, do rough system balancing and do a system sweep if used with a tracking generator. Using an RF bridge, it's possible to do structural return loss measurements. If only one piece of test gear can be purchased, this is the one Texscan Instruments recommends.

The 95521 T and R Sweep System is used to align amplifiers in the field. Available for \$6,500, it inserts a sweep signal 20 dB above carrier levels and displays the results on a receiver. Device sweep flatness is equivalent to or better than more expensive microprocessor-controlled units that are comparable.

For audio level testing, Telecommunication Products recommends the PVM-1000, which sells for \$295. The company's NVU noise generator and comb generator can be used to measure frequency response and cost \$525 each.

Cable

Building a system with lower loss cable is one way to stretch a cascade. Velocity of propagation, attenuation and loop resistance are the key factors. Simply, higher VP, lower attenuation and loop resistance mean fewer actives. CommScope's Quantum Reach cables, for example, have a velocity of propagation of 88 percent as compared to 87 percent for Parameter III. Half-inch QR attenuates at 1.25 dB per 100 feet at 300 MHz. Parameter III of the same size attenuates at 1.31 dB per 100 feet at 300 MHz. QR also is easy to handle and should therefore decrease installation time. If keeping track of drops is important, CommScope sells a tracer-coded cable that is color-coded.

Times Fiber, working to reduce attenuation of its cables, focused on reducing aluminum sheath wall thickness, thereby allowing a larger dielectric; working on foam densities (less dense foam has a higher velocity of propaga-

tion); and minimizing center conductor coating (because the thinner the coating the less the attenuation).

TX Series cables of 0.565-inch diameter have nominal 1.09 dB/100 feet attenuation at 300 MHz; maximum of 1.13 dB/100 feet. T4 Plus cables of 0.500 diameter have nominal attenuation of 1.29 dB/100 feet at 300 MHz; maximum of 1.32 dB/100 feet. Velocity of propagation reportedly reaches 90 percent.

Also new in the drop area is Times Fiber's lifeTime flooded drop cable. The flooding provides better moisture resistance and significantly cuts RF leakage. The company estimates that lifeTime will last three years longer than conventional drop cables.

Capscan's half-inch Super Low-Loss cable has an 87 percent velocity of propagation; nominal attenuation of 1.27 dB/100 feet at 300 MHz and maximum attenuation of 1.33 dB/100 feet.

Trilogy's air dielectric cable has 93 percent VP and attenuation specs that will be less than for a gas-injected foam dielectric. The company estimates that by using its air dielectric cable for a 75-mile plant with 3 to 1 feeder to trunk ratio, 21 dB amp spacing and 25 dB LE spacing, the cost savings compared to foamed cables would be \$18,431.

Power supplies

System powering options for smaller systems will focus on battery backup at the headend instead of generator backup; higher efficiency transformers in conventional supplies; and heat sinking to extend transformer life. Alpha Technologies, for example, suggests using a low-cost battery backup system at the headend instead of a generator system. The Lectro Division of Burnup & Sims recommends using a simple supply like the Mini-Max for system powering. It features a heat sink system that extends transformer life. Power Guard has a 90 percent efficient retrofit transformer module that swaps with certain models of existing conventional supplies made by Alpha, Control Technology, C-COR, Larson, Lectro, Jerrold, RMS, Sawyer, Scientific-Atlanta or Siltron in about 30 minutes or less.

—Gary Kim

Network management products debut

Autofact, a major manufacturing automation trade show held recently in Detroit, is a place broadband LAN vendors prospect for business. C-Cor Electronics, General Instrument's LAN Division, Merit Communications, Chipcom, Allen-Bradley, Communications Technology Group, Brentec, Phascom and Communications Systems & Design were there doing just that. Traffic was brisk but the show seems to be turning into a CAD/CAM forum.

At the same time, Localnet, a trade show for the local area network industry, was being held in Anaheim. Exhibiting: Zenith Communication Products, General Instrument, Halley Systems, Wavetek, C-COR Electronics, AM Communications, Western Audio & Video, CaLan, RFI Communications, Lanex, EF Data, ComNet Engineering, Brentec, Bridge Communications and Allen Bradley. The good turnout by broadband vendors wasn't matched by much traffic, though.

Still, there were glimpses of inspiration and feats of technical prowess at the two shows. Zenith, for example, has made key additions to its Z-LAN product line, cleverly building on its technical background in CATV and consumer electronics (where manufacturing cost control is excruciating). The Z-LAN 500 system now supports physical layer status monitoring at the drop level from each modem location (receive and transmit levels, loop loss), remote or local frequency and protocol configuration. Z-LAN now also supports IBM 3270 environment devices with transparent protocol translation between any async device and synchronous device on the network. DEC VT-100 terminal emulation, the Novell operating system and NETBIOS are supported. The system also is compatible with data switches made by Gandalf and Mitel.

In sum, Z-LAN 500 now supports transparent terminal-to-host, PC-to-PC or host-to-host communication on a robust network at prices possibly 30 percent to 50 percent lower than equivalent systems from other vendors. Any async terminal on the network can talk to any other synchronous terminal or device on the network.

Halley Systems showed just a glimpse of the new products and systems it intends to develop as it moves away from a "box-level" approach and becomes a system integrator and value-added reseller. The products are intelligent and innovative. They'll say more in early 1988. What Halley says now is that a line of "smart" modems, bridges and routers will form the backbone of the company's internet-working system, which aims to unify LANs and WANs.

C-COR Electronics introduced a new 19.2 Kbps frequency agile broadband modem; version 4.0 of its Quick Alert status monitoring software; and a 117 volt stand-alone status monitor for Quick Alert. The company also was featuring its new line of 300, 500 and 1000 watt standby power systems for network devices; the 1000R/W redundant power supply; 1.5 dB step and split-band taps made by Broadband Networks (C-COR is distributing Broadband's IEEE 802.7/802.4 taps).

The new 91XX modem is agile over 42 MHz, uses 50 kHz data carrier spacing and is available in both 156.25 (Model 9110) and 192.25 MHz (Model 9120) offsets. Transmit frequencies for the 9110 are 5.75 MHz to 47.75 MHz and receive frequencies are 162 MHz to 204 MHz. Transmit frequencies for the Model 9120 are 23.79 MHz to 65.75 MHz and receive frequencies are 216.04 MHz to 258 MHz. Both use FSK (frequency shift keyed) modulation and offer 840 data carrier channels.

