JUNE 1988

COMMUNICATIONS ENGINEERING AND DESIGN
THE MAGAZINE OF BROADBAND TECHNOLOGY

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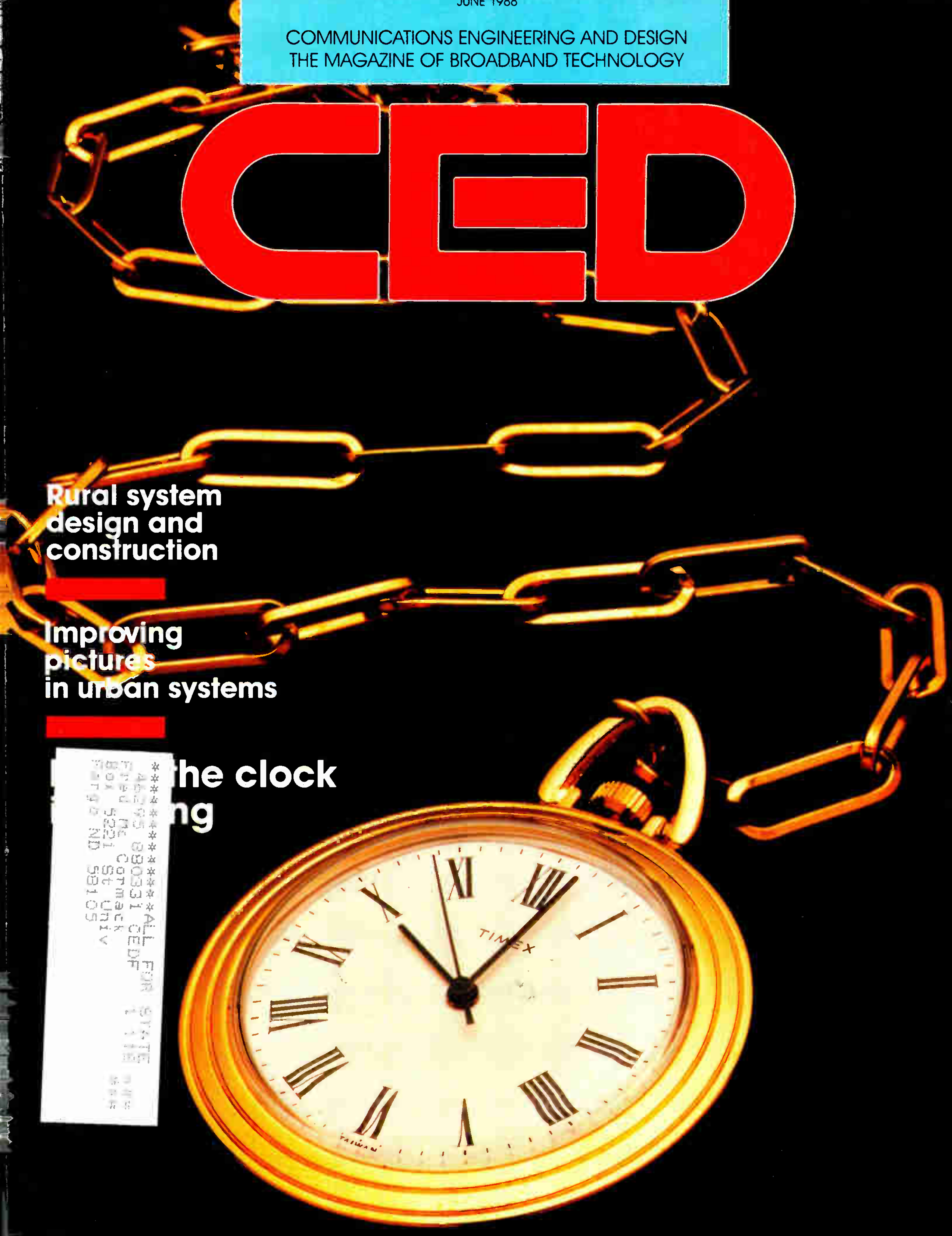

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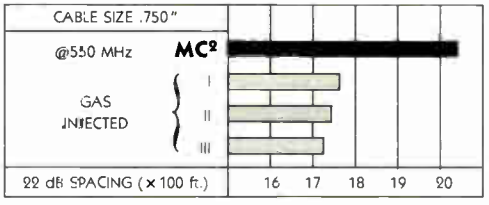

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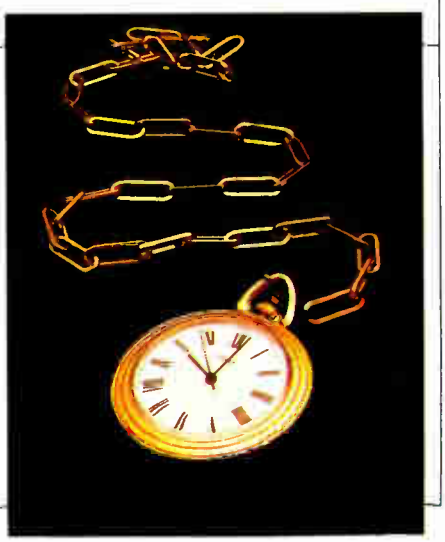

About the Cover:
Has the time arrived for high definition television? If the NCTA Convention was any indication, the answer to that question should be a resounding 'yes!'
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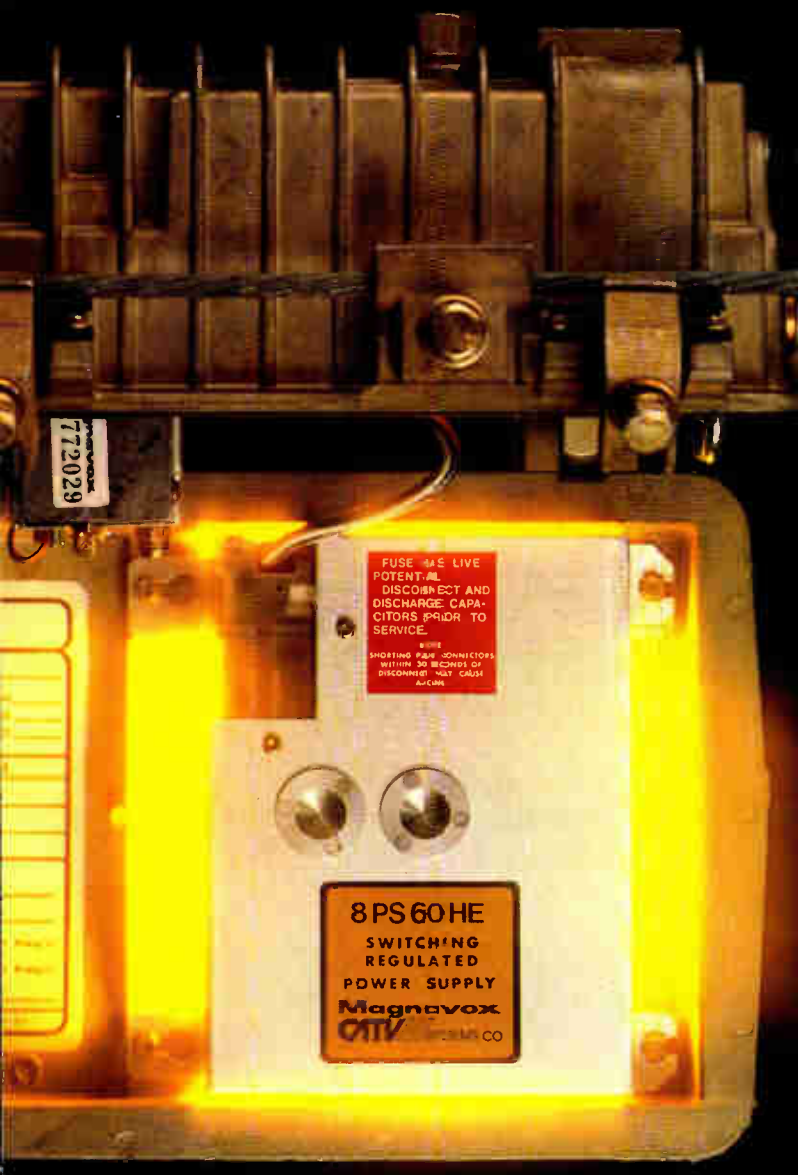

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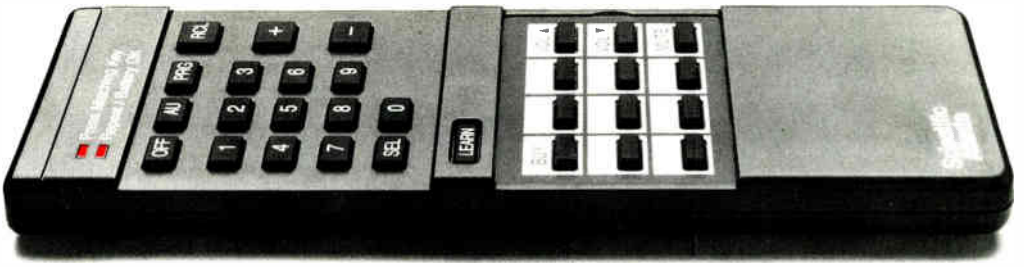

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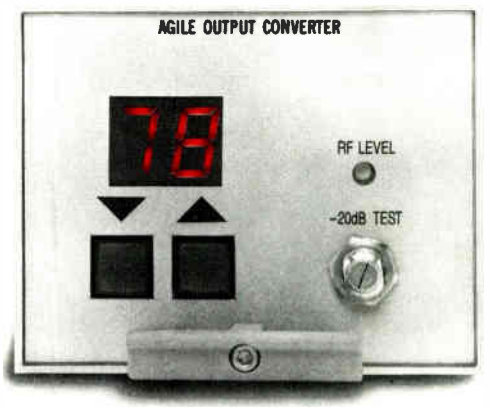

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Reader Service Number 4

Program provider or cable provider?

Just what business are we in? Entertainment? Telecommunications?

If you talk to members of the Society of Cable Television Engineers, the answer is likely to emphasize telecommunications.

If you talk to Ted Turner, or CBS, or the manager of a local TV station, the answer is more likely to emphasize the distribution of entertainment and information.

In most of the world, these two businesses exist, separate but equal. Neither side has significant authority or primary responsibility on the other side. In England, for example, two separate licenses for cable TV are issued: "one by the Department of Trade and Industry (DTI) under the Telecommunications Act of 1984 for the running of a telecommunications system; and one by the Cable Authority under the Cable and Broadcasting Act of 1984 for the provision of a cable programme service by means of that system."

The Cable Authority license covers such matters as diversity of programming, programs originating in the European Economic Community, educational access, local origination, programs for the hearing impaired, codes regarding violence, appeals for donations, must-carry, copyrights, obscenity, incitement to racial hatred and so forth. Program regulation is far more intrusive in England (and most of Europe as well) than in the U.S.

A potential cable operator is encouraged to contract with British Telecom (the telephone company formerly owned solely by the government) to design, construct, and operate (i.e. maintain) the physical network of coaxial cables or optical fibers. However, the program provider is not foreclosed from also obtaining a telecommunications license to construct and operate the cable facility, much as we do in the U.S.

There is nothing to indicate that a similar dichotomy might develop in the regulatory patterns of government in the United States, at federal, state or local levels. However, it could develop in the marketplace in the next decade or two as the telephone companies begin to install Broadband Integrated Services Digital Network optical fiber subscriber loops to serve residential subscribers.

Cable TV is certainly well established in the business as program provider. Probably the only way the telephone industry might also become program providers would be through mergers and acquisitions. Telephone companies themselves have demonstrated no experience in programming, and little taste to learn.

The pressure will come on cable TV to give up its little niche in the telecommunications business. However, the cable TV networks are still the best way to provide multi-channel, one-way, point-to-multipoint video services. BISDN is best suited to providing point-to-point, full duplex (i.e. two-way with equal capacity in both directions), voice, data and video services.

The ATC hybrid fiber backbone system using multiplexed VSB/AM transmission has lots of advantages at relatively low incremental cost. It does not, however, provide assurance of satisfactory transmission of advanced or high definition TV. The system could accommodate premium ATV or HDTV signals by multiplexing one or more FM special channels along with the VSB/AM basic channels. There is plenty of bandwidth in the fiber backbone. The necessary bandwidth would have to be made available on the coaxial part by deleting non-revenue generating channels, rebuilding or utilizing existing idle channel capacity.

Subscribers would be supplied a set-top converter/interface unit to be used only for ATV, HDTV or other premium channels. The customer would use the TV set channel selection facility, with all of its remote convenience features, to select basic channels. One channel on the TV would be designated for premium service. The converter would have an IR receiver designed to respond only to that channel's signal from the customer's remote. Whenever the customer presses that key, the interface box would advance to the next premium. No other customer control would be necessary.

Technically, the box would be designed for perhaps five to 10 FM channel inputs. Whether these would be 12 MHz each, for NTSC, or wider for other ATV formats would develop in the next few years. The interface converter might be single or dual heterodyne, depending on how practical it might be to limit the input frequency range.

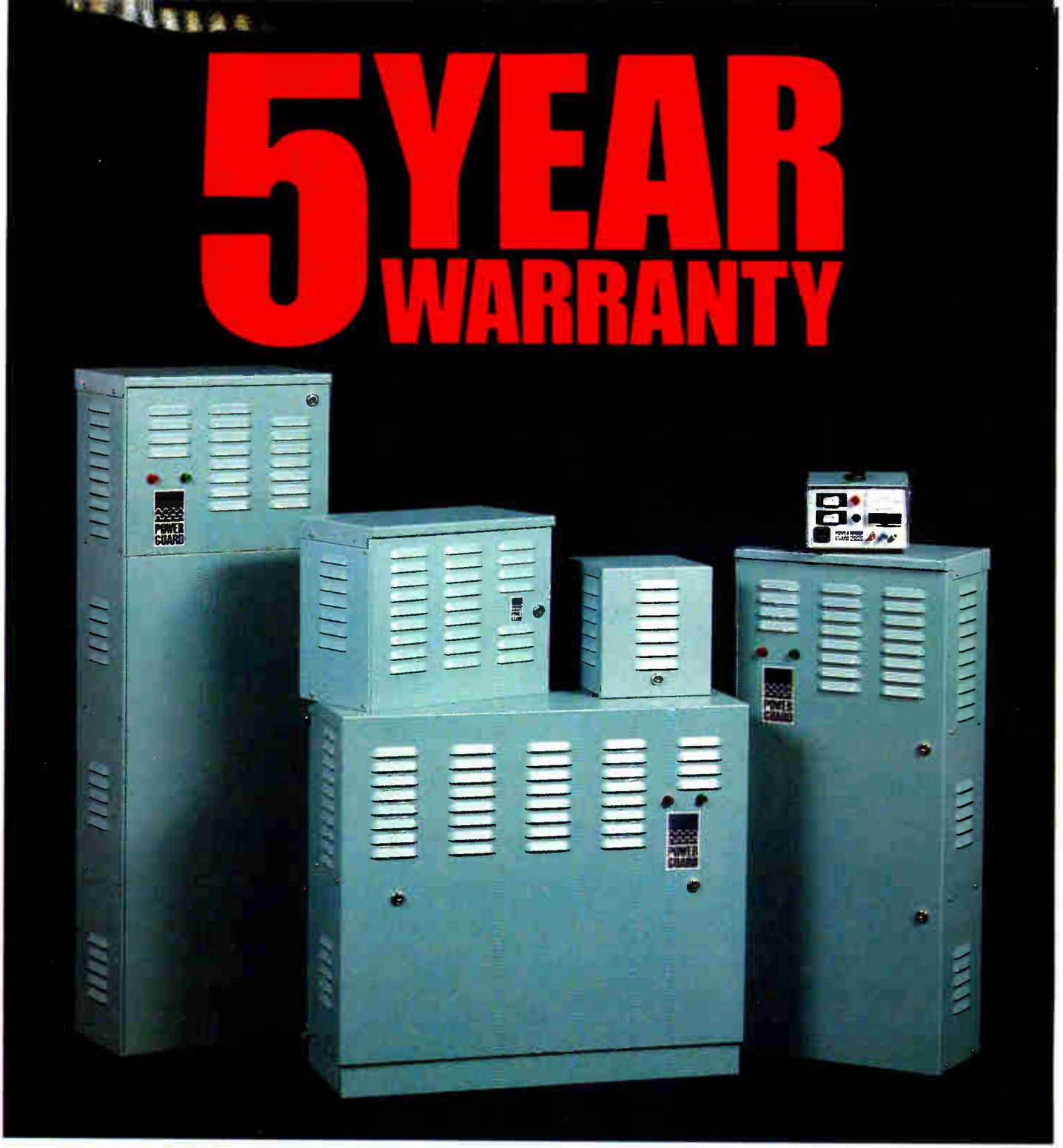
The output would be designed to accommodate several interchangeable modules. One output might simply be standard NTSC VSB/AM on channel 3 (or other designated channel). Another might be a standard NTSC TV transmitted at FM in a 12 MHz channel. Another might be HDTV in whatever format is finally adopted. Then, there might be a module that would deliver baseband Y and C components (or Y and color differences; or RGB) for TV sets and VCRs.

The point is that the TV set would operate as it was intended on all basic channels, with all special premium channels coming in on a designated channel. Adapting the cable TV network to HDTV would be easier with most of the transmission path in optical fibers, and even the part of the path in the coaxial plant released from the VSB/AM ghost generator.

If we can accomplish this, I believe we will not be forced to surrender our niche to the telephone companies.

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

5 YEAR WARRANTY



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Reader Service Number 5

R&D consortium: It's time has come

How did an industry like ours get to a position of prominence and success? Is it because we were fortunate enough to hit upon an idea whose time had come? That clearly isn't the case because cable took quite a long time to become synonymous with video entertainment. Is it because we've filled a vital need, one that was utilitarian in nature and deemed a necessity of life? That can't be the case either because if you look at the national penetration rates you see that only a little over 50 percent of all of the people who are offered cable television actually subscribe to it.

No, cable reached its level of acceptability and prominence only after many years of hard work, slow but steady growth, learning how to appeal to our customers and, more importantly, appeal to those who are not yet customers.

All along the way, we've paid attention to our instincts. We've done precious little in the way of marketing studies, preferring instead to merely ask ourselves what would make us happy. We've benefited from the ingenuity and creativity of engineers, first in figuring out how to accomplish this basic business of retransmitting television signals via wire and subsequently by figuring out ways to transmit more signals and interface between consumer electronics and cable systems. There has been little sustained R & D by the industry as a whole.

Of course, you could point to the innovative manufacturers in our industry, like Jerrold, Scientific-Atlanta, Times Fiber, Comm/Scope, Zenith Electronics and Hughes Communications. There is a long list of those who are still active (and an even longer list of those who were in our industry at one time but have subsequently left) and have spent millions of dollars developing products for our industry. There are also notable companies in the MSO ranks who have spent more money in research and development than the bulk of their brethren. Gill Cable and ATC come to mind, so do Viacom, Comcast and TCI.

These MSOs and vendors spent their R&D money on specific issues that, for the most part, addressed issues they deemed important or to fix long-standing problems and enter new business ventures. While all this R&D effort as beneficial to the industry at large, it was not undertaken without specific motives from the parties involved. In the future, when we look back at the efforts and accomplishments from these R&D efforts, we'll see they were and still are the underpinnings of our success.

The ongoing efforts of certain vendors and certain MSOs will always be of vital importance. But the time has come for the industry to embrace research and development for the good of the industry overall. The time has come for cable executives to ask themselves whether or not a centralized, coordinated R&D effort is a worthwhile investment in our future, and consider whether or not to maintain a centralized group of people whose primary activity is to concentrate on technologies and how they may be applied, expanded, refined or implemented.

Such a group should have no profit motive per se and no particular interest in developing a product, but could instead feel free to work on issues that may not have a direct profit potential but are nonetheless vital to the cable industry. A group of this nature could work on issues that are not pleasant but which desperately need understanding by the technical community and industry management. That type of R&D entity could look into the future without the pressures associated with fixing a current problem to provide technology guidance on how best to position ourselves for future, dimly seen opportunities.

Such an entity is taking formation right now. Tentatively titled "Cablelabs," it is to be an entity supported by cable system operators and independent of NCTA, representing the entire cable television industry. It will be an entity run by professional R&D personnel, adequately funded over a sufficient period of time to make a significant difference in our future. A committee of the NCTA board of directors, under the guidance of TCI's Dr. John Malone, has met several times, taking a no-nonsense approach to getting the job done. The enthusiasm and commitment of these MSO chiefs is welcome. The attention to detail paid by these people in the formation of a new entity has given everyone confidence that the consortium will be born properly, with the greatest chance of success.

This was no easy task. The legal ramifications, the tax ramifications, the corporate structure, how to staff it, who pays for it, the issues to be tackled—all were thought out with the greatest care to make this entity as attractive as it could be to those who will be asked to support it. The engineering community, too, has enthusiastically applauded the efforts to this committee to do what volunteers have too long been expected to do—provide guidance and effort in the R&D area.

The Bell telephone companies have a centralized facility, called Bellcore; the electric power industry has one; and the semiconductor industry has one. Indeed, there are literally dozens of R&D entities that are formatted and responsive to their industry's future needs and desires. As cable's identity comes more into public consciousness, as the benefits and services which we bring to the consumers begin to be recognized by public policy thinkers as well as our subscribers, the time to pay attention to what part technology plays in our daily activities, as well as our future, is now.

By Wendell Bailey, Vice President Science and Technology, NCTA

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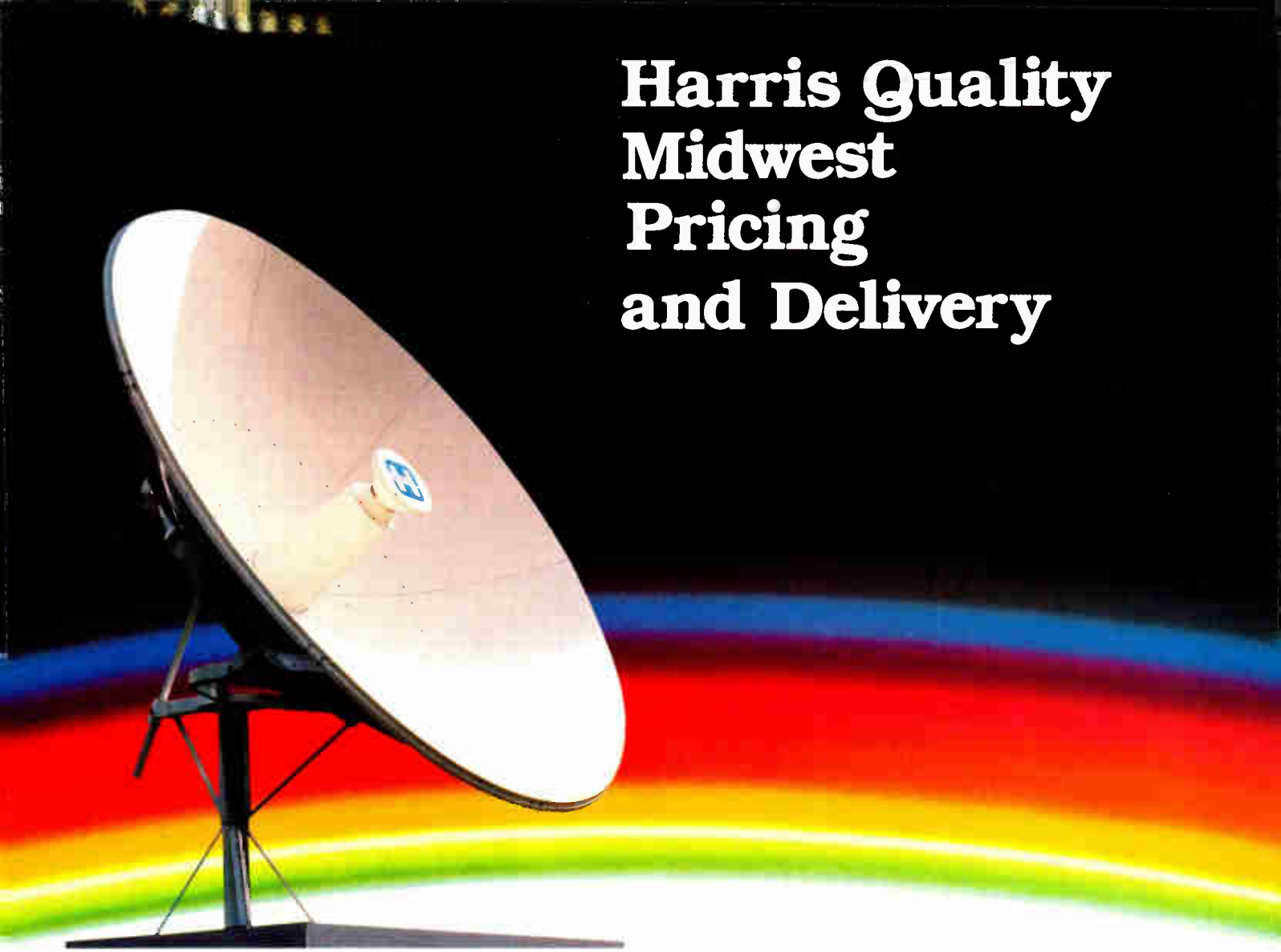

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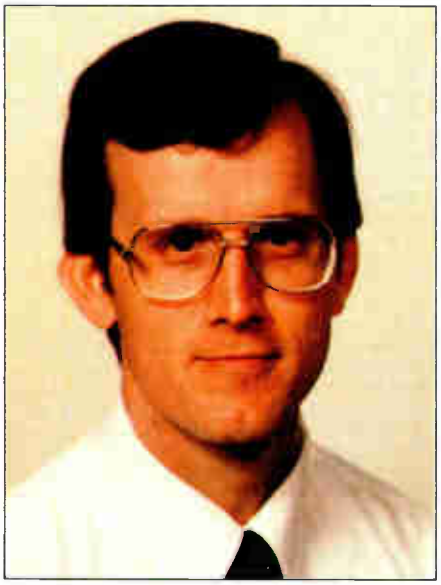


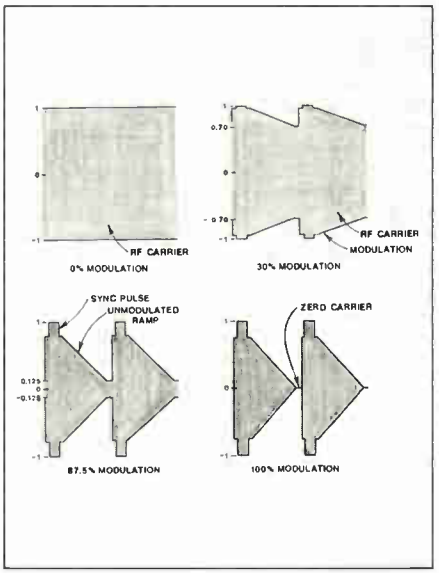
Video depth of modulation

Amplitude modulation is defined as a variation in the amplitude of the RF carrier with changes in the *amplitude* of the input modulating signal (vestigial sideband modulation, which is ultimately transmitted by a CATV modulator, is a form of AM). One characteristic of an AM signal is that the *envelope* of the RF carrier has basically the same profile as the modulating signal.

An example of this characteristic for an unmodulated ramp is quite clearly shown in the accompanying diagram. As shown, the maximum peak-to-peak amplitude of the modulated RF carrier occurs during the sync pulse, while the minimum peak-to-peak amplitude of the modulated RF carrier occurs during periods of "peak white." Note also that the higher the modulation percentage, the "deeper" the RF carrier is modulated until you reach 100 percent modulation. At that point, the RF carrier amplitude is zero, and strange things begin to happen. More about this later. It is this depth of modulation that you are controlling when you "tweak" the Modulation Depth or Mod Level pot on a modulator's front panel.

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

For consistency, all modulators should be set for a modulation depth of 87.5 percent for peak-white information. Doing so establishes the correct relationship between sync, peak-white and zero-carrier (100 percent modulation). This is accomplished very easily in most modulators by adjusting the Modulation Depth pot on the modulator until the White-Clip LED illuminates, and then backing off very slightly on the control until the LED is just off. If the modulator has been set up correctly at the factory, the modulation depth will now be very close to 87.5 percent. Of course, some modulators do offer modulation meters that are useful, and for a more exact measurement, a spectrum analyzer, or a TV demodulator with a "zero chopper" (zero carrier reference) along with an oscilloscope, can be used to monitor the depth of modulation.



Accurate adjustment of video depth of modulation is important for several reasons. If the depth of modulation is set too low, the displayed picture on your subscriber's TV set will appear darker than it should and contrast will be poor; video S/N will begin to degrade, though by the time this occurs, the picture may be too dim to notice.

On the other hand, if the video depth of modulation is set too high, other problems may begin to develop. In addition to causing the perceived brightness of the picture to be greater than it should, excessive depth of video modulation, approaching 100 percent, can actually cause an unbearable buzz in the audio. This situation is due to the fact that the typical home TV receiver uses an "intercarrier detector" to recreate the 4.5 MHz audio subcarrier prior to audio demodulation. An intercarrier detector is a device that mixes the video carrier (typically 45.75 MHz at IF) with the audio carrier (typically 41.25 MHz at IF) to recreate the 4.5 MHz audio intercarrier.

In order to prevent overmodulation of the video carrier and its resulting problems, most modulators contain "white-clip" circuitry. The white-clip circuit is typically pre-set at the factory to prevent the video depth of modulation from exceeding a certain level—typically 93 percent to 95 percent, no matter how poorly the Depth of Modulation pot has been adjusted by the operator. Therefore, with correctly operating white-clip circuitry in the modulator, intercarrier detectors in consumer TV sets are protected from a "zero-carrier" situation, thereby eliminating most audio buzz problems.

Even though the "white-clip" circuit does prevent the operator from overmodulating the video carrier, it will not prevent him from grossly clipping the video peak-white information, which can cause a substantial amount of video distortion. Such distortion can be expected in a modulator if its White-Clip LED is illuminated.

If you are having difficulty setting the video Depth of Modulation control because the White-Clip LED indication seems to be dependent upon scene information and blinks at you from scene to scene, then you probably have a modulator with white-clip circuitry that is not fast enough to operate using only the vertical interval test signal (VITS) that is present on much of the programming these days (either that or a VITS signal is not present). If this is the case, and you try setting the modulator's Depth of Modulation pot during a scene in which the program material has no peak-white information, chances are that later in the program when peak-white information is present, the White-Clip indicator will illuminate, and the information will be severely clipped. For that reason, modulators with fast-acting white-clip circuitry are far easier to set-up.

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Reader Service Number 7

HDTV—When?

There are major changes coming for TV viewers in America. It is not clear that they necessarily involve high definition television (HDTV) in as straightforward a way as some have speculated, but change is certainly at hand. The cable television industry has developed a relatively comfortable business delivering television video to half the homes in the country. Significant change in the world of television presents both dangers and opportunities to us, but as yet there has been more information than insight into strategies which could benefit CATV. What do we see if we peer into the future?

There are some fundamental and powerful forces at work here. First is the intense desire of the television receiver and VCR industry to sell more units into American homes. This market is dominated by the Japanese, who are putting important resources toward this end, and have developed a careful strategic plan. Next is the seeming willingness of at least a segment of American consumers to spend more for higher quality equipment.

The third significant factor is the arrival of exceedingly cheap digital memory. When applied to television receivers, this offers an opportunity not only for "gee-whiz" features like picture-in-picture displays, but also offers a subtle but powerful tool for changing the display timing of received pictures. Thus, rather than scan each line of a television picture as it is received in a continuous stream, there is an opportunity to store received information and then recall it from memory at different times or rates in order to feed a display.

This kind of digital storage and processing has several implications. The first is an opportunity to *dramatically* improve the display of good old NTSC television. There is a limitation to the amount of information we are able to transmit using NTSC, but many of the format's most obvious shortcomings occur in the display process itself. These faults are not necessarily inherent in the NTSC information we are transporting, but grow from analog processing and real-time display.

Digital processing gives us the potential to do a better job displaying information distributed in the NTSC format, whether by over-the-air broadcast, through cable or via videotape or satellite. If NTSC information is dissected, digitized and stored, it can be used to feed an entirely new type of display. Within the next year, we will see sets in stores which do precisely this. These sets will double the scan rate, and thus the horizontal frequency, of displays.

The result is going to be an absolutely stunning picture with no change in the transmission system itself. There is even an opportunity to achieve a certain level of subjective noise reduction in this process. All of this will initially be introduced in high-end equipment, but there is no reason that it should not move rapidly down through a TV manufacturer's product line. This is good news for cable television: our customers are going to have dramatically better pictures and it will cost us nothing—we are ready for it today.

OK, that's great news! What else can digital technology do? The same kind of digitizing, storage and playback at different times or in different ways is fundamental to virtually all transmission systems which are being proposed for high definition. The NHK MUSE standard developed in Japan has different waveforms for color and luminance information which are interleaved in time. If played back exactly as transmitted, MUSE would result in side-by-side narrow and wide pictures of the same scene, one consisting of the chroma information and one of the luminance. Sarnoff Research Institute's NTSC compatible transmission standard uses digital memory (also referred to as "frame-store") to time expand and compress augmentation information hidden within an NTSC signal. In its ACTV-II system, they also add lines of information to the digital read-out process to produce a picture which is not only wide-screen, but has high resolution.

Because of digital memory, it is highly likely that HDTV receivers will also have the ability to provide high quality, line-doubled display of NTSC signals. Thus, HDTV sets will have utility to discerning viewers, even in the absence of HDTV programming.

HDTV programming *will* be available, however. At the recent NCTA Convention, Mitsubishi showed a real-time high bandwidth videocassette recorder, using a VHS transport and playing one hour of high definition television on metal tape. It seems likely that such a device will be available to the consumer at the same time that wide-screen high definition sets show up in the marketplace. Thus, videotape rentals could become the distribution medium of choice for premium product. We have already seen erosion of our pay television business with the advent of tape rentals.

It is clear that the cable industry should, from a strategic standpoint, be prepared to offer at least our key premium (and possibly sports) programming to high definition set purchasers early in the adoption cycle.

If cable is ready when high definition sets begin to appear, we stand to benefit by becoming immediately associated with the delivery of high definition product. If we go slow, there is the potential to lose that primary position to other distribution systems. It is therefore crucial that we as an industry work with various HDTV transmission system developers and with FCC industry groups to insure there are high-quality cable-rugged systems for delivering these pictures.

By Jim Chiddix, Sr. Vice President, Technology and Engineering, ATC

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'Spurred' to reply

Many thanks to Donald C. Vought for the kind words about me in CED's April "Return Path" (p.14). Yes Don, I did state that a good designer can design two miles per hour. I also went on to say that most of the rebuilds we have been doing recently are more complicated and require increased communication with the system, so the design rate may slow to one mile per hour, but this was not included in the "Spotlight" article.

I have consistantly designed between two and three miles per hour for most of my 15 years in this business. This includes about 10,000 miles I have personally designed consisting of all frequencies and densities, and is trunk and feeder design with all tap and splitting devices written down. If I include amp schematic, level analysis sheets and powering with voltages, the rate drops by about one-half mile per hour.

This is not "guesstimation" design (I do about five to 10 miles per hour for this process) but actual design recorded on maps that a construction crew could build from, although we always have our rough design drafted by drafters in ink and Leroy (they average 1 to 1½ miles per hour). Last week I designed a 58-mile phase (400 MHz, push-pull, very normal system) in 3½ days with 0.83 trunk amps and 1.52 line extenders per mile; not exactly "guesstimation."

When I first started the business eight years ago, after taking six weeks to write a design program in Basic, I timed myself for one entire job of 75 miles. The design rate was 3.5 miles per hour. By the time I did everything else, including pencil drafting on paper sepia, the rate for the job was 1.1 mile per hour. Thus one of the reasons I started my own business.

I checked with other design departments in Denver and the consensus seems to agree with me: that a trained designer should average at least one mile per hour in a normal office environment. This would include set-up and phone calls and should increase with experience. We all use similar design programs and many of us were trained directly or indirectly by Terry Hulseberg.

In addition to having a good design program, I am fortunate to have a good memory, a quick and mathematical mind and a love for this work. Every job is a challenge to do better and I especially enjoy design comparisons. The only other variable might be the high altitude in Denver which makes us a litle lightheaded and giddy. So all I can say to your "Whoa" letter Don, is "Giddy Up" (just kidding)!