Lanex Corp. introduced a new MAC Layer Bridge linking 802.3 LANs independently of the media used. It sells for \$3,995. Also new: a broadband transceiver for running Ethernet over broadband. The TR8002 costs \$595.

The company also offers TCP/IP software that runs over broadband networks. TCP/IP is a popular set of protocols for linking different computers over a single network, originally developed by the Defense Department but increasingly favored for networks linking computers made by different vendors. Lanex also introduced a PC interface running NETBIOS and operating over broadband networks. NETBIOS is an IBM protocol for link-

ing PCs over LANs.

Chipcom Corp. has added a transceiver connecting thin Ethernet segments to a broadband backbone. The new transceiver uses 18 MHz of bandwidth.

General Instrument has a new LAN tap featuring improved response flatness across the 4 MHz to 450 MHz bandwidth and 1.5 dB steps to meet MAP/TOP and IEEE 802.7 specs for broadband LANs. The new eight-outlet tap comes in 14 values and is specified for minimum as well as maximum tap loss. The tap also has low insertion loss, and a separate RF gasket.

Phascom International was showing a new Model 402 networking modem running to 19.2 Kbps agile over 24 MHz and using 50 kHz spacing for data carriers. The Model 402 is locally and remotely addressable and can memorize the parameters (data rate, transmit and receive frequencies and synchronous or async format) for up to 20 frequently called devices.

Wavetek has a new MicroSAM three-channel signal level meter aimed at the installer market. It is frequency agile up to 550 MHz in certain bands and uses internal DIP switches to set the frequency ranges. It has an auto-ranging attenuator with 40 dB range; an over-range and under-range indicator; low-battery indicator and is powered by two alkaline 9V batteries. List price is \$369.

AM Communications has a Network Control Switch used to attenuate and cut RF signals. It's like an amplifier bridge switch, only designed for placement at any point on the distribution system. Also new: the AM-Stat status monitoring module that fits in J and X series amplifiers made by General Instrument's Jerrold Division.

Allen-Bradley has a new 19.2 Kbps frequency agile RF modem designed for point-to-point and multidrop applications.

Brentec, a broadband LAN installation company headquartered in O'Fallon, Mo., now is a value-added reseller for Chipcom Corp. Started three years ago by Dick Beard, who'd been a district engineer with Continental Cablevision for 13 years, Brentec has worked with EDS and a number of federal government jobs.

CS Systems & Design Inc. is an

Western, which is also affiliated with Western Cable Systems, has found a profitable niche in the LAN marketplace.

engineering and electrical contracting firm that designs, installs and tests broadband systems for clients like General Motors, Ford and Navistar. The firm also sells status monitoring and broadband network design software.

Merit Communications Supply has a "Just-in-time" material management program that provides bonded inventory, on-line access to Merit's computer system, a choice of stocking locations, monthly usage reports and guaranteed 24 or 48 hour shipment.

Western Audio recables UCSC

Western Audio Video of Redwood City, Calif., is currently cabling the University of California at Santa Cruz (UCSC) to accommodate an institutional network for data related services and a residential network for video which will attach to their CATV feed.

Sam Barnes, vice president of local area networks at Western offered some

details on the \$375,000, 12-mile cabling project. "UCSC has been evaluating the need for improving their data transportation system," said Barnes. "Western was put under contract to install the network. We're in the cabling phase, which includes the removal of existing coax (placed a decade ago in preparation for this system) which we found was not technically capable of supporting their needs; the installation of the two separate backbone cabling systems; and, where possible, the installation of the fiber optic inter-duct to support future fiber optic connections."

Barnes went on, "The system then will grow to serve a combination of needs. As most universities are very departmentalized, what might happen is a variety of smaller sub-networks will eventually find their way into the broadband institutional net backbone. The broadband could conceivably grow within the building and find its way generically to all the buildings that

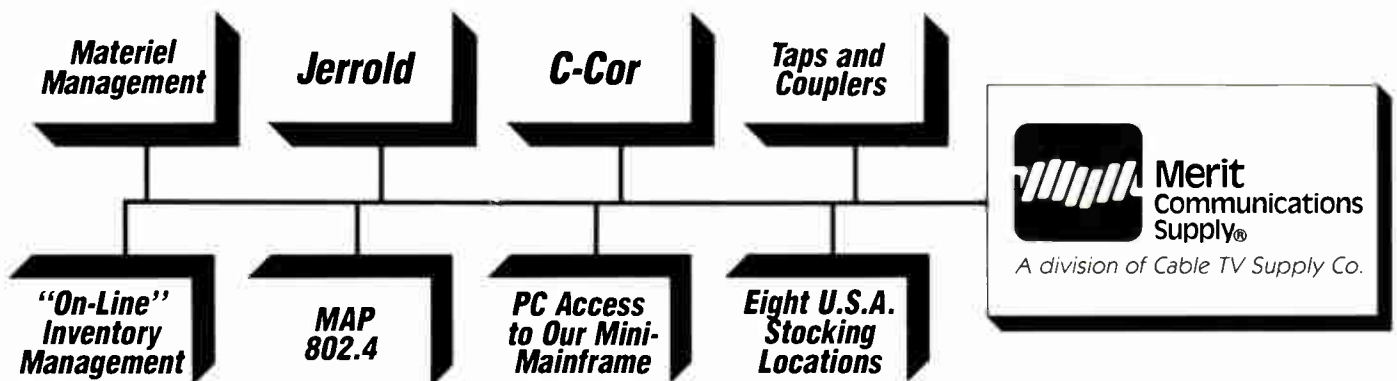
we're entering.

"They have selected broadband as the transportation medium based on the multi-channel capabilities. For a university, it seems to be the winning choice. It gives the person in charge of creating the backbone scheme the most flexibility in serving the multi-departmental situation."

Western, which is also affiliated with Western Cable Systems, has found a profitable niche in the LAN marketplace. Their knowledge, experience and growing reputation for quality work has made them the choice of several larger western area LAN users. That list of clients includes: Hughes Aircraft (Tucson), Hamburg Nuclear Power Reservation (Pasco, Wash.), The University of Nevada (Reno), Hewlett-Packard (Roseville), FMC (San Jose), Lawrence Livermore Labs and United Motors.

The **Jerrold Division** of General Instrument will host a two-day technical seminar on LAN system tech-

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The Navy is evaluating a technology similar to that used in the CTS 40 for its conformance testing requirements.

nology Feb. 16 and 17, 1988, at the Ramada Hotel Culver City, 6333 Bristol Parkway, Culver City, Calif.