Sally L. Kinsman
President
Kinsman Design Associates Inc.

Risky business?

Mr. J. Richard Kirn's article on Ku-band reliability in your April 1988 issue (p.40) may have given your readers the impression that this method of satellite transmission is, at best, a risky business. In particular, he mentions that fades on the order of 30 to 60 dB can affect sites in Florida and other Gulf states: taken at face value, this statement would appear to rule out the possibility of using Ku-band in those locations.

Although Mr. Kirn does say that deep fades are "probable," he fails to emphasize with sufficient clarity the fact that the analysis of rainfall and its effect on microwave transmission is a statistical procedure. In dealing with this subject, we can speak of the average rate of precipitation, taken over a period of, say, 12 months, but the maximum rate (which would cause the deep fades described in the article) can only be described in terms of probability. From this understanding comes the concept of "link availability", which is specified by every user of a Ku-band satellite link and which forms a part of every comprehensive link analysis.

To take an example, an availability of 99.9 percent is frequently specified. What exactly does this mean? It means that, based on average rainfall figures, the link should be designed with sufficient margin to ensure that the probability of total link failure is 0.1 percent. This is equivalent to the statement that, given a reasonably long observing period, the link will be out of commission for 0.1 percent of the time. In a period of 12 months, it is equal to approximately nine hours.

Working backward from Mr. Kirn's results, and using a fade of 45 dB (mid-way between his figures of 30 and 60 dB), we can calculate the probability of such an occurrence. Assuming a path-length of five kilometers (three miles, as stated in the article), the specific attenuation due to rain is 9 dB per kilometer. For a downlink operating at 11.7 GHz, this degree of attenuation would be caused by rain falling at a rate of 190 mm/hour (CCIR Report 721-1). Upon consulting the Reference Manual For Telecommunications Engineering, we find that this rate of precipitation can be expected to occur for less than 0.001 percent of the time. In the course of 12 months, it will probably cause such a deep fade for less than 5.3 minutes.

A well-designed Ku-band satellite link will have sufficient excess power to absorb the effects of rainfade for more than 99 percent of the time. Naturally, by increasing the amount of power margin, one can reduce the probability of total failure to an arbitrarily small value, but economic considerations obviously impose some limits. Nevertheless, it must be concluded that, in such a well-designed link, the probability of exceptionally severe fades as described by Mr. Kirn is very low, and in most practical situations can be ignored.

David H. Slim
Wegener Communications Inc.

Advanced TV systems

New and improved. Marketing specialists say those are the two most powerful words in advertising. If so, look out. Advanced TV systems were widely trumpeted at the recent NCTA convention using just those two compelling adjectives. Bill Thomas of ATC and Paul Heimbach of HBO declared flatly that "HDTV has the potential to be the most significant development in the home-entertainment arena since the introduction of color television." That's important to the technical community because HDTV will "undoubtedly lead to new technical standards of quality in broadcast and cable," they emphasized.

Among the hornblowers at the most technology-driven show in recent memory: Jerrold, Scientific-Atlanta, Magnavox (North American Philips), ATC, HBO, NHK (Japan Broadcasting Corp.), Mitsubishi, High Resolution Sciences, JVC, the David Sarnoff Research Center, the Del Rey Group (Compatible Video Consortium), Faroudja Laboratories and Bill Glenn of the New York Institute of Technology. (See Figure 1.)

The most immediate implication: cable operators and their technical staffs must plan now for better S/N and C/N performance in their distribution plants. It appears advanced TV systems will require a bit of extra headroom. The good news is that some advanced TV signals are pretty rugged when run through cable plant.

The new picture technology falls into three basic categories: systems that are improvements to existing NTSC; systems that are compatible with—but not identical to—NTSC; and systems that are incompatible with NTSC.

In the first group are companies like High Resolution Sciences and Faroudja Laboratories, which propose to improve existing NTSC by removing artifacts like dot crawl and improving picture resolution. In the second group are proposals from Bill Glenn and Philips (HDNTSC) that require more than 6 MHz bandwidth. Other NTSC-compatible systems from the Sarnoff Labs and Del Rey Group are confined to a 6 MHz bandwidth. Systems incompatible with NTSC include the NHK MUSE and HDB-MAC systems (a decoder is required to change MAC to NTSC) as well as the Philips HDMAC.

A side-by-side comparison of NTSC pictures from David Sarnoff Research Center's ACTV-I (left) and ACTV-II show a dramatic difference in resolution. Both photos are of actual screens.

Better C/N and S/N in the distribution plant will be required to carry the improved pictures.

What CATV needs

ATC's Thomas and HBO's Heimbach outlined their perceptions of what the industry needs from an HDTV delivery system. Such a system must:

- Provide at least 850 lines of horizontal and vertical resolution;
- occupy one 6 MHz channel;
- not require major rebuild or modification of existing distribution plant;
- co-exist with NTSC and other channels using existing channelization plans;
- not require adjustment of existing signal parameters;
- allow real-time transmission of programming;
- interface easily to the SMPTE HDTV production standard;
- use scan rates and other parameters that allow NTSC/HDTV receivers to be reasonably priced;
- provide four CD-quality audio channels;
- include built-in security and addressing;
- be capable of satellite delivery and not require more than 15 dB C/N; and
- be recordable on VCRs and optical disks.

SuperNTSC

Advanced TV systems come in many flavors, including the SuperNTSC approach recommended by Faroudja Laboratories. Full NTSC compatibility is the way Yves Faroudja approaches better TV. NTSC can be made to emulate HDTV using comb filters and line doubling frame stores, Faroudja argues. And the technology is here today in production form. Faroudja technology is used in Super-VHS VCRs, for example.

ACTV

The most sharply-defined pitch for advanced TV came from the David Sarnoff Research Center (aligned with NBC/RCA), which made a splashy push for its 6 MHz-compatible version of

are on the way

higher definition TV. Known as Advanced Compatible Television (ACTV), it comes in two versions. ACTV-I is a single-channel NTSC compatible system offering a 5:3 aspect ratio, 420 lines of horizontal resolution and can be designed for either 1125 or 1050 scanning lines with a 2:1 interlace or 525 lines with 1:1 progressive scan.

ACTV-I uses two separate signals: a 4.2 MHz main channel and an auxiliary signal containing side panel information, RGB information and other required data. The entire signal has four components:

- Component 1 is the main 525-line, 2:1 interlaced NTSC signal;
- component 2 contains the additional left and right panel information required for the wider high definition picture;
- component 3 contains the horizontal luminance detail; and
- component 4 is a "helper" signal containing extra lines of horizontal resolution.

ACTV-II

ACTV-II is seen as an evolutionary development of ACTV-I that should be ready for deployment in the latter 1990s. It will use two channels to offer "true" high definition signals. And Sarnoff wasn't the only major company proclaiming the importance of new TV standards at the show. ATC and HBO announced funding and support for further development of ACTV in several areas. Among them:

- Ensuring the ruggedness of ACTV for cable transportation systems;
- developing appropriate satellite-to-headend technology;
- perfecting encryption and addressability aspects of both ACTV-I and ACTV-II; and
- ensuring that ACTV is subscriber-friendly.

New media lab

Jerrold gave big play to its plans for a $1 million Applied Media Lab intended to probe consumer appetite and perception of advanced TV systems. At its booth Jerrold had a four-monitor side-by-side display showing studio-quality NTSC; NTSC after it's gone through an amplifier cascade; Super-VHS; and HDTV pictures. Jerrold used the Glenn 9 MHz HDTV system for its demonstration. The Glenn system uses a regular NTSC channel plus a 3 MHz augmentation channel. The company stressed that it is not endorsing this or any other proposed HDTV format, however.

Asked why this particular demonstration had been scheduled, Advanced Technologies Product Manager David Robinson said "Super-VHS is the competition for CATV now." In fact, the company is investigating a test system that would deliver S-VHS quality pictures to the home. This system "probably would require a special modulator and an adapter box of some kind in the home because most subscribers don't yet have high resolution displays," Robinson said.

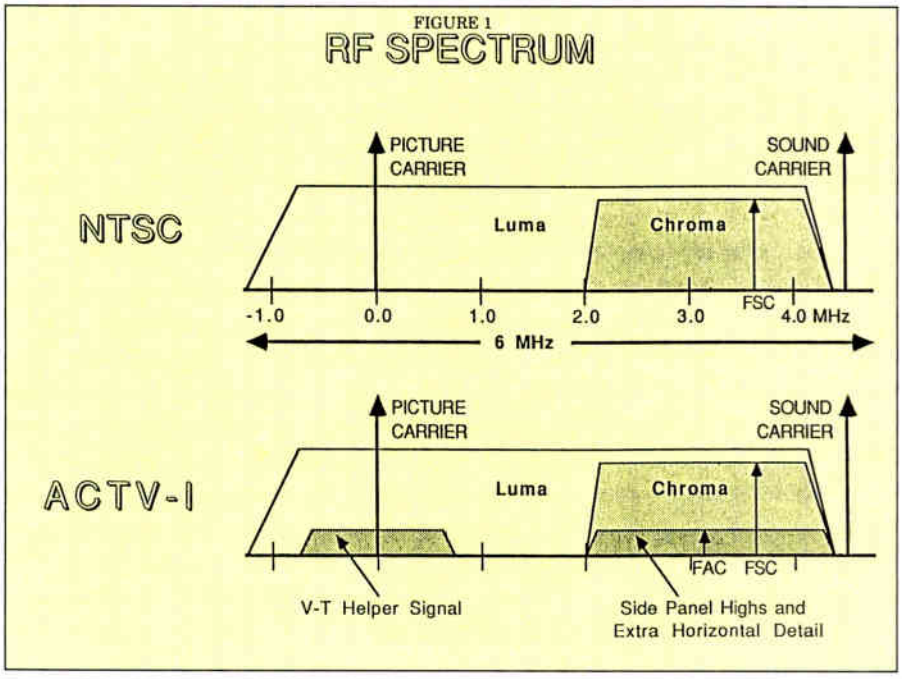
HDB-MAC

Scientific-Atlanta gave ATV a push with its own 10.7 MHz high definition B-MAC (HDB-MAC) system. B-MAC is the firm's 6.3 MHz, 525-line interlaced satellite video delivery system. HDB-MAC is an adaptation of that

CABLE 88 COVERAGE

Highlighted as a 'technology discussion' rather than a product was a test fiber transmission system.

FIGURE 1
RF SPECTRUM



older technology using 10.7 MHz bandwidth and progressive scanning to provide higher resolution and a 16:9 aspect ratio. The company's booth had a four-monitor display of standard NTSC; Super-VHS; ED-MAC and Wide-MAC formats. ED-MAC uses 1:1 progressive scanning, a 4:3 aspect ratio, twice the NTSC line frequency, chrominance bandwidth of 2.2 MHz (4.4 MHz in the line doubled mode), and 6.5 MHz luminance bandwidth (13 MHz with the line-doubled display). It offers a picture that is free of cross-color and features reduced flicker. ED-MAC is a 6-channel digital system incorporating color teletext and data channels.

Highlighted as a "technology discussion" or "familiarization exercise" rather than a product was a test fiber transmission system using amplitude modulation and running 36 channels through 15 kilometers of fiber. The company said it was "evaluating detector and laser sources," and while

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Reader Service Number 13

Magnavox gave show attendees a report on tests of the HDNTSC terrestrial system.

admitting that a lot of work still had to be done, indicated its interest in AM rather than FM fiber transmission systems. Laser linearity and the connector issues in an optical splitting environment are issues the company still is investigating.

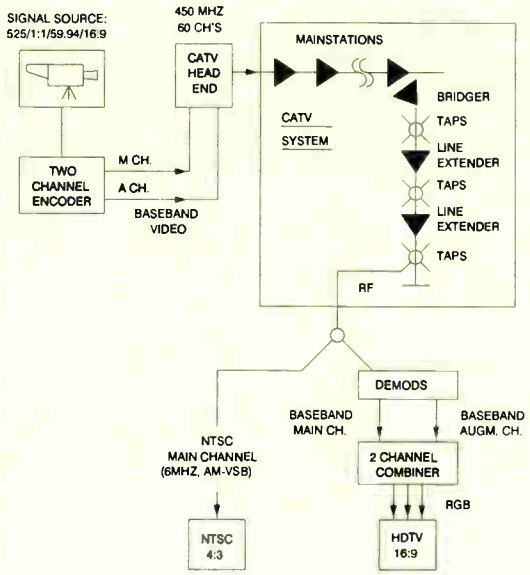
Why AM instead of FM? Because it might fit more economically with the approach ATC is taking with its fiber backbone/coax distribution system offering much shorter amplifier cascades, especially as fiber penetrates more deeply into the distribution network. Today though, the company still feels that conventional coax distribution, especially using feedforward technology, was a better choice in terms of delivered signal quality.

HDTV over cable test

Magnavox gave show attendees a report on tests of the HDNTSC terrestrial system developed by its parent, Philips. Based upon the HDMAC-60 satellite delivery system using a 24 MHz FM transmission bandwidth, HDNTSC uses a 4.2 MHz main channel and a 3 MHz augmentation channel. The main channel is VSB-AM. The augmentation channel can be either analog or digital. Both systems use progressive scanning and either 525 or 1050 scan lines per frame.

The HDNTSC signal was run through a fully-loaded 60-channel CATV system using an eight-amplifier cascade spaced at 22 dB; one bridger and two line extenders spaced at 27 dB; and three feederline tap strings representing 24 eight-way

FIGURE 2



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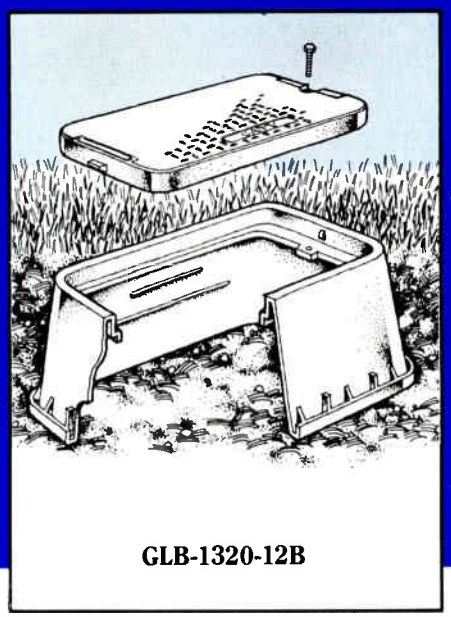
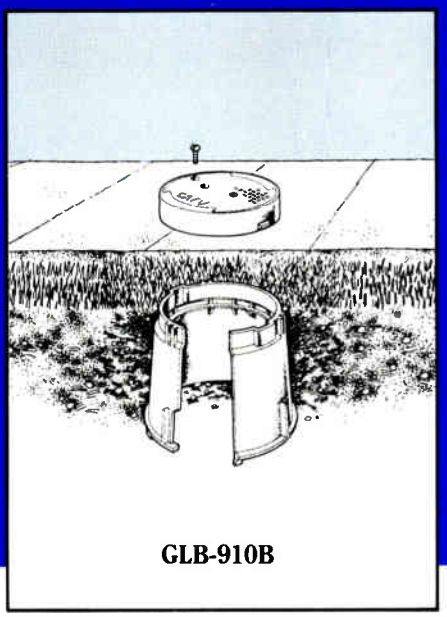


GLB-1320-12B



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Reader Service Number 15

NHK fed its convention hall high definition TV demonstration from an American Cablesystems headend.

taps. (See Figure 2).

Both the main and augmentation channels were modulated on standard RF carriers and parameters such as C/N, composite triple beat, cross-mod, group and chroma delay, and reflections were measured for a period of 10 days.

The results, when both main and augmentation channels were simultaneously tested, are as follows:

- HDTV was about 3 dB more noise sensitive than NTSC;
- HDTV and standard NTSC were equally sensitive to CTB;
- HDTV was about 3 dB more sensitive to cross-mod;
- reflections causing ghosting were equally perceptible on both HDTV and NTSC channels;
- there were no noticeable color shifts because of chroma delay; and
- group delay seemed to have no effect on HDTV picture quality.

Two major implications for the industry: HDTV signals probably will require 3 dB better S/N at the subscriber's set compared to NTSC. Otherwise the signal appears to be as rugged as NTSC.

Improved NTSC

High Resolution Sciences of Los Angeles made its first appearance at a cable show to exhibit its family of products that improve NTSC by eliminating dot crawl, correcting aliasing and improving apparent vertical resolution. Dot crawl is caused by cross-modulation between the luminance carrier and color subcarrier, resulting in small dots that move upward on the TV screen. HRS can solve that problem by putting a "Chroma Crawl Free" board into a device (a camera or transmitter, for example) anyplace between the program source and distribution channel. Installation of the CCF board also has the added benedit of improving horizontal resolution.

Theoretically, 480 vertical lines can be displayed on an NTSC receiver. In practice, fewer than 350 actually are shown. But HRS uses a board in a camera and a matching board in a display to increase the amount of displayed vertical information. This product also simultaneously takes care of aliasing. Aliasing is an observed shimmering effect seen on NTSC receivers. It occurs whenever a horizontal scan line encounters a line or edge in a picture that is almost horizontal.

MUSE test

NHK fed its convention hall high definition TV demonstration from an American Cablesystems headend with signals running through a 12-amplifier cascade. Two channels were used and the signals were VSB-AM modulated. It is possible to use FM but this requires five channels. The advantage

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CPH-1730B Trunk Amplifier Pedestal with bracketry and ground skirt pre-installed	1	2 Pedestals @ $159.80 each $319.60	1 Free CPH-1730B Pedestal
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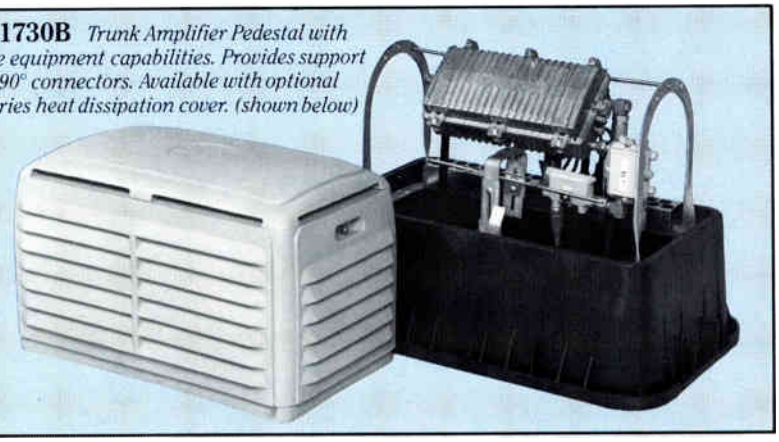

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Worried about Super-VHS? Mitsubishi's got something to make you sweat: a startling baseband HDTV VCR.

of FM is that there is no amplifier cascade limitation. NHK was recommending that its MUSE (Multiple Sub-Nyquist Sampling Encoding) signals not be run through cascades longer than 25 amps when VSB-AM modulation is used. It also said that low C/N and distortion figures were necessary. How much lower? C/N of 46 dB and CTB of about -62 dB. (See Figure 3).