The program will provide an understanding of the concepts of broadband LANs, and explain the typical equip-

ment and design parameters.

For information, write Chris Tancredi, Jerrold Division/General Instrument, 200 Byberry Road, Hatboro, PA, or call (215) 674-4800.

ComNet Engineering Co. recently

introduced Broadband System Engineering, a computer-aided engineering software package that designs RF broadband cable networks for both the LAN and CATV industries.

The package designs any kind of split or dual cable from 1 MHz to 600 MHz, automatically selects taps by minimum drop level, changes cable sizes anytime, deletes, inserts or replaces designed components followed by an automatic recalculation of their paths, speeds key commands, saves and reloads design files and more. The software also conforms to MAP, IEEE 802.7 and NCTA standards.

VANCE Systems Inc., announced that it is working closely with the U.S. Navy's Space and Naval Warfare Systems Group (SPAWAR) in defining conformance test procedures and equipment for its SAFENET (Shipboard Advanced Fiber Optic Embedded Network) LAN standard.

VANCE's CTS 40 and 45 Conformance Test Systems are currently in use worldwide for testing IEEE 802.4 Token Bus LAN implementations. The Navy is evaluating a technology similar to that used in the CTS 40 for its conformance testing requirements.

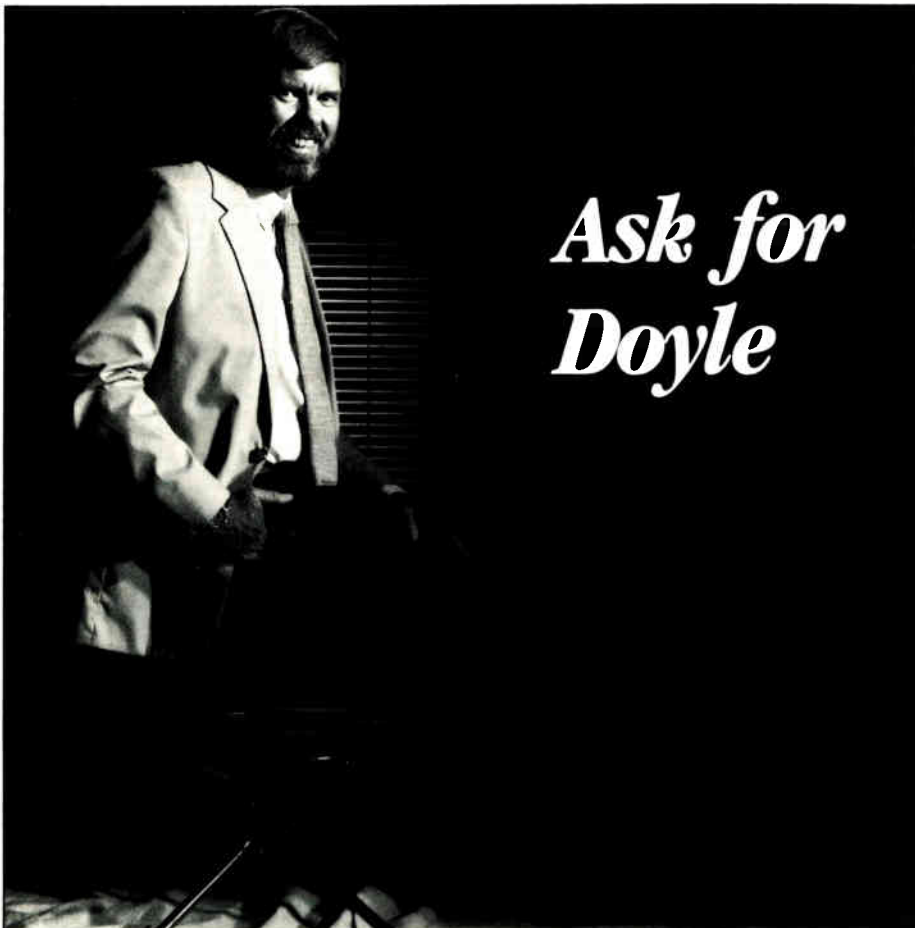
The SAFENET standard is being developed by the Navy in cooperation with international standards organizations as well as over 50 U.S. and European corporations. The Navy intends to use this standard in tactical systems to interconnect computers and intelligent devices on board ships.

Concord Communications Inc. announced that it has been selected to provide MAP 2.1 connections for Apollo Computer Inc.'s workstations.

Under a third party reference agreement, Apollo Series 3000 TM Personal Workstations TM and Series 4000 TM Personal Super Workstations TM can interface to MAP via Concord's MAPware Series 1200 Communications Controller. The series 1200 is a PC/AT-compatible controller that implements the seven-layer MAP 2.1 specification and supports up to eight sessions.

The Series 1200 operates in conjunction with MMS-EASE (Manufacturing Message Service-Embedded Application Service Element), available from SISCO of Warren, Mich.

—Gary Kim and Greg Packer



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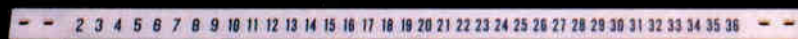
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Reader Service Number 52

No surprises here

If there was any doubt before that the burning technical issues of 1988 will revolve around fiber optic technology and delivery of high definition television, it was laid to rest at the 1987 Western Cable Show in Anaheim.

Double-length technical sessions were held to explore development and deployment of fiber and HDTV and vendors who came to the show armed with new products or plans were swamped with inquiries. And there were new things to report.

For instance, Catel Telecommunications and Ortel, a California-based company making its debut at a cable trade show, announced significant breakthroughs in cost, size and channel capacity in their fiber optics systems.

Catel's TransHub product converts FM signals to AM for about \$1,000 per channel, or roughly 20 percent the cost of previous systems, according to Dr. James Hood, president of Catel. The system accommodates 40 channels per fiber and features an output of 550 MHz into coaxial trunks. The system is transparent to scrambling, BTSC and headend frequency plans.

Jim Chiddix, vice president of engineering and technology at American Television and Communications, said developments like Catel's bode well for the future use of fiber in cable systems because costs are brought closer to coaxial systems. "I'm encouraged," Chiddix said. "I'm eager to get it into our lab and take a look at it."

TransHub features 40-channel capacity and signals can be sent up to 25 km without repeaters. The FM to AM conversion is accomplished on one printed circuit card instead of the two pieces of equipment needed previously. Also, scrambled channels are converted within the same module. The result? A system with just one rack of equipment instead of eight or 10.

Ortel, which previously concentrated on government contracts for business, brought its working high frequency 40-channel analog AM system featuring its 3510B and 4510B 1300 nm transmitter and receiver to show to the cable industry. The demonstration, which sent the signals through 6.5 kilometers of fiber, was designed to prove that improved technology now enables high performance lasers to

Technology developments center on fiber, HDTV at 1987 Western Show.

transmit AM signals for several kilometers over singlemode fiber without repeaters.

Ortel recently successfully tested the system at the ATC lab in Denver. The number-two MSO is considering the system for its planned fiber optic "backbone" it plans to install and test in one of its systems in the near future, said Dave Pangrac, director of engineering technologies at ATC.

Meanwhile, HBO displayed HDTV images to show operators the type of picture quality made possible by the new format. In addition, a special double-length technical session examined in detail three of the various transmission methods being proposed

(NHK's MUSE system, Sarnoff's ACTV and North American Philips' HD-MAC-60), followed by more video produced by U.S., Canadian, Italian and French producers.

Perhaps the most significant developments were the announcements about HDTV tests and hardware. NHK will have consumer products available in the U.S. by about 1990, while the ACTV system will have associated hardware by sometime next summer. NAP plans to test its HD-MAC-60 system in a cable system in January 1988 to determine how much the signal is distorted through a CATV plant.

Two companies making their first appearance at a major cable show are betting the industry's keen interest in HDTV will also drive a desire to improve the quality of audio over cable. Kenwood, manufacturer of consumer stereo systems, showed off a digital sound system designed specifically for

Building a fiber system, from design to operation

Jim Chiddix, vice president of engineering and technology at ATC, served as moderator for this fiber optic technical session entitled, "Building Fiber Optic Supertrunks Today." The panelists included Al Johnson, vice president, Synchronous Communications; John Holobinko, vice president marketing and sales, American Lightwave Systems; Douglas Truckenmiller, vice president engineering, Heritage Cablevision and Tom Jokerst, director of engineering at Continental Cablevision.

This session, the first of two on fiber optic technology, covered design, economics, construction, testing and operation.

Holobinko began the session by covering the key factors considered when designing a fiber optic system: determining the length, deciding how transparent the link should be, minimizing repeaters and guaranteeing the minimum performance level. All those factors help establish the greatest economy of design, said Holobinko. He went on to list the following as "loss" factors: attenuation, splices, optical connections and patch panels.

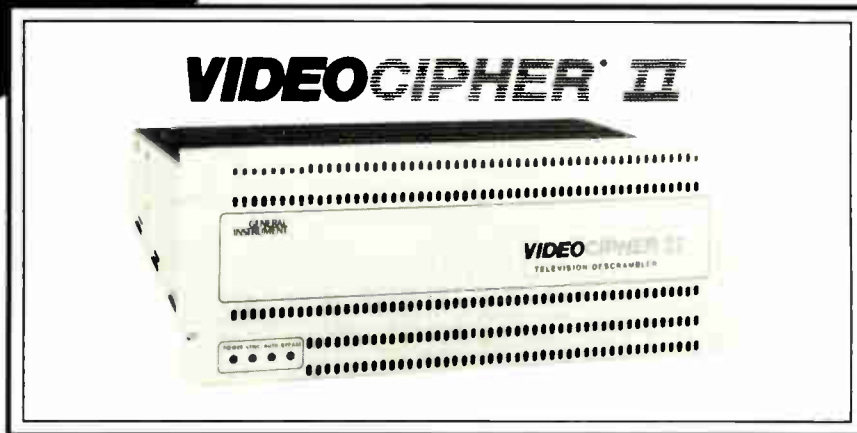
Johnson focused on the costs involved with fiber optic technology. Through several examples of using fiber, coax, and AML technologies in the same hypothetical system applications, Johnson effectively showed fiber to be a viable alternative to the other two technologies. In addition to the rapidly dropping price, Johnson pointed to "protection" and "preparing for future competition" as reasons to consider fiber. "One thing that's hard to put a price on is reliability," added Chiddix.

Truckenmiller covered construction methods by relating his personal experience with a fiber optic installation. Truckenmiller said that his involvement showed the "degree of difficulty" associated with fiber installation was actually "quite similar" to that associated with coax. Most of the data he detailed pertained to the Dallas, Texas, system. That system totaled 62 miles; some aerial, some direct bury and some underground in duct.

Jokerst finished the session by covering testing and operation techniques.

—Greg Packer

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'We're seeing more interest in good, clean sound,' said Skip Whelan of Kenwood.

use in a CATV system. Developed jointly by Kenwood and NHK, the compression system allows an operator to send 10 channels of audio over a single 6 MHz-wide video channel. The system is now being tested in Japan and will be introduced in the U.S. in about 18 months (after FCC approval and cosmetic changes).

The system, which consists of a \$30,000 processor located at the head-end and subscriber terminals costing about \$150 each, uses satellite feeds, compact discs or FM off-airs as signal sources. "We're seeing more interest in good, clean sound," said Skip Whelan of Kenwood. He added that the system will be aimed primarily at audiophiles initially, but he anticipates that more interest would be generated as HDTV becomes widespread.

International Cablecasting Technologies didn't have any hardware to show yet, but was talking about its CD/8 system of satellite-delivered digital music. ICT envisions itself as a programming provider of eight separate channels of varying formats of CD music, without disc jockeys or commercials, over cable systems to subscribers who purchase it as a premium service. A ninth channel, consisting of "pay-per-listen" special events, is also planned.

However, subscribers need to have a decoder to receive the service, which will cost operators between \$80 and \$90 to provide, according to ICT officials. The system is slated to be rolled out in April 1988.

Other products unveiled at the Show include:

Alpha Technologies

Alpha's tentatively titled "Cable Crowbar" product (the company held a naming contest at the Show; the winner hasn't yet been announced) suppresses surges and transients from nearby lightning strikes, sheath currents and other disturbances.

Factory installed in General Instrument's SSP-PI power inserter, the device protects passive and active devices along the trunk and distribution lines. Insertion and return loss characteristics of the power inserter remain unchanged while peak line voltages

exceeding 100 volts are clamped to ground.