NHK, by the way, has developed no fewer than seven versions of its high definition system. Reportedly, six are compatible with NTSC, although not all six are confined to a 6 MHz bandwidth. MUSE originally was developed as a way of compressing the 30 MHz baseband HDTV signal into 8.1 MHz of transmission bandwidth. It's anticipated that 9 MHz will be required for broadcast transmission of MUSE. However, NHK also has developed several transitional systems such as MUSE-6 that is compatible with NTSC receivers but really doesn't offer much picture improvement compared to standard NTSC. NTSC MUSE-9 is a 9 MHz bandwidth system that NHK says really is best done with a contiguous 9 MHz block of spectrum. Narrow MUSE fits into a 6 MHz channel (it actually uses 5 MHz) but is incompatible with NTSC.

HDTV VCR

Worried about Super-VHS? Mitsubishi's got something to make you sweat: a startling 25 MHz baseband HDTV VCR running half-inch tape in a package that looks and feels like VHS. No compression here—it's full bandwidth HDTV. Mitsubishi also was showing a 40-inch HDTV receiver that did a spectacular job of displaying output from the hi-def VCR. We understand the chip set for the receiver will be in production later this year; certainly by next year. No details yet on production of the HDTV VCR.

Looking for support at the show was the Compatible Video Consortium, a limited partnership headed by the Del Rey Group, which itself has proposed a 6 MHz-compatible HDTV format. CVC seeks establishment of an HDTV transmission format requiring a single 6 MHz channel. Two current limited

C-band's future looks healthy

In spite of all the furor and debate about coaxial vs. fiber optic delivery of video signals to the home, a large proportion of today's service depends upon wireless signal distribution via terrestrial and satellite means.

What's the future of C-band delivery of programming look like? Very healthy, according to Bruce Elbert, director of Galaxy systems at Hughes Communications, who authored the paper entitled, *Next Generation C-Band Satellite Systems for Cable Program Distribution*.. "The next generation of satellites will essentially be the same, but with some enhancements," said Elbert.

- Attenuators will be used between the input and output multiplexors and before the power amp to oppress interfering signals (like Captain Midnight).
- Power levels will be increased to 16 watts.
- The footprint of each new satellite will remain unchanged but overall EIRP within the footprint will be increased by about 3 dB to 39 dBw (this will be done by improving the efficiency of the antenna and increasing the power level).

Multichannel Multipoint Distribution Service (MMDS) was once seen as a competitive threat to cable TV overall. Today, however, except in a few urban markets, MMDS is rarely considered to be a threat to cable's overall wellbeing. Instead, MMDS proponents are now touting the technology as an excellent way to extend a cable system into an area that was previously unprofitable or a housing development that was just recently built.

According to George Harter, systems engineering manager for GE's Comband Products Operation, MMDS is an effective line extension alternative to traditional coaxial plant, especially when amplifier cascades will have to be lengthened.

Harter's paper, *Wireless or Wired Cable: Comparable Technologies?* points out that a 10-watt output MMDS transmitter beats carrier-to-noise performance of coaxial plant up to a distance of 23 miles. This observation was based on an MMDS system with a 500-foot tall transmit tower, receive antennas 20 feet high and a cable system using feedforward trunk amps spaced 2,600 feet apart.

Other MMDS advantages include equipment reliability (gained through the use of more solid state hardware) and quicker start-up times (a system can be fired up in 30 to 90 days after construction begins.

Microwave AML transport of CATV signals remains a viable alternative to cable operators who anticipate the need to deliver improved pictures to their subscribers, said Thomas Straus, chief scientist at Hughes Aircraft. In his paper, *Optimization of Subscriber Signal Quality through Local Distribution Microwave*, most of the emphasis is placed on how to get better C/N numbers with AML because advanced television systems may dictate that C/N be at least 49 dB *at the last subscriber's drop.*

How do you get that kind of performance?

- Adjust the AGC threshold on the receiver (levels have already been adjusted to 53 dB at the factory since 1981).
- Use a two-stage LNA on the outdoor receiver.
- Lower the noise figure on the LNA (but be careful of added distortion).
- Reduce transmitter noise.
- Use higher output transmitters.

Improving system operations without additional personnel is rapidly becoming a hot topic in engineering circles. In his paper, *A Unique Cable Advertising Interconnect*, Norman Weinhouse of Norman Weinhouse Associates explains how the Los Angeles Interconnect services five counties of LA totally automatically.

The system consists of a central hub location which acts as the business and control center for the entire interconnect. Each affiliated cable system is equipped with a commercial insertion system dedicated to the interconnect by telephone lines. By utilizing tape recorder/players, each cable system can record a master tape of spots which is satellite uplinked during off hours. ■

Transmission systems will have to be improved because of the threat of increased competition from overbuilds.

partners are Cox Enterprises and Tribune Broadcasting.

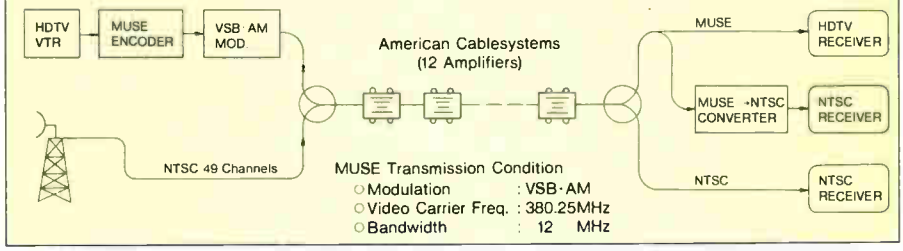
Implications for CATV

Bandwidth will be an issue as advanced TV systems take commercial form. In general, there is a trade-off between bandwidth and resolution. Systems such as those proposed by the Sarnoff Labs and the Del Rey Group are 6 MHz compatible. Other systems, such as the Glenn, Philips HD-NTSC and HD-BMAC require between 9 MHz and 12 MHz but offer higher resolution. The NHK MUSE system would take up 16 MHz of bandwidth.

Noise performance also will be an issue since, as Scientific-Atlanta's Gerald Robinson said at a panel discussion on HDTV and cable, "it is reasonable to assume that the closer viewing distance permitted by HDTV will require an increased signal-to-noise ratio in the displayed picture."

Reflections might also be a problem. Robinson pointed out that echoes are more noticeable when advanced TV systems are run on CATV plant for a number of reasons. "Some systems transmit information in time-compressed form and echo delay results when the signal is expanded to proper display time. Also, echo delay is related to horizontal displacement on the screen. A system using a shorter active line time will cause a given horizontal displacement to relate to a correspondingly shorter delay. Wider aspect ratios have the same effect," he said.

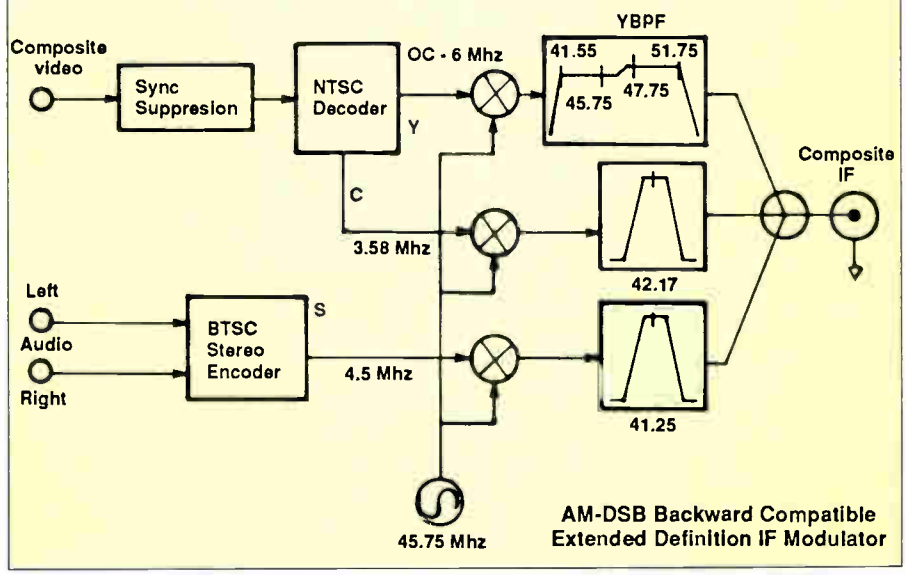
FIGURE 3
Experimental Setup of HDTV Cable Transmission

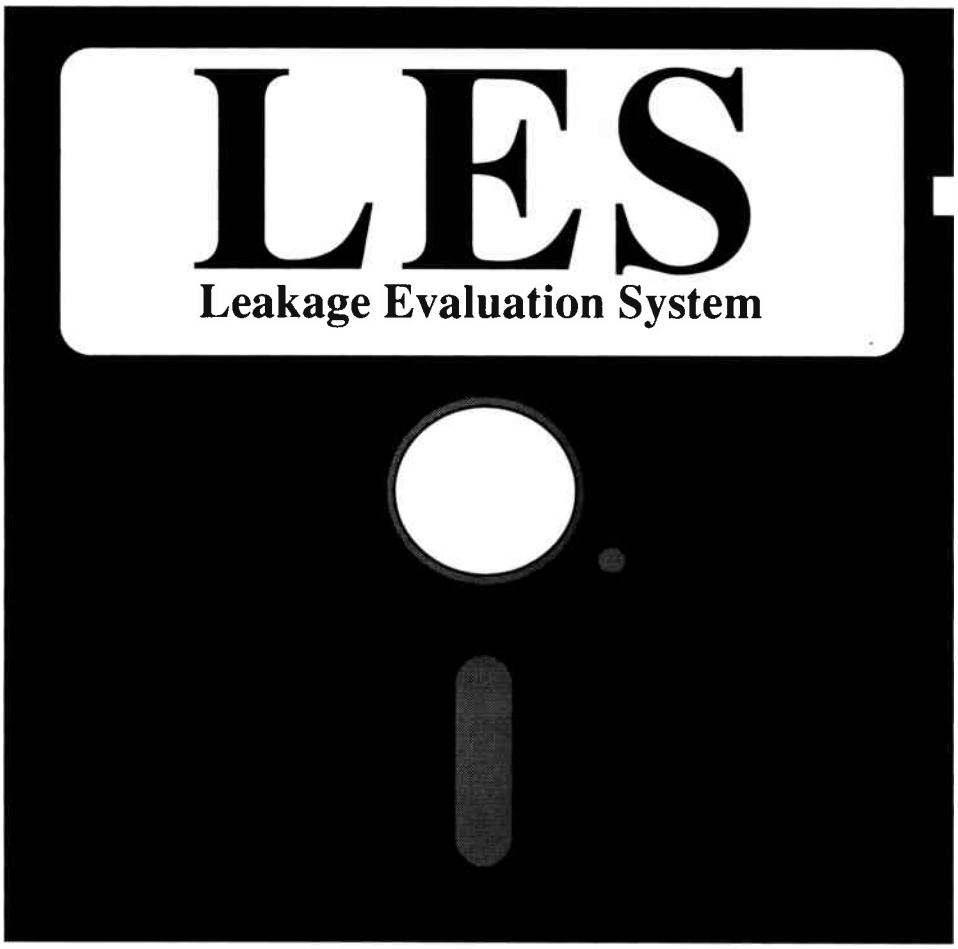


Better pictures now

Transmission systems will have to be improved because of the threat of increased competition from overbuilds, Super-VHS, laser disks and ED-Beta, said Clyde Robbins, Jerrold senior

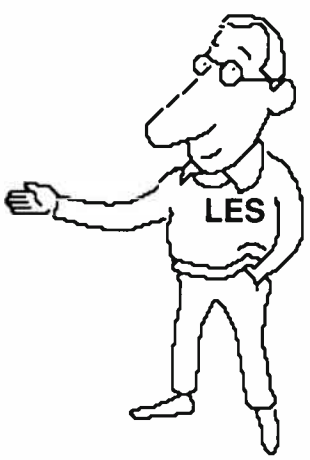
FIGURE 4





"July 1, 1990, is a deadline for compliance, not a program to meet compliance. Programs for leakage detection and correction should start now."

Ron Wolfe
CED, October 1987



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If a system is both noise and distortion limited such that levels cannot be increased, a rebuild and redesign is called for.

engineer. Noise is one of the main culprits. Often, systems are operated with too low a level of distortion at the expense of noise performance, he said. "If you lower an amplifier output you get lower distortion; if you have higher input to the amplifier you get lower noise. Combining lower output level and lower input level you get lower distortion and lower noise but more amplifiers in the cascade and higher costs per mile.

"I'm suggesting that operators give serious consideration to alternate configurations that deliver higher signal quality," Robbins said. "An excellent picture should be at 55 dB C/N and I have some concern that many cable systems won't measure up to that standard. A much better target is 50 dB." The point, Robbins said, is that good NTSC will look as good or even better than a Super-VHS picture. About the much-touted Y/C connector system, Robbins said that techniques such as Faroudja encoding would produce pictures as good as those.

For a relatively new system running C/N in the mid-40s, it might be possible to improve picture quality by so simple an expedient as dropping the pilot levels 3 dB and trading distortion performance for noise performance. That can raise converter input levels enough to effectively double the length of permissible cascades, Robbins said.

If a system is both noise and distortion limited such that levels cannot be increased, a rebuild and redesign is called for. "You want to design for high C/N and wide bandwidth, the reasons being that we aren't certain what high definition standard will ultimately be chosen but we do know

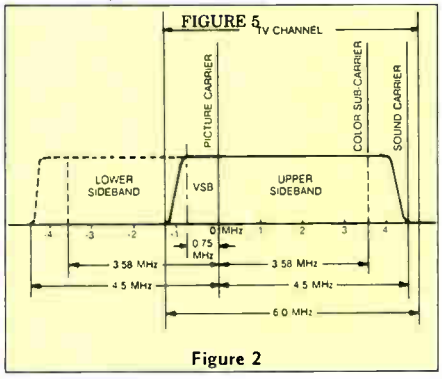

Figure 2

that high C/N will be required," Robbins said. "There's no point in showing high resolution snow." It's also probable that whatever system is chosen, bandwidth demands will be increased, he added. (See Figure 4).

There also is another way to increase system performance in newer systems with adequate C/N performance and unused bandwidth, Robbins suggested. The solution is to carry signals in a non-standard modulation format. AM with a double sideband is one approach

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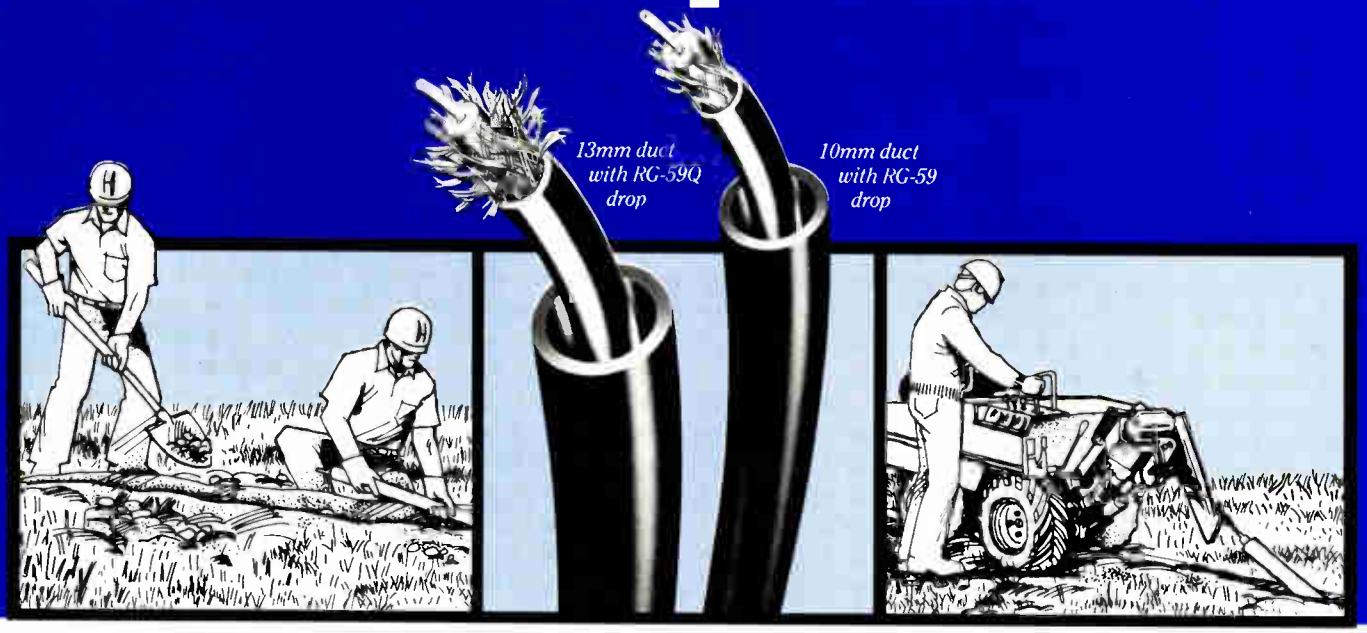

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Reader Service Number 21

Fiber optics action really heats up

For perhaps the first time, a wide range of CATV industry personnel were able to put away the books and promotional materials and actually see and touch fiber-based system hardware and learn how it works—all in one place.

In fact, the pace of fiber optic system development for CATV use has accelerated so quickly that American Television and Communications is close to the point when it can begin testing hand-selected equipment designed for its fiber optic "backbone" concept and come close to the operating specifications the MSO requires, said David Pangrac, director of engineering and technology for the second-largest operator.

As a point of review, ATC's backbone concept consists of a series of fiber strands emanating from the headend to a number of receiving points, or nodes, located throughout a system. The nodes are located at approximately ever other power supply and designate the point where light is converted back to RF energy for distribution throughout the local neighborhood. (See Figures 1 and 2.)

Judging from activity at Cable '88, fiber's role in CATV will be expanded—soon.

The plan was conceived by Pangrac and Jim Chiddix, ATC's vice president of engineering, as a way to improve picture quality, reduce cascade lengths, lower maintenance costs and improve reliability for the subscriber. The idea is to reduce cascades from 30, 40 or even 50 amplifiers to no more than four in any given instance. Both amplitude and frequency modulation techniques can be accommodated in the backbone concept and both are being investigated currently.

Anticipated operational benefits of the system are overall reliability (outages affecting fewer subscribers per occurrance); improved signal quality and operational simplification by reducing the number of amplifiers, which introduce noise and add degradation, in cascade; increased channel capacity through shorter cascades; and network flexibility via diverse signal offerings to differing demographic areas within the same franchise area.

Strategic advantages include the ability to carry HDTV signals, the ability to provide reliable two-way transmission and reception of signals and possible carriage of additional commercial services.

The biggest hurdle yet to be overcome before implementing such a system is the performance of the electro-optical components required by such a backbone architecture. Chief among these is laser performance, Pangrac said. Because the devices are rarely used in analog modes, laser linearity

Keeping up with growing ad sales

Advertising on cable has become big business. With more and more time being made available by the programmers for local ad insertion (local avails), a truly successful ad sales force can easily tax a system's commercial insertion gear if new or more equipment is not purchased in time.

That's the situation Oceanic Cablevision found itself in recently, said Gregory Davis, director of video operations at Oceanic. Because of equipment restraints, the system couldn't handle more than about 100 active spots per day, but was running as many as 250. Something had to be done.

But a choice had to be made: should the system invest in more VCRs or be forced to change tapes manually as the first tape ran out? Systems that required more equipment or manual operation either required more capital or heightened the possibility of human error.

Oceanic finally settled on a sequential/automatic compilation system, which combines the best features of random access and sequential insertion. The system uses library reels of spots, logs are loaded (which become edit lists) resulting in a daily tape for each channel.

This system required Oceanic to modify five VCRs with SMPTE time code for frame accurate editing. The spots are compiled on the tape out of sequence, checker-boarding the tape until all spots are filled; multiple players are used to reduce the number of library reel changes. Down-loading of commercial logs from the traffic system avoids the need to type in logs manually.

The system cost more up front (to modify the VCRs with time code), but it allowed the system to eliminate eight part-time positions. System pay-back is expected in about 18 months after the system was implemented, Davis said.

Surge protection

With the summer months now upon us, the potential for damage from lightning strikes or surges is at its highest point of the year. Outages are the number two cause of subscriber dissatisfaction, according to Jones Intercable's Roy Ehman, so anything an operator can do to ward off lightning and surges will lower repair costs and heighten subscriber happiness.

A number of solutions to electrically related problems appear in the trade press during the summer months, but a system in Virginia was having an especially difficult time with repeated electrical storm damage.

Ehman called Tom Osterman of Alpha Technologies and asked him to build several heavy-duty transient protection devices into power inserters. Ehman told Osterman the device needed to take fault currents to ground for several AC cycles and had to have a response time of less than one microsecond.

After the units were installed in the Virginia system, the area of the plant covered by the device was no longer damaged, while the unprotected area was. the crowbar device is "safe, legal and it works," reported Ehman. "Be ready for the summer storms—try it for yourself."

Continued on page 38

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Reader Service Number 24

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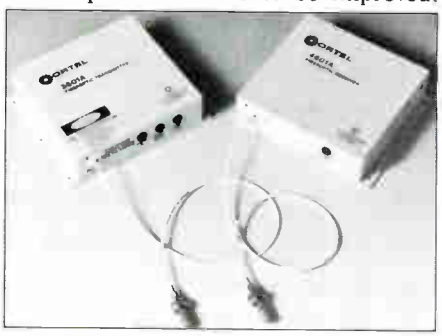
Continued from page 38

Video Transmission System, is considered "an interim step" in Ortel's development program for CATV products, said Larry Stark.

The system boasts carrier-to-noise ratios (an important gauge of signal quality) of better than 47 dB for distances up to 10 km and better than 50 dB for less than 6 km. Obviously, those specs will have to be improved,



Ortel announced its new broadband video transmission system.

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Costs coming down

Perhaps more surprisingly, the fiber approach is quickly coming close to meeting ATC's cost goal of $27 per subscriber, Pangrac announced. Based on a model where a portion of ATC's Orlando, Fla. system was analyzed, it seems with just a little more movement, fiber will be a reality. The model looked at 375 miles of plant with a density of 60 home passings per mile that is 49 percent penetrated and serves 11,000 subscribers. Twenty-nine fiber trunks or "runs" would be needed (allowing for a cascade of no more than four trunk amps to follow the fiber) under the backbone scenario. Anticipated costs would be about $356,000 to install the system. That works out to about $12,300 per fiber trunk or $950 per mile or nearly $32 per subscriber. "We're making progress," said Pangrac.

Significantly, ATC's computer model of that real-world system showed that implementation of the backbone system would yield an improvement in

Continued on page 42

Industry waking up to CLI

Perhaps indicative of the industry's overall reaction to the FCC's Cumulative Leakage Index rules, which go into effect July 1, 1990, a relatively sparse turnout showed up to hear a series of papers delivered on the subject.

What was missed was a valuable discussion of how leakage detection is performed, how to set up an effective leakage detection program and just how serious this whole subject is to the future of cable television.

Robert Dickinson of Dovetail Systems led off the program with a discussion of how aerial detection is performed. "There's a lot we don't know yet," he admitted, because the FCC has not specifically spelled out how to perform each and every necessary task. In fact, every flyover is a learning experience, and hardware and software are developed in an ongoing fashion, added Dickinson.

Using a single-engine plane with a horizontally polarized antenna attached beneath, the pilot flies a series of parallel passes, spaced nearly a half-mile apart, over the area covered by the cable system. A series of reports can then be generated to show the areas where leakage exceeds the allowable limit. The cable operator can identify the offending area within a few blocks and then locate the source of the leak with ground-based equipment.

However, receive antenna positioning may not detect all leak sources. "The bottom line is that in three dimensions, specification of polarization as simply 'horizontal' or 'vertical' does not completely define the energy received by the measurement antenna, particularly when the reception is accomplished by use of a linearly polarized element," writes Dickinson in his paper, *CATV Leakage Aerial Surveys*, co-authored with his son, Edwin.

A series of possible solutions is being examined, including the possibility of using vertical and horizontal antennas simultaneously. According to Dickinson, procedures will be more adequately defined as experience is gained.

Bill Park and Collin McIntyre of Cablesystems Engineering found that there are four keys to developing good airborne measurement techniques. Selecting the proper type of aircraft, antenna, collection equipment and proper calibration of equipment.

They recommend:

- Using a reliable, simple to fly, high wing airplane with good downward visibility.
- Antenna placement should be such that the airplane is in a null point of the antenna. (In this case, a spar-mounted coaxial dipole was attached behind the airplane's tail section.)
- The collection package is designed for ease of shipping from point to point and ease of mounting in the plane.

In more than two years of observation of its systems, MetroVision has found that 200 leaks are generated in 500 miles of plant every quarter. "Leakage is like an appetite—we all have it, we just have to control it," said Victor Gates while delivering his paper, *CLI—A Total Proven Approach*, co-authored with Clayton Collins.

Starting an in-house leakage detection and repair program isn't hard, it just takes a lot of coordination, said Gates.

- MetroVision uses a team of existing personnel, including CSRs, installers, salespersons and technicians.
- Drive-outs are performed either on Saturdays or during slow times. A team drives eight miles of plant per hour for six hours.
- A practical schedule/calendar showing when certain tasks need to be performed is set up.
- Proper detection equipment is used.
- Signal leakage logs are maintained showing map number, leak level in dBs, estimated distance, who reported the leak and when and where the leak is located.

Interestingly, MetroVision noted that as leaks were detected and then repaired, service calls experienced significant declines. The program cost $2,600 per 100 miles of plant driven every quarter. However, a savings of $7,800 through reduced truck rolls (based on $30 per truck roll) was realized from the tighter plant, said Gates. ■

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Reader Service Number 24

The company displayed a working system in the Los Angeles Convention Center hall where 42 video channels were transmitted.

has not been much of a problem in the past but becomes a major stumbling block for CATV use (as prescribed by ATC). However, laser manufacturers are making steady improvements and Pangrac said he will probably be able to test some hand-picked lasers by the end of 1988, if not sooner.

For example, the prospect of receiving a large purchase order from ATC has spurred Ortel Corp. to improve its AM video system. The company displayed a working system in the Los Angeles Convention Center hall where 42 video channels were transmitted over 6.5 kilometers of fiber cable to a receiver and then shown on a TV. Direct A/B comparison between that signal and the signal provided by the convention center complex could then be made.

This new product, consisting of an analog transmitter and receiver and designated Model 5601A Broadband

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FIGURE 1

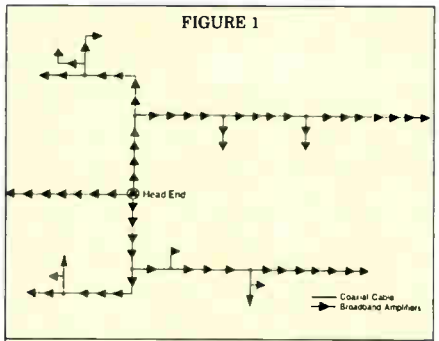
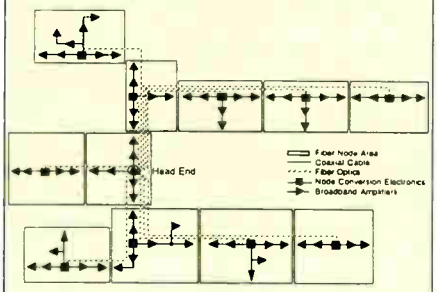


FIGURE 2



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Agile modulator parameters

Planning on using multiple frequency agile modulators in your headed? If so, you need to be aware of some performance parameters to make sure you're still delivering good quality signals, said William Woodward of Scientific-Atlanta.

With respect to spurious signals, it has long been recognized that they should be at least 60 dB below the desired video signal. But because spurious signals that can get into the output portion of the output converter are added together in agile modulators, a better spec to look for is 75 dB down, although the "acceptable" level depends entirely on the number of agile mods are to be used.

Thermal noise is also contributed from almost every agile modulator. It is important that the C/N spec not decrease as the output level decreases. ■

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Continued from page 38

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Perhaps indicative of the industry's overall reaction to the FCC's Cumulative Leakage Index rules, which go into effect July 1, 1990, a relatively sparse turnout showed up to hear a series of papers delivered on the subject.

What was missed was a valuable discussion of how leakage detection is performed, how to set up an effective leakage detection program and just how serious this whole subject is to the future of cable television.

Robert Dickinson of Dovetail Systems led off the program with a discussion of how aerial detection is performed. "There's a lot we don't know yet," he admitted, because the FCC has not specifically spelled out how to perform each and every necessary task. In fact, every flyover is a learning experience, and hardware and software are developed in an ongoing fashion, added Dickinson.

Using a single-engine plane with a horizontally polarized antenna attached beneath, the pilot flies a series of parallel passes, spaced nearly a half-mile apart, over the area covered by the cable system. A series of reports can then be generated to show the areas where leakage exceeds the allowable limit. The cable operator can identify the offending area within a few blocks and then locate the source of the leak with ground-based equipment.

However, receive antenna positioning may not detect all leak sources. "The bottom line is that in three dimensions, specification of polarization as simply 'horizontal' or 'vertical' does not completely define the energy received by the measurement antenna, particularly when the reception is accomplished by use of a linearly polarized element," writes Dickinson in his paper, *CATV Leakage Aerial Surveys*, co-authored with his son, Edwin.

A series of possible solutions is being examined, including the possibility of using vertical and horizontal antennas simultaneously. According to Dickinson, procedures will be more adequately defined as experience is gained.

Bill Park and Collin McIntyre of Cablesystems Engineering found that there are four keys to developing good airborne measurement techniques. Selecting the proper type of aircraft, antenna, collection equipment and proper calibration of equipment.

They recommend:

- Using a reliable, simple to fly, high wing airplane with good downward visibility.
- Antenna placement should be such that the airplane is in a null point of the antenna. (In this case, a spar-mounted coaxial dipole was attached behind the airplane's tail section.)
- The collection package is designed for ease of shipping from point to point and ease of mounting in the plane.

In more than two years of observation of its systems, MetroVision has found that 200 leaks are generated in 500 miles of plant every quarter. "Leakage is like an appetite—we all have it, we just have to control it," said Victor Gates while delivering his paper, *CLI—A Total Proven Approach*, co-authored with Clayton Collins.

Starting an in-house leakage detection and repair program isn't hard, it just takes a lot of coordination, said Gates.

- MetroVision uses a team of existing personnel, including CSRs, installers, salespersons and technicians.
- Drive-outs are performed either on Saturdays or during slow times. A team drives eight miles of plant per hour for six hours.
- A practical schedule/calendar showing when certain tasks need to be performed is set up.
- Proper detection equipment is used.
- Signal leakage logs are maintained showing map number, leak level in dBs, estimated distance, who reported the leak and when and where the leak is located.

Interestingly, MetroVision noted that as leaks were detected and then repaired, service calls experienced significant declines. The program cost $2,600 per 100 miles of plant driven every quarter. However, a savings of $7,800 through reduced truck rolls (based on $30 per truck roll) was realized from the tighter plant, said Gates. ■

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Reader Service Number 27

Another key component critical to the success of ATC's project is the development of an interface device.

Continued from page 40

carrier-to-noise of 4.8 dB to 5.7 dB, said Perry Rogan, ATC's senior CATV project engineer. That's critical because early investigations into delivery of high definition television over cable have shown that present day signal levels will likely need to be improved at least 5 dB or 6 dB to adequately deliver enhanced definition pictures to the subscriber.

Another key component critical to the success of ATC's project is the development of an interface device at the receive end—where fiber and coax technologies come together. It is at this point where light energy must be converted to RF for delivery to consumer electronics in the home. Synchronous Communications showed a prototype model of its line-mounted Terminal Distribution Receiver designed to receive up to 60 AM channels or 50 FM channels.

Dubbed Model TDSR, the new unit contains up to three AM-1000 dual optical receivers or combinations of AM-1000s and FM-1200s. Up to 10 channels per fiber can be received, according to Al Johnson of Synchronous. The unit is housed in a rugged metal housing that is similar, yet different, to a standard CATV amplifier mainstation.

Catel Telecommunications showed its Transhub device, a low-cost FM-to-AM conversion device that was originally announced at last year's Western Show. A single-channel conversion is accomplished using just one printed circuit board; a 48-channel hub location can be accommodated in one rack at the price of about $1,000 per channel, said Catel's Wendell Woody.

Corning Glass Works, looking to cash in on industry excitement over fiber, exhibited for the first time, sharing its booth with PCO, a FM hardware manufacturer. Corning's booth showed how robust fiber cable is by submitting a length of cable to a variety of mechanical and environmental tests and simultaneously delivering a studio-quality signal through the fiber cable. Traffic and interest in fiber products was very high, according to Susan Klinger, Corning's business public relations supervisor.

PCO was on hand to make operators aware that it too can design and build a fiber system to meet CATV demands. According to Robert Walker, PCO's vice president of marketing, PCO has no plans to market directly to MSOs, it intends to approach other system manufacturers instead. "We're positioning ourselves to be a major player, but we're not marketing directly to the operators," Walker said.

PCO, which is 80 percent owned by Corning, presently builds single-

Reader Service Number 29

Fiber optic technology even found its way into traditional cable television suppliers' booths as well.

channel, studio-quality systems. "But there's no real trick to making a multi-channel system," said Walker. Nevertheless, it's doubtful that the PCO logo will appear on much equipment that finds its way into a cable system headend, Walker added.

A new remote status monitoring system for frequency division multiplexed fiber transmission systems was unveiled by American Lightwave Systems. The SMS-1500 monitoring system, consisting of microprocessor based hardware modules, allows operators to monitor up to 100 remote installations from a central site via a single PC and real-time operating software, said John Holobinko, ALS' VP, marketing and sales.

The system identifies and reports soft or hard failures, pinpointing the

American Lightwave unveiled its status monitoring system.

fault by equipment location right to the actual module level.

Finally, fiber optic technology even found its way into traditional cable television suppliers' booths as well. Tucked away into an innocuous corner of the Scientific-Atlanta booth was an AM optical transmitting and receiving system. CATV signals were sent through 15 km of fiber cable and received at the other end for comparison with a standard coax system. S-A officials said the resulting picture was not perceived as better than coax, the demonstration showed that it can be done.

Although S-A officials downplayed the products (preferring to call them "anticipated" products) even to the point where they ignored the model

Scientific-Atlanta exhibited an optical receiver, but claimed it wasn't a 'real' product yet.

numbers assigned to them, the display was important in that it showed the MSOs that a traditional CATV manufacturer is poised to enter the fiber market. "We think it's important for cable operators who are considering the fiber alternative know that we'll be there to support them when the time comes," said Steve Necessary, S-A's distribution and subscriber system marketing manager.

Midwest CATV made a special point to mention the availability of fiber optic equipment during its press conference at the convention. Even though the splice case Midwest showed has been available for some time, the full-line supplier wanted operators to know that it has the equipment they need. "We can push in an area where there's a need," said Chris Sophinos, vice president. "We want to show that if an operator shows a need we'll go out and get what he wants. We'll act like a manufacturer."

So, for someone who has spent the better part of the past year reading technical papers and attending seminars devoted to fiber optic technology and exploring its promise, the 1988 NCTA National Show should be remembered as a watershed convention. For many attendees it was the first time they could get hands-on experience with a variety of viable products they may someday be putting in their headends.