Anixter Communications

A new full-featured 550 MHz Hamlin converter made its debut in Anaheim. The CR-83-V is similar cosmetically and in size to the CR-6000 but adds volume control and audio mute to the other features already included. A set-top cradle is incorporated for the hand held IR remote that enables the remote to function as an on-board keypad.

The new raw CR-83-V costs \$12 more than the previous model and units are available.

C-COR Electronics

The new E-539 parallel hybrid device line extender incorporates advanced double darlington hybrid circuitry for forward amplification. Operators who plan to upgrade or rebuild can use fewer extenders because of the increased, according to C-COR executives.

The parallel hybrid circuitry pro-

vides for increased output without additional distortion. A conventional hybrid circuit is utilized for amplification in the reverse pass band. The new high gain LE is available with one- or two-output ports and uses an aluminum housing designed for either pedestal or aerial mounting.

The E-539 provides 32 dB of gain and operates in the 54 to 550 MHz (77 channels) range forward and from 5 to 30 MHz (four channels) in reverse. A two-output housing with built-in internal splitter is available as an option to eliminate the need for a separate external splitter.

The PowerVision division of C-COR introduced the PS900 standby power supply. Transfer time is 16 milliseconds or less. The single-module supply, available in pole-mount or pedestal version, will be available in January 1988.

Channel Master

Three new additions were made to Channel Master's Micro-Beam CARS-band microwave product line. The new 10-watt 450 MHz transmitter Model



Bill Killion, president of Channelmatic, greets Alan McGlade of Choice Television, at the Channelmatic Booth at the show.

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Jerrold easily won the award for most new product introductions.



Channel Master's microwave transmitters.

6612 provides 3 dB more power than the 5-watt unit and features a GaAs FET amplifier, stable local oscillator and complete AGC capabilities, the company said. With improved linearity, the new unit delivers more power-per-carrier and improved distortion ratios.

Model 6624 is a new 2-watt transmitter that delivers 3 dB more power than the 1-watt transmitter. Features are the same as above and channel capacity is 60. A low phase noise microwave oscillator allows the transmitter to carry standard CATV channels, data and scrambled channels.

Finally, a new 450 MHz Dual AGC receiver immune to overload was shown. Model 6635 uses PIN diodes inside the GaAs FET LNA amp to provide variable gain with minimum through loss. Trunk output level is a constant 30 dBmV and a dual interlock circuit provides exact on-frequency operation, the company said.

Channelmatic

The contract for the Los Angeles Interconnect was signed during the Western Show at the Channelmatic booth. The interconnect system will allow the Cable Advertising Partners (an alliance of several MSOs serving the area) to sell and deliver commercial spots by satellite on Prime Ticket's (a regional sports network) feed to every cable system in the LA area.

Both spot reels and schedules will

Keeping up with fiber technology

Forget what you thought you knew about fiber optics because developments are occurring so fast that it's hard to keep up.

Reductions in costs of hardware and better performance characteristics are bringing fiber use for more than super-trunking applications closer to reality all the time, according to those who spoke at the "Fiber Optics in CATV Tomorrow" session at the Western Cable Show.

Dave Pangrac, director of field engineering and support at American Television and Communications, outlined how the MSO's "fiber backbone" concept would substantially reduce the effects of outages while saving money through a reduction in maintenance costs.

"This concept grew out of a need to improve the reliability and picture quality" of ATC's systems, said Pangrac. The backbone system would keep amplifier cascades to a maximum of two, as opposed to the 35, 40 or even 60 amps in cascade in some systems, he said.

Additional benefits include easier and less frequent maintenance, more bandwidth, a simplified distribution network and more flexibility. From a strategic standpoint, the system permits two-way interaction, heads off DBS and telco competition and accom-

modates the implementation of HDTV, he said.

New high performance analog lasers and detectors make sending up to 40 channels over a single fiber possible, noted Dr. Lawrence Stark, director of applications/marketing at Ortel. Because of recent breakthroughs, Stark said analog lasers are available in up to 6 GHz frequencies, carry guaranteed noise and distortion performances and are impedance matched.

Photodiodes have lower reflections, are fully tested and can handle higher frequencies, Stark said.

Presently, efforts are underway to develop a fiber system that can carry 42 channels 15 km without repeaters, with a C/N of greater than 56 dB and CTB of greater than 65 dB. "We're still shy of meeting these goals, but they can be met in a short time frame," said Stark.

Despite its higher distortion levels, the merits of AM systems are enough to consider an AM system over an FM system, said Jack Koscinske of General Optronics. Of course, there are C/N vs. distortion tradeoffs.

"To improve performance, you need to reduce residual intensity noise and use higher power lasers," said Koscinske.

—Roger Brown

be transmitted from the central hub to the headends by satellite. Each headend will record the current spot reel as directed by the central hub and then verify back to the hub on a sampling basis that the spot was recorded accurately.

Each headend will utilize Channelmatic's ADCART 2+2 Ad Insertion System. The system will automatically record the spot reel during off-air hours of the Prime Ticket feed and then cue and play commercials as directed. Channelmatic will also supply its Ad Manager traffic and billing software package.

General Instrument/Jerrold

The Jerrold division of General Instrument easily won the award for most

new product introductions. A new line of converters, power doubling modules, addressable controller and frequency agile modulator all made their debut.

The Starcom 7000 series of addressable converters features a high-tech black outer casing and built-in impulse capability, eliminating the need for sidecars. The units are one-third smaller than the Starcom VI line. The basic model 7100 and enhanced model 7200 (volume control) both work in RF systems. Other features include electronic parental control via remote control; 63-event PPV limit; electronically downloadable output channel; eight event, 31-day VCR timer; last channel recall; and more. Delivery will begin in early 1988.