—Roger Brown

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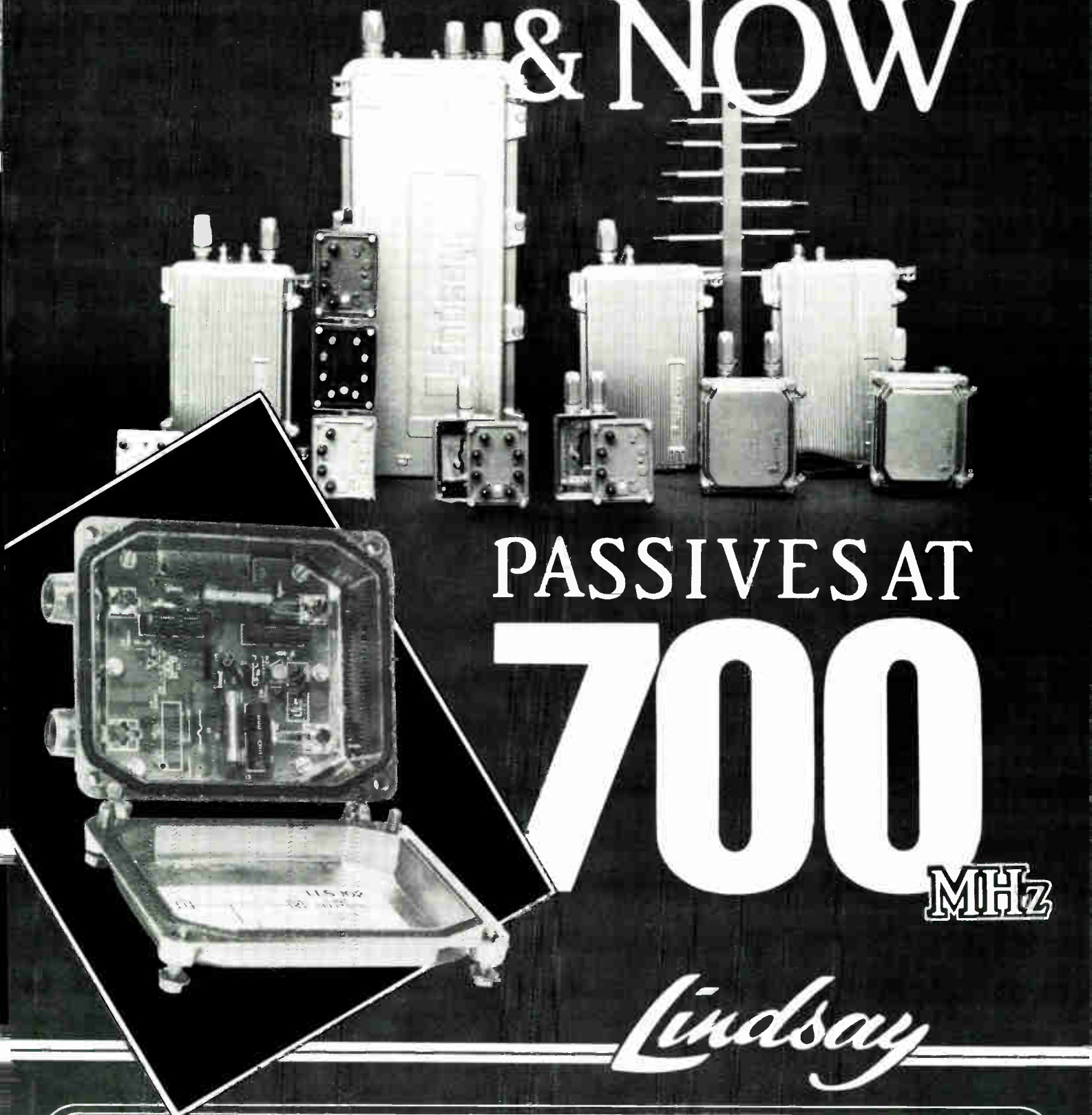

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Reader Service Number 31

CABLE '88 COVERAGE

High-quality audio: An idea that won't go away

At long last it looks like the cable industry is going to catch on to the idea of offering premium audio services. Carrying high quality audio over the cable system is not a new idea (remember Studioline?), it's just an idea whose time has come.

No fewer than three exhibits of digital audio were found on the convention center floor, including a portion of Jerrold's booth. But, right now, it appears that Digital Radio Laboratories and CD/8 from International Cablecasting Technologies will be fighting it out for market share later this year.

Both firms plan to offer multiple channels of compact disc quality audio that operate 24 hours a day without commercials, talk or other interruptions to cable headends for delivery over the coaxial system to subscribers' homes. The difference between the companies is in the technology they use, how many channels they plan to offer and timing.

It only took compact discs a few years to outsell albums as the consumers' primary music source. With almost 10 million disc players and more than 100 million discs sold last year, the popularity of the format cannot be doubted any longer. And ICT, for one, is counting on it catching on in an even bigger way.

Both DRL and ICT plan to uplink their signals to headends all over the country and then offer decoding devices—similar in size and design to a CD player—to consumers directly. The in-home units are connected to the incoming cable and then to the home stereo equipment for amplification and output. The decoders are expected to be priced in the $100 to $150 range, company spokesmen said. After that, subscribers pay an additional monthly fee to receive the programming.

ICT, which exhibited in a small, hidden booth at the 1987 Western Show, had an impressive display this time. Attendees were asked to don infrared headphones and walk through the maze-like booth, where programming from eight different channels were delivered over small transmitters. So, depending upon where a person was standing in the booth, different music formats were available on the headphones.

ICT's DM-100A may get a darker outer case in the next version.

Also on display was ICT's prototype in-home decoder. The sleek, low-profile unit had a power button and nine

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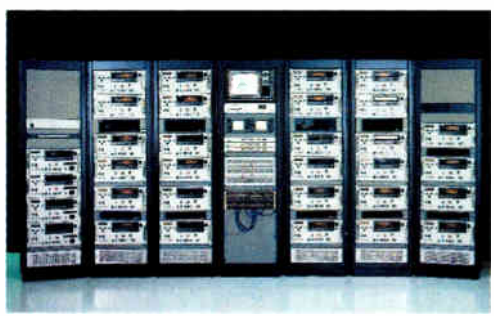


Reader Service Number 33

ICT also showed up in Los Angeles with an agreement from Tele-Communications Inc.

selection buttons on the front of its light-gray outer case. ICT officals said the final color of the decoder will probably be much darker in order to complement present in-home stereo electronics.

ICT also showed up in Los Angeles with an agreement from Tele-Communications Inc. to offer the service in several of its systems representing about one million subscribers. The actual systems will be announced later.

DRL, on the other hand, exhibited in a small booth and displayed little more than its prototype decoder/receiver. The black-faced unit contains a graphics/text generator which connects to the TV to display information to the listener/viewer about the music being played. As channels are changed, the graphics display artist, composer, title, album label and liner notes for each selection, said Norm Hogarth, president of DRL.

—Roger Brown

Ways to improve system reliability

"Six months ago nothing even looked hopeful. Today we have devices that will do the job," says Catel's President James Hood. He's talking about tools to take fiber-delivered video all the way to the home. Catel, among others, has announced plans for technology to do so in evolutionary steps and updated company plans at the show. TransHub I is the company's backbone distribution product that gets signals out from the headend about seven to 10 miles. Initially, "we're seeing 10 to 20 fiber hub architectures," Hood says. "The next step, TransHub II, will take fiber deeper into the system and handle about 1,000 subscribers per hub. Finally, we plan to offer technology to carry video all the way to the home on optical fiber."

TransHub I requires an enclosure of some sort to protect it from the elements. TransHub II will be designed for pole mounting.

The debate over modulation schemes (AM versus FM) likely will grow heated soon, but Catel actually thinks it is a non-issue. "FM is good for optical repeating while AM isn't so good for branching. Ultimately we see going AM to the home because it just makes more economic sense. We'll use FM where it makes more sense as well."

How soon will fiber-to-the-home systems be ready to ship? "In three to five years," Hood suggests. That drop will carry "60 to 80 channels and be consumer friendly." Of course, such a system also will require a laser and detector per home so prices will have to fall by orders of magnitude. "Today one laser costs $10,000. It needs to be in the $100 range before fiber-to-the-home makes economic sense," Hood says.

So can it be done? Hood is optimistic. "We've looked at passive optical switching using prisms to handle tiers and technically we should be able to do so rather cheaply."

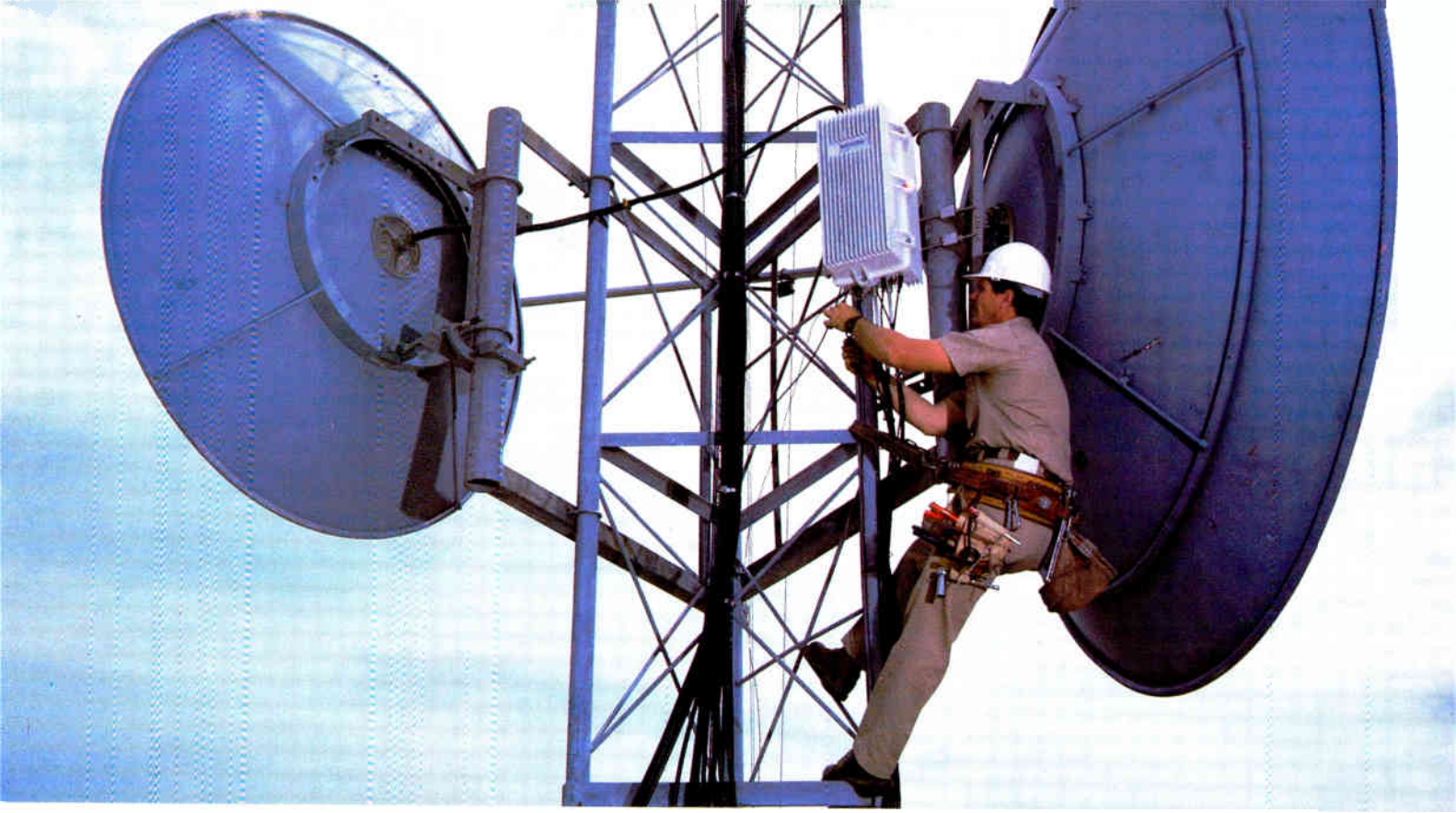
TransHub delivers 16 to 40 channels per fiber to distances of 40 kilometers without repeaters and to 1.5 GHz bandwidths. The system uses FM for trunking and then converts signals to AM for distribution over coaxial cable.

New system architectures

ATC's Jim Chiddix, senior vice president, engineering and technology, has probably done more than any other single individual on the operator side of the house to push fiber optics forward as a CATV technology. Here are a few of his thoughts. "I have to assume that 10 years from now fiber will be deeply penetrated into the local loop. That's disturbing for us," he said. "The telcos are talking about video-on-demand switched to the home from anyplace in the nation. They'll deliver clean, reliable video, probably in an HDTV format."

The issue, as Chiddix sees it, is simple. "Right now we control the delivery system. The Bell operating

Continued on page 52



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CABLE-TEC EXPO '88 COVERAGE

New products ro out in Los Angeles

As in years past, the 1988 NCTA National convention was highlighted by a number of new product announcements. What follows is a listing of products unveiled by a number of CATV suppliers, listed in alphabetical order.

Anixter Communications

The full-line CATV supplier demonstrated the recently-introduced CR-83-V volume control converter with switchable output channels. The 550 MHz converter with remote features last channel recall, volume control, audio mute, favorite channel memory and parental control. Either channel 2/channel 3 or channel3/channel 4 can be selected for the output channel.

Call (312) 677-2600 for more details.

CATV Data Link

A computer bulletin board service dedicated to the cable industry was announced at the show. The service features electronic mail, material listings, career opportunities, technical talk, systems for sale or wanted to buy, and more. It was developed by cable veteran Tony Jones and will be based in Laguna Hills, Calif.

Membership is open to anyone in the industry. For information or to request membership, contact Jones, 23151 Alcalde Drive, Suite B-1, Laguna Hills, Calif. 92653, (714) 837-3038.

CableData

The new Tandem 3107 Disk Controller was on display in the huge CableData booth. The new controller reportedly improves the sorting performance of the Tandem TXP from 150 percent to 300 percent, the company said. A trade-in program is offered through Sept. 1 to all systems using Tandem controllers other than the 3107.

The company also debuted ADSERT Services, a program that "fills" the pre-paid postal ounce of subscribers' bills with national advertising inserts. The service is designed to produce revenue for the operator by offering products and services to consumers.

For info, call CableData, (916) 636-4500.

Cable Converter Service Corp.

Automatic test equipment that troubleshoots and diagnoses defects in cable converter digital addressable boards (DAB) was announced by CCS. The MPT-1000 is reportedly the first in a series of automatic test systems designed by CCS.

The system consists of a menu-driven computer and monitor, printer, keyboard and personality modules specific to various brands and models of addressable converters. The unit, which is priced at $70,000 is being marketed to converter repair houses, MSOs who do their own in-house repair and converter manufacturers.

According to Pete Morse, a consultant to CCS, the unit eliminates the need to purchase expensive digital boards and brings converters that were considered to be irrepairable back into inventory, usually for about $10.

Call (812) 829-4833 for details.

Cable Security Systems

The new Beast II apratment box was introduced by Cable Security Systems. The new box features a self-locking lid designed to make the high-security line tech-proof as well as vandal-proof. For info, call (205) 821-0745.

Cadco Broadband Communications

The Color Weather Radar system receives real-time National Weather Service radar picture, satellite cloud cover picture and forecasts via FM radio subcarrier and displays animated weather movement by displaying timed sequences of stored information. The system reprocesses the signals for broadcast on a cable system through a standard modulator.

The system may be used as a stand-alone channel, in conjunction with a local origination channel or as a local ad channel.

The unit is priced at under $6,000 and is rack mountable. Call (214) 271-3651 for information.

CaLan

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Continued on page 53

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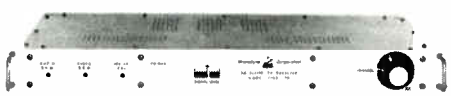

Since its introduction in 1984, the 1100 LPR LNA-type 4 GHz satellite receiver has become the reliable work horse in cable systems across the country. The LPR's single conversion, 24-channel frequency synthesized tuner has a stability of ±.001%, and its less than 8 dB threshold level delivers excellent performance, even in weak signal areas. It is also compatible with the VideoCipher™ scrambling system.

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Reader Service Number 37

The objective is to break a single tree-and-branch system up into many smaller systems.

Continued from page 48

companies could change that." Today, the only players with broadband capability to the home are in CATV. Chiddix recommends the industry not dawdle on changing the traditional CATV architecture to provide better reliability and signal quality, primarily by drastically cutting the length of a typical amplifier cascade to two. "The shorter system is simply more forgiving; more tolerant and flexible," Chiddix argued. "Shorter systems also offer the chance to feed different nodes with different signals. Not every subscriber in every part of a franchise has to get the same menu."

The objective is to break a single tree-and-branch system up into many smaller systems. Not just for the operating advantages, however. The strategic advantages are more important.

What about DBS? "DBS will be more reliable and provide higher signal quality in the future. But, long term, telco competition is the issue," Chiddix argued. "We need to compete in voice, video and data."

"For $20 to $30 a sub, including fiber and the electronics, we can build a fiber backbone network. That's a lot, but it's not overwhelming. The point is, one day the regulatory barriers to telco entry will fall. We have to be ready. Still, telco fiber to the home will be glacial in pace. Our job is simply to stay ahead of the glacier."

More reliable power supplies

Transformerless switched-mode power supplies are capable of efficiencies exceeding 90 percent but have been seen as susceptible to high-amplitude transients and surges, said Magnavox Senior Engineer Peter Deierlein. These can be controlled using standard clamping devices. And low-amplitude voltage surges common in CATV environments can reach more than 120 volts for periods exceeding one second. Not to worry. It's possible to build a high-efficiency, transformerless power supply that can take and store surge potentials in excess of 400 volts DC, Deierlein said. "Since the surge energy may then be passed to the load rather than being interrupted or dissipated by a clamping device, the power supply is inherently more rugged and reliable, and service interruption due to blown fuses and damaged power distribution equipment is much less likely."

The point is that transformerless, switched-mode power supplies can be designed to operate under the most critical conditions encountered in the CATV environment. Compared to conventional power suplies, SMPS units "have considerably lower dissipation under normal operating conditions and far lower dissipation under surge conditions," Deierlein said.

—Gary Kim

The new Li'l Ben Clock Controller is a low-cost, seven-day programmable controller.

Continued from page 50

for the Model 1776 Integrated Sweep Receiver/Spectrum Analyzer were announced. The unit now can make semi-automatic carrier levels measurements, automatic C/N measurements in addition to measuring hum modulation, cross-mod and FM deviation.

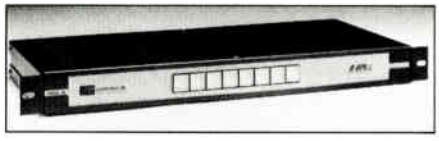
In addition, the Model 1776-1 sweep unit includes the above-mentioned measurements plus internal calibration reference, internal 20 dB pre-amp, an IBM/Epson compatible printer screen dump and independent carrier analysis. Call (717) 828-2356 for information.

Catel

A new frequency agile modulator was shown by Catel. The ATM-1500 is agile from 54 MHz to 450 MHz, features front panel selection and a positive lock to avoid accidental channel changes. SAW filter usage and spurious signal control (better than 60 dB below video) allows for adjacent channel operation.

A separate 4.5 MHz input allows for BTSC stereo encoding.

Call Catel for details, (415) 659-8988.



Channelmatic's new '8-ball' signal switcher.

Channelmatic

A series of new products was announced by Channelmatic. The new 8-Ball is an instrument-grade monitor switcher designed to simplify signal monitoring.

It offers electronically controlled vertical interval switching, stereo audio capability and front panel switches with gold contacts, long-life bulbs and field legendable caps. The unit is priced at $750.

A new series of random access ad insertion systems, called the ADCART 1+1, ADCART 2+2 and ADCART 4+2. Fully automatic two-channel stereo ad insertion is possible with the 2+2 and 4+2.

Also new is the Broadcaster II, which now can function as an automatic cassette duplicator. It is designed for use in educational facilities, teaching hospitals or small cable operators.

Finally, the new Li'l Ben Clock Controller is a low-cost, seven-day programmable controller designed for application in cable headends to automate switching between several services that share a single channel. Eight outputs can be individually programmed to turn on/off up to 100 times.

For details on any or all of these products, call (619) 445-2691.

Holly Anne announced that it has signed a contract with the National Weather Service.

High Resolution Sciences

This newcomer to the industry has developed hardware it says will correct chroma-crawl, improve vertical resolution and correct aliasing. The equipment is entirely compatible with NTSC signals and is available today, a company spokesman said.

Dubbed HRS CCF, the small rack of equipment is placed at the source of signal transmission to improve the picture. Premium program services (HBO and Showtime, for example) and cable operators have been targeted as initial licensees. The technology is also being made available for use in camcorders and computer monitors to improve resolution.

Call (213) 463-9000 for details.

HollyAnne Corp.

This Nebraska-based firm announced that it has signed a contract with the National Weather Service and United Cable of Bellevue, Neb. to place its Safety Alert Monitor (SAM) warning system in subscribers' homes. The unit, which is about one-third the size of a cable converter, is linked through the headend to the NWS. When an emergency situation arises, subscribers are warned audibly and visually.

The units are being offered to cable operators at no cost for rental to subscribers. Subscribers will pay $2.95 per month for the service and alarm device. So far, 12 systems serving about 40,000 subs have signed on, said a company spokesman.

Call (402) 397-2002 for details.

ISS Engineering

The new Series II Plus frequency agile modulator was announced by ISS. It offers expanded output to 550 MHz without the need for comb generators or modifications to meet FCC requirements. The microprocessor controlled unit is available in all frequency formats.

Also, a new computer driven test modulator was shown. The GL2610XT II/PC, designed for use in testing and aligning converters, allows manual step tuning by computer. For details, call (415) 853-0833.

Leaming Industries

A new, low-cost stereo generator was announced by Leaming. The MTS-3 generates a BTSC stereo composite multiplex signal from left and right baseband audio inputs and a video sync-locked pilot signal.

A Bessell-null deviation test tone is built-in to ensure accurate setup. All major controls are located on the front panel and a peak limiter is included to protect against overmodulation. Typical stereo separation is greater than 30 dB and frequency response is 20 Hz to 14 kHz. The unit is priced at $990 ($1,090 with 4.5 MHz baseband output).

Also new are the SAP-1 and SAP-2 second audio program generators. Both are designed to encode a mono signal into the BTSC format. SAP-1 can be used with virtually any stereo generator; SAP-2 works specifically with Leaming equipment. For information,

Continued on page 58

How to prevent service calls

Fritz Baker, regional manager of engineering with Viacom Cablevision, presented a paper that focused on how to prevent customers from calling for service.

By using fairly simple procedures and pre-existing CableData software, the company realized significant decreases in customer complaints, downgrades and disconnects in its Nashville system.

Billing system data can usually identify why customers called, what was done on a service call, which employees were involved and which areas of plant have the highest percentage of service calls. The latter can be particularly important when examining rebuilding costs.

The billing system breaks out portions of the physical plant into "management areas." These areas can be by franchise, tax codes, ZIP codes, mail routes, cities, etc. Often these divisions fall along sales territory lines. Whatever the divisions, "the smallest division is the most helpful for tracking service calls," said Baker. Ultimately, if one could set up a system from scratch, the best way would be to make the divisions "equate to customers fed from a trunk amplifier," he added.

By providing an on-line visual display of pending service calls sorted by management area, CableData's data also enables Viacom to consolidate service calls to given areas. And by displaying a "problem code" assigned to various service requests, most system problems (vs. non-system problems, i.e. chewed cable, bad remote) can be localized and fixed in one call. Then, after a problem is corrected, related customer complaints can be addressed from the office through phone calls. The Nashville system reduced Viacom's "No Problem on Arrival" calls 80 percent by doing this, Baker said.

Another effective method of reducing service calls is to maintain and analyze converter histories. In addition to the billing information supplied to the Viacom Nashville system, they maintained their own records through stickers inside the converter. This allowed them to see trends and problems.

The 'F-connector'

The "F-connector" is the most widely used part in a CATV system, and the most troublesome, said Donald Dworkin, special projects engineer at United Artists Cablesystems. When trouble calls are analyzed, anywhere from 25 percent to 90 percent of all repairs are classified as loose connectors.

This is because there are "widely varying instructions" pertaining to the exact length to which the center conductor should protrude from the male connector. "These range all the way from slightly below flush to 1/16th of an inch above flush...," said Dworkin. "Obviously, only if the center conductor is long enough will it penetrate the spring contacts' closure and establish a reliable pressure contact," he said.

Preventive maintenance

As a rule, most preventive maintenance programs at CATV systems are confined to "signal sweep response"

Common myths of agility

by John Coiro

There are many common myths about agility and its "limitations" in Cable TV applications. While many of these myths were true at one point in time, technology has taken agility beyond its earlier limitations.

Spurious beats. *"Agiles throw beats all over your system."* Development and implementation of better convertors and better alignment techniques have made "beats" an unheard of complaint at ISS. Of all QC reports for the last six months beats have not accounted for a single rejection.

Carrier to noise. *"You can't stack agiles without C/N eating your lunch."* True, it is a known fact that a broadband hybrid outputs a low level noise on the unmodulated bandwidth, and the summation of these "noises" will pull your C/N to an unacceptable level. However, rather than a) pretend the problem does not exist or b) go elsewhere and use an inflexible technology, we have opted to do something unheard of in the industry...work with the customer. If you are going deeper than four channels, ISS will provide at no cost the filtering necessary to exceed the NCTA spec of a C/N of 60 dB. In fact, this filtering allows C/N of better than 90 dB out-of-band. The C/N actually becomes unmeasurable on most test equipment found in CATV systems.

Why buy agile, my system lineup won't change. True, and pressure taps are good enough and 220 MHz is all the bandwidth needed for cable. Literally hundreds of firms and individuals are reaping fortunes in the sale of surplus equipment annually. This surplus is simply because system needs and lineups DO change. This change, sadly enough, occurs before a piece of equipment has lived its useful life. This only serves to increase the real cost of equipment.

Another key factor for both the customer and manufacturer is that the Cable TV version of Mr. Murphy's Law states that *"Regardless of the channel desired, there will be a six-week lead time before that item is manufactured and in stock."* With agility there is no need for a manufacturer to forecast what channels to build for the next production and any channel you might need is available with a simple selection of a dip switch. If someone needs a channel W and inadvertently orders a "WW" there is no panic, no restocking charge and no lead time. You simply retune, via a dip switch, from WW to W.

Stability, offsets, scramblers and the FCC. *"Brand X says that the only way to get required stability in hyperband is to buy special outputs and a comb generator"* or that *"Special charges apply for your offset requirement,"* or *"To get the offset you need, we offset the IF and your scramblers won't work."* We have been able to offer as a standard specification ±5 kHz stability from 2 through WW. But this is only a specification and not to be believed. In actual measurements in the field and in QC the ISS modulator averages ±3 kHz throughout the entire bandwidth. Offsets are a user selectable option with ISS. You can choose 0, plus, or minus in 12.5 and 25 kHz. In offsetting, you do not lose standard IF frequencies. The ISS modulator offsets via microprocessor control, not by shifting the IF frequency. In fact, ISS agile equipment meets all FCC requirements through 1990.

HRC, IRC or T channels. *"You just can't get agiles for these requirements."* Because of microprocessor control, all of these are available (even in the demodulator) with a whopping one-week lead time and $150 option charge.

Reliability. *"The technology is too new and they just won't work for more than a month."* In fact, the technology used for agility is not new; it has been proven in other markets but is now being applied to Cable TV. The reliability of ISS agile modulators allows us to stand behind them with a **full three-year warranty**.

Most sweep systems create picture problems by interfering with TVs, VCRs and decoders.

and their attention is directed to the headend, trunk system, power supplies and amplifiers, said Ian MacFarquhar with CUC Broadcasting Ltd. "System sweep—both high and low level—and amplifier level balancing, are the most common forms of electrical preventative maintenance with system test point monitoring being the normal method of assessing a system's performance," he said.

But there are three major problems in relying exclusively on system sweep for PM work. Sweeps can overlook problems that either are or will soon affect picture quality (small cracks in sheaths and loose connectors generally aren't easily recognizable). Generally speaking, current practices are to sweep only the trunk lines. According to MacFarquhar, most cable systems have, three to four times more distribution plant than trunk... (and) the shear volume of plant makes complete system sweep impractical.

Finally, most sweep systems, create picture problems by interfering with TVs, VCRs and decoders. The recurring "blip" causes some units to lose lock and create broad bands in the picture; which does not create a favorable impression on subscribers

Cable systems should approach the problem in a series of waves with ever-increasing threshold levels of leakage being sensed, he said. For example, the first pass might use a leakage threshold of greater that 100 uV/m. The second might reduce the threshold to 75 uV/m, and the third to 50 uV/m.

Keeping records

The importance of maintaining and using accurate records cannot be understated, said Larry Richards of Magnavox. Six ground rules to use follows:

The entire record-keeping system exists to track both trouble calls and PM work, with a goal of reducing the number of trouble calls.

Think of the types of information that would help you attack problems, then make up forms that ensure the information gathered will be useful to you and is gathered in groupings convenient to use.

A sincere commitment to preventive maintenance and record-keeping must be felt throughout the operation.

Force yourself to maintain and use the records.

System records can be maintained without increasing staff—if a system is appropriately staffed to begin with and that staff is wisely allocated.

With or without a computer, you should keep a master hardcopy of your records, warns Richards. And never let that copy find it's way out of your office.

—Greg Packer

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We recently asked our first ADCART customer what he thought of his new ad insertion system. His immediate reply was *"AWESOME!"* His was a typical reaction among those who've seen the ADCART in operation, especially after having grown accustomed to other manufacturer's systems.

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■ **ALL NEW DESIGN.** The ADCART is not one of your run-of-the-mill, me-too, Johnny-come-lately copies of some existing system. In fact, it is new from the bottom up, and it has virtually every worthwhile feature offered in any ad insertion system today. It's state-of-the-art software running on state-of-the-art hardware; the latest 16-bit CMOS microprocessors and real-time, multi-tasking software developed by experts in advanced traffic and scheduling concepts. Add to that a host of all-new features, combined with a low, low price, and you get a system that will knock even the best competition right on its tail.

■ **GREAT SOFTWARE.** With the ADCART, everything you need to easily set up and program a random-access schedule is integrated into the software. From the very first screen you'll see on the CRT terminal, plain language will guide you to the next logical step; simple English prompting natural program flow. Our tape-encoding and traffic and billling software flows just as naturally. The system's architecture was designed from the outset to simplify user-training and to make life easy for the operator.

Just imagine having up to 75 auto-prompting screens to assist your operator in programming, and up to 200 additional color screens designed to facilitate traffic and billing functions. Then add 35 more screens that direct the simplest tape encoding in the business. Your ad insertion people will love you. . . and so will your accountant.

■ **SUPER FLEXIBLE.** Flexibility is synonymous with ADCART. Insert on virtually any number of channels. Assign VCRs to fit your avails: two on two channels, four on one channel, or four VCRs between two channels. . . without overlapped avails. You'll even have an auto-record capability, which has already made the ADCART the de facto standard in new interconnect design.

■ **SMALL STUFF.** The ADCART has many other features, some of which you probably never thought about. To name a few: stereo audio, with computer-controlled audio-level matching; TBC-switching; stereo simulator inputs; super-capacitor memory backup; non-volatile memory for system configuration data; and premium plug-in interface connectors to simplify installation and maintenance. Add to this an award-winning electronics package and numerous other features and you have the best cost-benefit ratio in the business. . . *by far.*

■ **DON'T WAIT.** If you're thinking ad insertion, take a close look at ADCART before you buy. If you don't, you'll hate yourself once you see one operate. Even if you have a system now -- regardless of the brand -- you owe it to yourself to look at the ADCART. Looking doesn't cost you a cent, but relying on outdated equipment can cost you plenty.

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Reader Service Number 41

The recognized leader in ad insertion. More than 4,500 channels in operation.

Further proof that videotape isn't the only medium CATV has to rely on was found in Pioneer's booth.

call (714) 979-4511.

Magnavox CATV Systems

A new power supply and on-line monitor was added to the Magnavox product lineup at the NCTA Show. The power supply, dubbed 8 PS HE, is said to be 90 percent efficient, which will save operators power costs.

Meanwhile, the MLM line monitor is the first stand-alone remote spectrum analyzer, according to Magnavox. The unit monitors all carriers in a broadband system and warns the operator when signals deviate from the desired levels. Frequency response, peak-to-valley and actual amplitude of carriers between 40 MHz and 550 MHz are monitored.

For details, call (800) 448-5171 or (800) 522-7464 in New York state.

Midwest CATV

This full-line supplier made a number of announcements in Los Angeles. First, the company's national headquarters has been moved to a larger facility. It is now located at 1012 Kanawha Blvd. East, in Charleston, W.Va. 25301. Also, a new distribution center was opened near Philadelphia to serve the Northeast. It is located in Pottstown, Pa.

Exclusive agreements with both Power Guard, a power supply manufacturer, and Trilogy Communications, which manufactures coaxial cable. In both cases, Midwest will be the only stocking distributor for each company's full product line.

Finally, a test of the Matrix System, an outdoor addressable trap system, showed that the product passed environmental tests in temperature ranges from -50 degrees Fahrenheit to 150 degrees Fahrenheit. The unit, which is manufactured by Syrcuits and distributed by Midwest, is slated for Beta site testing in an unannounced location in July.

For information, call (304) 343-8874.

Pioneer Communications

Further proof that videotape isn't the only medium CATV has to rely on was found in this company's booth. A demonstration of a videodisc-based ad insertion system was shown. The laser-based system has longer life than tape, doesn't deteriorate and has random access capability. Any one of 60 30-second spots can be queued and ready within two seconds.

The LD/VS1 video system consists of a video controller and touch-screen monitor. Also, two LD-6000A videodisc players and the LC-V33 autochanger are part of the system.

With the autochanger, 72 full-length films (or 148 hours of programming) can be stored and accessed as needed. So, a cable operator could program his own movie channel, complete with insertion capability, the company spokesman said.

On a more traditional front, the BC-4500 basic converter with volume control was introduced. It includes a larger and better-labeled remote control unit. Besides volume control, audio mute is included as is a sleep timer which can be set in 30-minute increments. That unit joined the BC-6000, Pioneer's most advanced converter, as the newest members of the company's product line.

Call (201) 327-6400 for details.

Qintar

The new "Top Switch," an A/B switch with top-mounted push button switches, was introduced. The new switch, dubbed TAB-2, boasts 95 dB isolation, heavy duty construction and heavy silver-plated contacts for reliability. Call (800) 252-7889 for information.

Texscan Instruments

Texscan introduced its new MDC-5 portable microwave block converter.

A new, two-band portable microwave block converter was announced by the Indianapolis-based firm. The MDC-5 converts signals in the TVRO and AML/CARS bands down to the VHF/UHF region of 200 MHz to 700 MHz to allow viewing of microwave signals on any 1 GHz spectrum analyzer.

The new unit covers 3.7 GHz to 4.2 GHz and 12.7 GHz to 13.2 GHz in two separate bands and replaces Texscan's MDC-3 downconverter. Call (800) 344-2412 or (317) 545-4196 for info.

Times Fiber

A new product and a familiar product in a new package are now available from Times Fiber. The newly approved CATVX drop cable, which meets specifications laid out by the National Electrical Code, is now available.

From a new product standpoint, T6 trunk and feeder cable was announced. It is the only cable specified to consistently sweep to 600 MHz, according to Times. T6 features triple-bonding and full wall seamless construction for environmental protection, longer life and increased reliability.

For info, call (203) 265-8500.

TV Answer showed its interactive system. The prototype transmitter is on the right.

TV Answer

Presently awaiting approval from the FCC to increase the size of its test in Media General's Farifax, Va. system, TV Answer nonetheless is optimistic. Transmitters are now located in several hundred homes throughout the system and the company is seeking permission to increase the test bed to 6,000 homes.

—Roger Brown

Strongest link.

Your satellite receiver is the first link in the transmission chain. And one thing you can always count on—the headend signal never gets better than it is at the receiver.

Which is a very good reason to specify Standard's Agile 40 C/K Satellite Receiver—but it's not the only reason.

The Agile 40 C/K was designed from the ground up solely for commercial applications. So it has all the features cable operators need most: rock-solid 100 kHz PLL tuning and total flexibility for the most accurate C/Ku-band operation; 70 MHz IF with a front-panel test point to minimize terrestrial interference; and a power supply built for the demands of 24-hour-a-day operation.