A new plain converter also was

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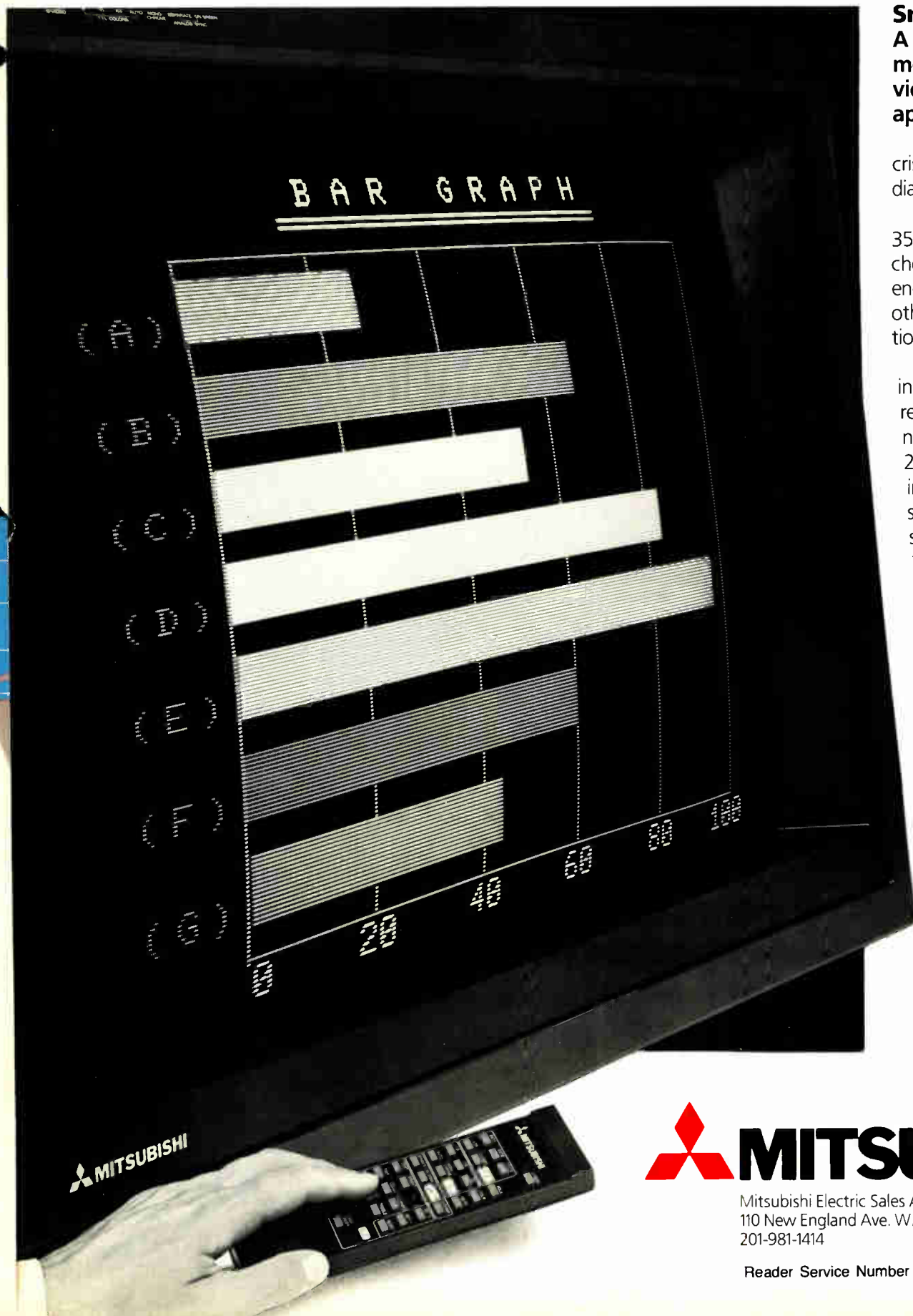
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Reader Service Number 55

NuCable unveiled a family of products to help operators create local ad spots.



Jerrold's Starcom® 7200 addressable converter.

shown. The new DQN7 features a smaller footprint, black styling, 550 MHz bandwidth capability, non-volatile memory and a host of subscriber features. The unit will be available in late spring of 1988.

A high gain power doubled trunk module for use with the Starline 20 trunk amp series was also shown. The SJPA-450/27 module features interstage pad facilities and is capable of interstage tilt. It provides 27 dB of gain for 300 MHz to 450 MHz operation. A power-doubled J-series line extender was intro'd too. Two models of LEs are available—one for use in 550 MHz systems and one for 450 MHz systems. Both have a plug-in interstage equalizer to improve performance.

For the headend, Model AH-0 addressable controller was shown for operators of small to mid-sized systems. The new unit is based on the IBM System/2 and will address up to 32,000 converters and is upgradeable to impulse capability. The controller will list for less than \$10,000.

Finally, a new frequency agile modulator designed for small system operators was shown. The S300M uses SAW filtered frequency agility over the entire 54 MHz to 300 MHz band. Control switches are located on the front panel.

Gilbert Engineering

Gilbert's new Weathergrade F-connector uses a metered volume of

controlled viscosity clear silicone gel to completely seal the cable end to the connector from moisture when crimped. The gel retains viscosity from -50 degrees to 200 degrees Fahrenheit. Other new products include: a heat shrink tubing with adhesive to bond

the plastic cable jacket to eliminate "pull-back" while retaining ease of peeling for rework; a splice block with ground lug to help eliminate many unsuccessful "lash-ups"; and a male splice adaptor designed to eliminate the need for coax jumpers and permit cascading of taps.

NuCable Resources Corp.

NuCable unveiled a family of products to help operators create local ad spots and insert those spots into local avails.

The new Cable Ad Channel System Mini Studio creates a series of still frames, runs them in quick succession to emulate movement and programs them to an audio track. The Inserter stores that audio and video in digital form and reassembles them in analog for insertion into local avails, without tape. The Inserter also features a cue tone detector and random access switch. The Photogenerator uses digital photo imaging to allow operators to replace

A/B switch ruling better, but...

It's better than it was, but...

That's the reaction to the Federal Communications Commission's latest ruling on the A/B switch controversy.

In case you've forgotten, the FCC ordered that cable operators offer an A/B switch to those subscribers who request them. At the time, a switch had to have at least 60 dB of isolation in order to be an approved switch.

The National Cable Television Association responded by saying that spec was inadequate and suggested that 90 dB would be sufficient.

As a way of compromise, the FCC's latest ruling requires 80 dB of isolation in the frequencies between 54 MHz and 216 MHz. From 216 MHz to 550 MHz, the switch must provide at least 60 dB of isolation.

"We're happy with the ruling," said Wendell Bailey, vice president of science and technology at the NCTA, "to the extent it should've been done right the first time."

In addition, the FCC at the same time extended until Feb. 29, 1988, the

part of the requirement that operators offer the switches and related consumer information to subscribers. The rules "also require that cable operators supply subscribers with information regarding the potential for interference related to the use of the switch and must suggest measures that can be taken to avoid such problems. These suggestions must include the recommendation that shielded coaxial cable be used between the television receiver and switch terminal and that at least four feet of shielded coaxial cable be used for connecting switch terminals to any unshielded antenna leads," said an NCTA press release.

However, the whole issue was muddled somewhat by an appeals court that threw out the must carry rules on Dec. 11. According to Brian James, director of engineering at NCTA, the rule that switches be offered to subscribers "probably" no longer applies, but the technical specs adopted for A/B switches would still be in effect.

—Roger Brown

S-A announced that shipments of its integrated impulse PPV system commenced during the show.

text-only character generator with photos and text. And the new Photoadvertiser creates, schedules and administers a photo ad channel.

Panasonic Industrial Co.

A new generation of non-addressables, Models TZ-PC140 and TZ-PC170, were shown by Panasonic. The former, a plain RF converter, is available in 450-and 550-MHz configurations and features parental control, remote control enable/disable, upper channel limit, favorite channel memory, last channel recall, stereo compatibility and a sleep timer that automatically turns both the converter and TV off. The baseband unit includes the above features, plus volume control. Units will be available in early 1988.

Scientific-Atlanta

A new parallel hybrid trunk amp

was added to the Scientific-Atlanta line of distribution products. The new AT amp delivers 8 dB of distortion improvement, a 2 dB improvement over power doubling amps. The unit was designed for operators who plan to perform "narrow upgrades" (upgrading one step) or for newbuilds (the units are needed only every 2,600 feet instead of every 2,200 feet). Available immediately.

S-A announced that shipments of its integrated impulse PPV system commenced during the Western Show.

Syrucuits International

Matrix, an outdoor security box employing standard trap technology was shown by Syrcuits International at the Midwest CATV booth (Midwest will be exclusive distributors).

Designed for attachment to the outside of the home (much in the way that TCI is placing the box manufactured

by Scientific-Atlanta), the unit utilizes multiple traps and filters to secure the proper programming mix without climbing poles.

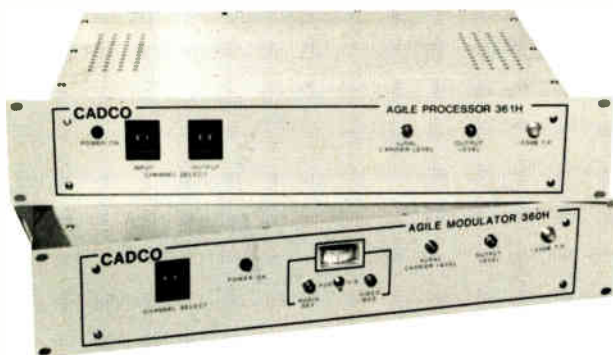
The unit is upgradeable to addressability. The addressable version can switch in or out of up to eight traps or filters of any kind and can be controlled from a central location. Up to 16 tiers of service can be controlled. An internal amplifier reduces losses incurred by routing the signal through the traps.

The device is targeted toward small operators who may want addressability but don't have the financial backing to do it, said Chris Sophinos, president of Midwest CATV. Final product delivery is slated for spring of 1988.

Texscan Instruments

Texscan Instruments rolled out a slew of new products. Among them: the TFC-600 tuned frequency counter with

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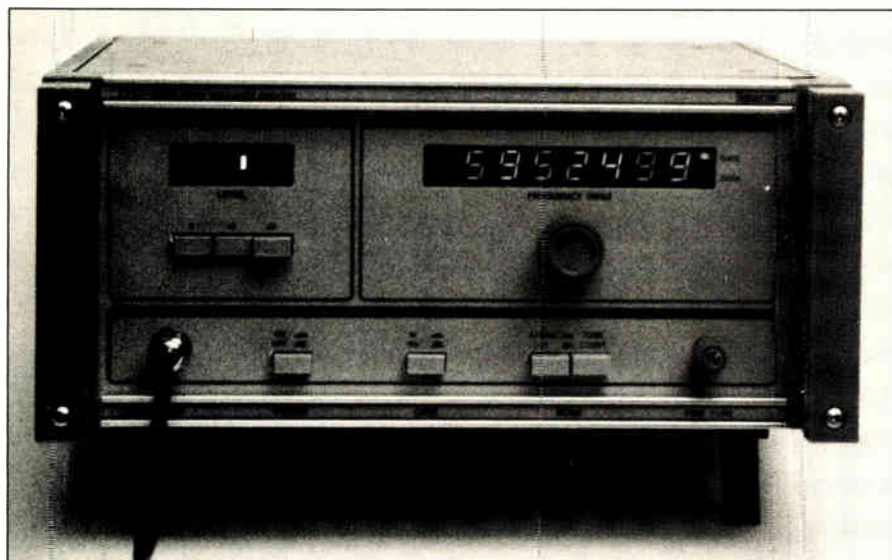
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Reader Service Number 56

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During the Show, TV Answer petitioned the FCC requesting 500 kHz of bandwidth between 216 and 222 MHz.



Texscan's TFC-600 tuned frequency converter.

TV Answer

This Fairfax, Va.-based company

proposes to use a portion of the frequency spectrum to transmit orders for pay-per-view, home shopping, audience

polling and the like. Hardware is being developed, including an infrared remote with joystick control, and will soon be placed in nearly 5,000 homes in the Washington, D.C., area for testing.

During the Show, TV Answer petitioned the FCC requesting 500 kHz of bandwidth between 216 and 222 MHz, said Steve Symonds, executive vice president and COO of TV Answer. The firm is now approaching cable industry leaders to join in the struggle for more spectrum.

In other notes, new from Catel is the TVS-2000 BTSC generator, the FMS-2000 FM stereo generator and modulator, the compact FMS-3000 FM stereo generator and a TX-2 FM/AM tuner. Call (800) 225-4046 for details.

Qintar has a new SP-60 heterodyne processor using PLL, SAW filter and AGC technology to deliver 70 dB of gain and maximum output of 62 dB. Call (800) 572-6262 for details.

—Roger Brown

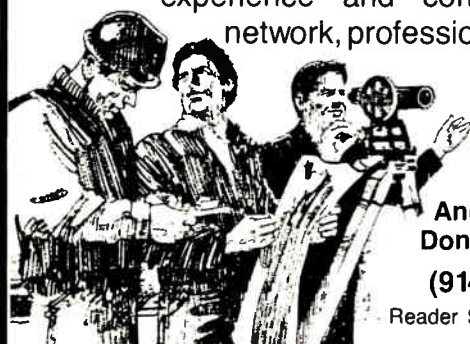


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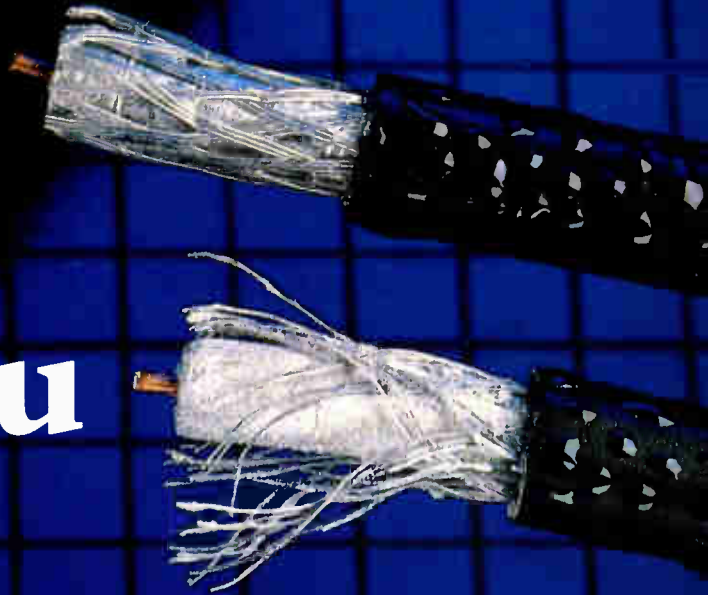
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Trilogy Communications	.2	.3
Triple Crown Electronics	.18	.26
Wavetek	.44	.53

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Times Fiber Communications has the answer to these problems. Tested and proven, T4 Drop Cable with exclusive lifeTime™ protectant offers maximum protection far

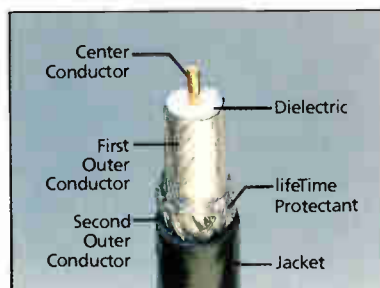
superior than the corrosion resistance of ordinary drop cable. Its total cable protection extends cable life and reduces signal leakage, flashing and customer outages. The

end result—lower maintenance and replacement costs.

Improve your return on investment by specifying the solution—T4 Drop cable with our exclusive lifeTime protectant.

For more solutions contact:
Times Fiber Communications, Inc.
P.O. Box 384, Wallingford, CT 06492,
(203) 265-8540 or 1-800-TFC-CATV.

*lifeTime is not recommended for indoor applications.



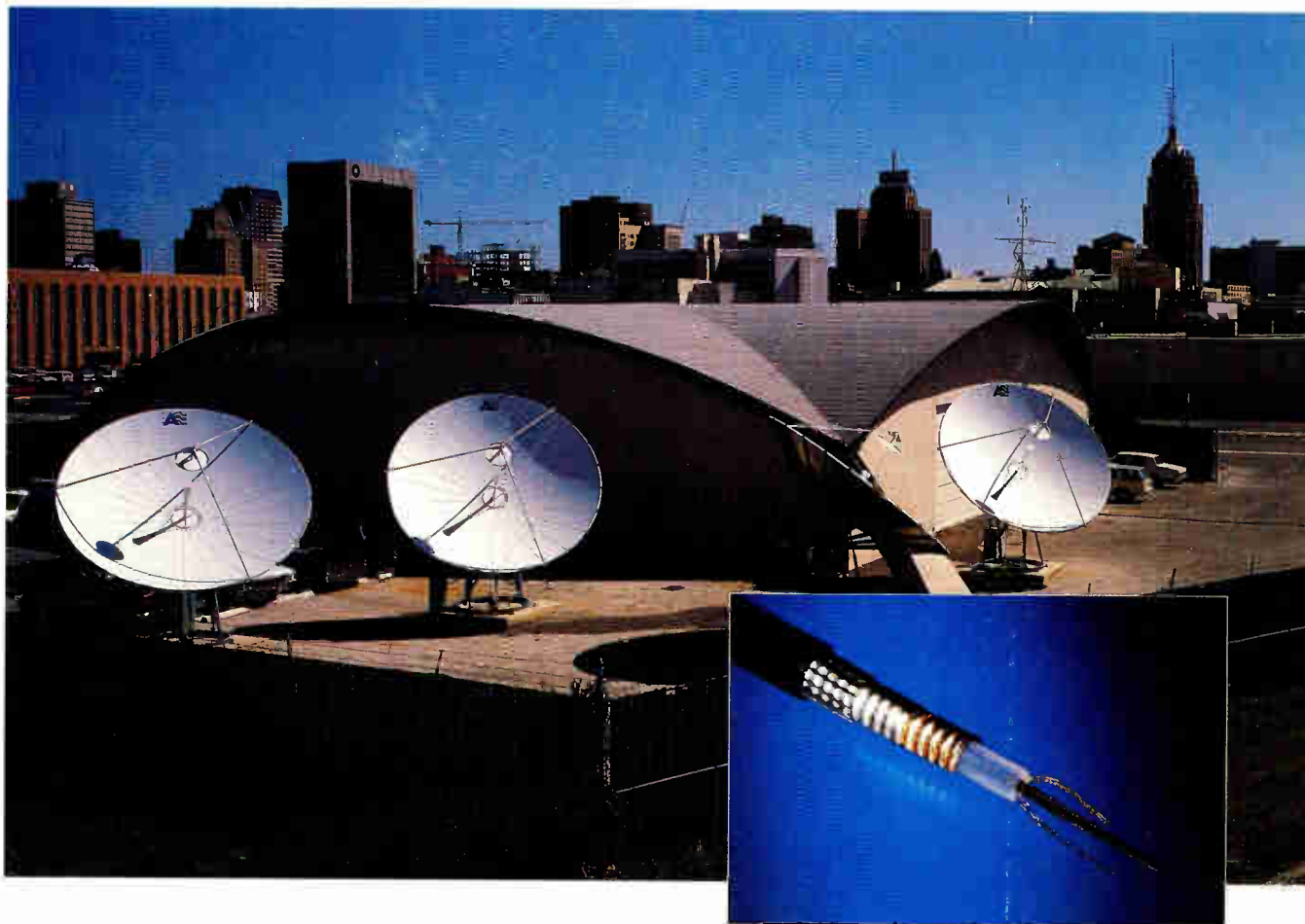
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