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And because it draws only 32 watts maximum, the 40 C/K runs cooler, lasts longer, and saves money year after year. So you'll probably never need our five-year replacement/warranty program.

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SATCOM Division
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Los Angeles, CA 90009-2151
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In California (800) 824-7766

Reader Service Number 42

There's more than one way to IPPV success

The session on impulse ordering technologies dealt with making the buying decision on 'one-way' systems. Each participant addressed a different physical sized impulse system ranging from a relatively small local application to Telaction's nationwide program.

In the paper entitled, *ANI as a PPV Ordering Tool*, co-authored by Jefferson Corbett and Glynda Caddell of Business Systems Inc., the following highlights were pointed out:

- Automatic Number Identification (ANI) has provided the cable system operator with "an easy to use, low cost, 24-hour a day method of ordering" pay-per-view programming.
- ANI "can reduce the number of CSRs and business phone lines needed and provide cost effective "impulse" ordering without thousands of dollars of specialized equipment.
- Some "obvious" drawbacks to older ANI systems included: "a demanding response time requirement for the billing system; no immediate positive or negative feedback to the subscriber; no security from unauthorized use by children in the home; and no convenient method for selecting a specific converter."
- Improvements to existing ANI technology included the "addition of newer, faster, cheaper computers..., a more effecient programming language" and the telephone company's allowance of two different recorded messages (positive or negative) offered in response to the customer's call.
- In a test situation (with North DeKalb Cable TV) "customer support representatives reported that ANI was easily and readily accepted by subscribers formerly ordering by manual methods." After six months, the buy rate is up 300 percent.

Using the same technology on a wider scale presented some different problems, according to the paper, *Launching A Statewide ANI Passing Impulse PPV System*, co-authored by David Woodcock and Larry Moreland of Centel Cable. Centel tested IPPV in its Traverse City, Mich. system and came away with these thoughts:

- In order to expand the system to a statewide operation, it was necessary to make software modifications, or translations, in order to route the ordering call(s) differently, allowing them to be placed on a different set of trunk lines. This allowed the system to bypass the normal telco switching equipment and connect directly to the Science Dynamic Multi-Access Cable Billing System.
- After reaching the MACBS, both the called number (identifying the event) and the calling number (identifying the subscriber) are sent in an asynchronous ASCII data packet, via modem to the CATV company. A digitally synthesized voice then thanks the customer for the order and instructs him to hang up.

This network will be launched in eight systems throughout the state linked by multiport asynchronous data modems, currently used to carry billing information. Seven of the eight will have their own addressable controller, effectively breaking them into "separate, yet linked, individual hubs," allowing for most of the network to function even if part of it goes down, said Woodcock.

An additional imput to the controller will be used for the ANI data packets from the MACBS. The output of each MACBS will be sent to all hub controllers. When a given ANI reaches the controller and is unable to match with its own data base it is rejected.

"With the burden of sorting the ANI being placed on the controller rather than the MACBS, the same order number can be used by one MSO for all area systems," Woodcock added.

Viewer's Choice will be implementing a national 800 number for impulse ordering purposes, as explained in the paper, *The Application of National ANI to Pay-Per-View Ordering*, co-authored by Thomas Neville of Viewer's Choice and Matthew Miller of Viacom.

The national ANI service is accessible from any telephone in the country. It also provides cable operators with a turnkey ordering system with a simple customer interface. Another attractive aspect of the system is its relatively low capital investment of somewhere under $10,000 for the necessary downlink equipment.

The system has three key components: Order collection and acknowledgement, satellite uplinking and transmission of order data and downlink screening of order data.

Ordering is handled through customers dialing a series of 800 numbers during a locally defined ordering window. The calls are connected to a "mass announcement node" where customers hear a pre-recorded confirmation message. The customer's 10-digit phone number, as well as the additional four-digit code indicating program selection are then simultaneously transmitted via the AT&T network to the Viewer's Choice satellite uplink facility.

The data then moves along through an AT&T work group where it is time stamped and tabulated for transaction billing purposes. It then moves on for transmission via an uplink data conditioner and proprietary simplex data transmission protocol. All uplink hardware is fully redundant.

Each downlink receives data via a General Instrument downlink card. Data then proceeds through an AT&T customer screener. The screener is pre-programmed to select out orders originating from designated local area codes or exchanges.

The proponents of this system feel its benefits include: Nationwide scope; high capacity; ease and simplicity; low upfront costs; full automation; and turnkey installation and operation.

Robert Dattner presented his paper, *Wireless TV Viewer Response*, in order to explain how the TV Answer, over-the-air interactive system works.

The system is presently being tested in several hundred homes in Media General's Fairfax, Va. cable system.

The system essentially places a radio transmitter, "the TV Answer Box" in each subscriber's home. The box is then polled via data inserted in the forward video signal, just off screen in the overscanned television receiver.

The return pulses are timed to reach the central computer located at the headend or studio in a continuous stream. Boxes more distant from the receive antenna anticipate the delay and launch their pulses early. A numerical value proportional to the delay is stored in each box during a calibration cycle, said Dattner.

The major problem is allocation of necessary bandwidth.

—Greg Packer

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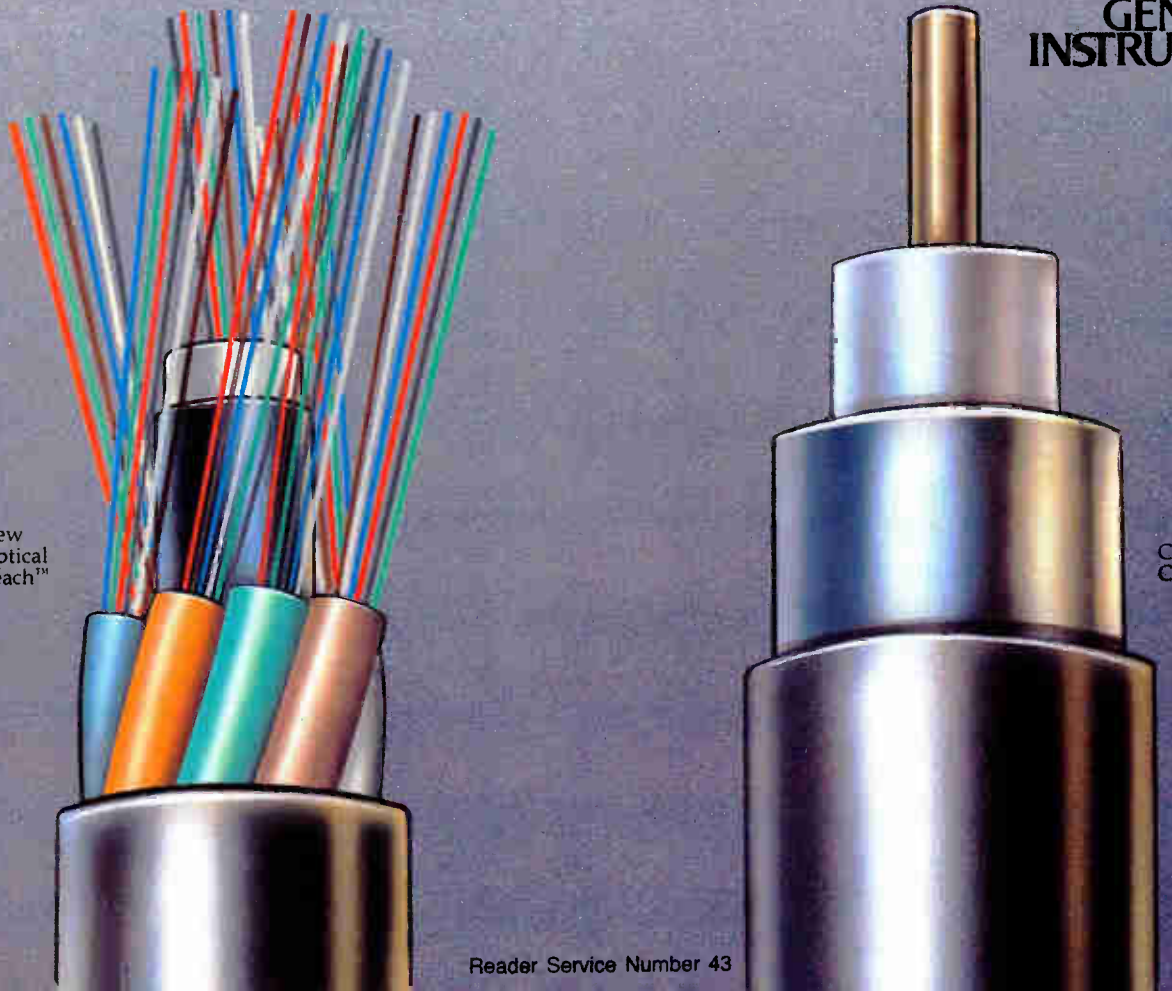
GENERAL INSTRUMENT



Advanced television systems

The first part of this article appeared in CED in the May 1988 issue and focused on a review of how the HDTV proposed production standard came about. This month's concluding article examines how several of the transmission proposals work.—Ed.

Part II examines the different transmission systems.

HDTV transmission

HDTV programs will be distributed via VCR, video disc, optical/electrical cable systems, DBS and terrestrial transmission. The most difficult will be terrestrial transmission because of standards and regulatory issues. However, it is my opinion that the terrestrial broadcasters will find a way to make significant improvements in the technical quality of their transmissions when the other distribution outlets begin using HDTV.

Will the technical standards for each of these media be the same? There may be advantages if they are the same, but it is not clear that they must be the same. Bandwidth is most limited for terrestrial transmission and compromises will be necessary. In audio systems, sound input devices (FM radio, AM radio, TV sound, LPs, CDs, reel-to-reel recorders, cassette recorders) vary widely but feed a common amplifier and speakers. Perhaps the consumer HDTV system will consist of a display driven by a frame store with multiple inputs to the frame store (NTSC, HDTV-VCR, HDTV-UHF).

Compatibility is a term that is often used and too oftem misused. I propose that we define levels of compatibility related to receivers. The highest level (Level 5) is represented by a system which allows HDTV transmissions to be received by an NTSC receiver and displayed as an HDTV picture. Although this seems absurd, the concept represents the highest attainable level of compatibility. The next lower level (Level 4) is represented by a system which allows HDTV transmission to be received by an NTSC receiver and displayed with the same quality as current NTSC transmissions.

Level 3 is represented by a system which allows HDTV transmissions to be received by an NTSC receiver and displayed with reduced performance when compared with the picture from an NTSC transmission—this was the situation when the United States added color to the black-and-white television transmissions. Level 2 is represented by a system which allows HDTV transmissions to be received and displayed by an NTSC receiver using a low cost adapter box—this was the situation when UHF transmissions first began.

Level 1 is represented by a system which requires a high cost adapter box, perhaps so expensive that consumers would prefer to purchase the new system. In the cases of Level 2 and Level 1, I assume that a new receiver can be designed to operate on both the current system and the HDTV system. Level 0 is the lowest level—and the only level which I would call non-compatible. It is represented by a system with which NTSC receivers cannot display HDTV transmissions in any form, even with adapter boxes, and new receivers cannot display an NTSC transmission.

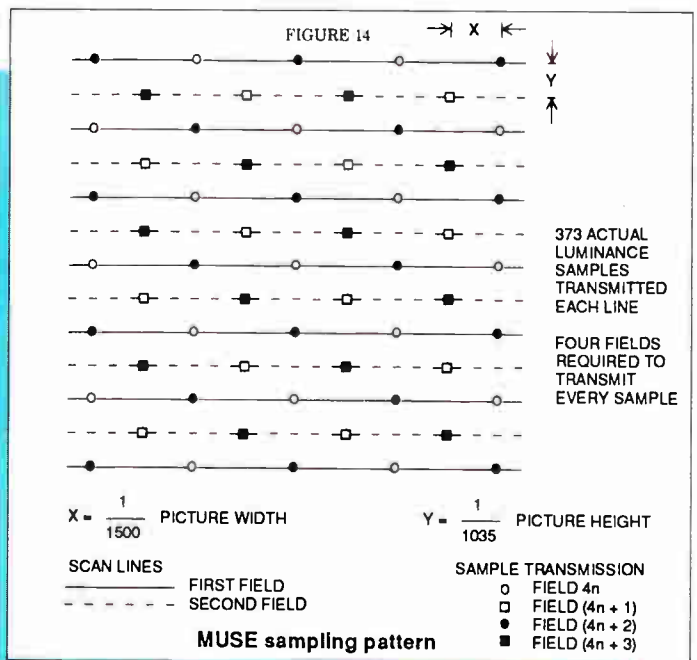
I believe that high performance HDTV transmission systems will have lower levels of compatibility. Also, I believe that high level compatibility systems will be lower performance HDTV systems. This must be acknowledged when making a decision. The trade-off is today's level of compatibility vs. tomorrow's level of performance.

CCIR Report 801 defines HDTV in comparison with current television systems as having twice the vertical spatial resolution, twice the horizontal spatial resolution, separate color-difference and luminance signals, improved color rendition, wider aspect ratio and multiple channel high fidelity sound. If one assumes these requirements for the transmitted signal, the bandwidth (BW) of the luminance signal becomes:

$$BW = (4.2)(2)(2)(16/9)(4/3)\ MHz = 22.4\ MHz.$$

The HDTV luminance bandwidth, compared to the NTSC 4.2 MHz luminance bandwidth, is increased by two factors of two because of the doubled vertical and horizontal resolution and by the degree to which the HDTV aspect ratio, 16:9, exceeds the NTSC aspect ratio, 4:3. Recognizing that 22.4 MHz bandwidth is required merely for the luminance signal—an additional bandwidth of 5 to 10 MHz would be needed for the separate color-difference signals and about 0.6 MHz would be needed for high fidelity digital stereo sound—it seems clear that the task of "compressing" this amount of information to fit within the current 6 MHz NTSC channel is difficult. Many organizations are searching

FIGURE 14



MUSE sampling pattern

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Reader Service Number 44

Eight proposals for HDTV transmission in the United States are examined.

for a transmission system which, in their view, represents an appropriate compromise in bandwidth, quality, complexity and level of compatibility. The compromises taken by any one organization may result in characteristics which do not meet the definition given above. In this paper, I do not intend to pass judgment on the compromises and will refer to all the proposals examined below as "HDTV transmission systems" since, in each case, HDTV program material is the input to the transmission system.

Eight proposals for HDTV transmission in the United States are examined:

1. MUSE proposal
2. Bell Laboratories proposal
3. CBS proposal
4. Glenn proposal
5. Del Rey Group proposal
6. North American Phillips proposal
7. Scientific-Atlanta proposal
8. NBC proposal

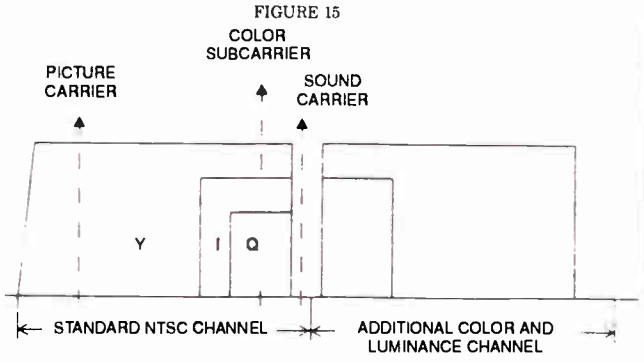
The proposals fall into three categories with respect to channel requirements:

A) one channel wider than current channels,
B) two channels with one channel carrying a "compatible" signal, or
C) one "compatible" current channel.

The MUSE proposal requires one channel, wider than an NTSC channel, and has Level 1 compatibility. The Bell proposal uses two NTSC channels where one channel has Level 3 compatibility and contains an NTSC signal. The CBS proposal is a two-channel DBS system which uses a MAC approach, rather than NTSC, for the first channel and thus has Level 2 compatibility with respect to NTSC receivers.

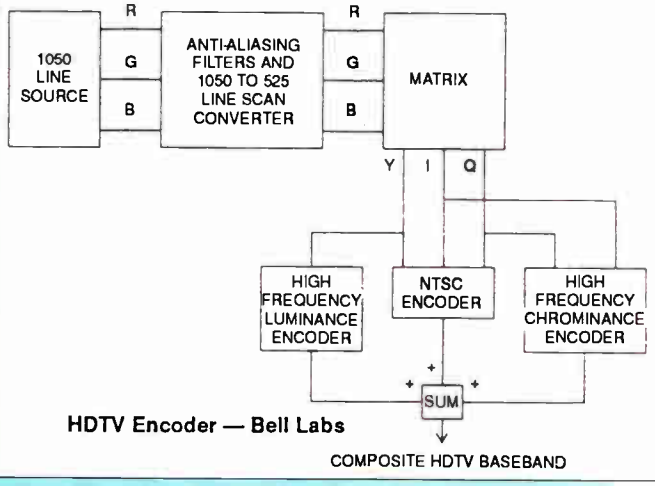
The Glenn proposal uses one NTSC channel and another low bandwidth channel. The first channel contains NTSC and has Level 3 compatibility. The Del Rey proposal requires only one NTSC channel and has Level 3 com

FIGURE 15



Transmitted spectrum — Bell Labs

FIGURE 16



HDTV Encoder — Bell Labs

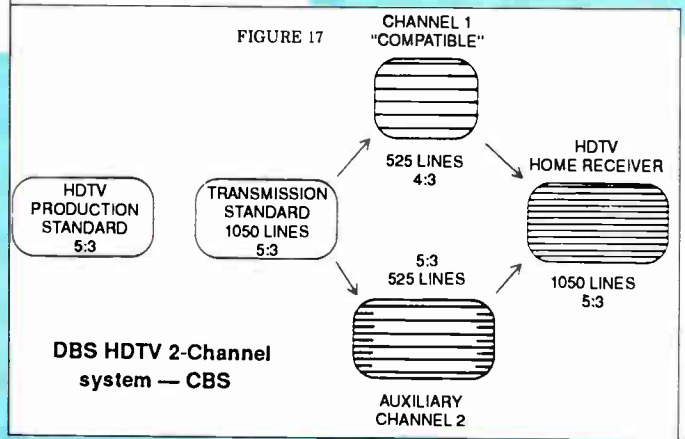
and has Level 2 compatibility. The NBC proposal requires one NTSC channel and has Level 3 compatibility.

MUSE proposal. Multiple Sub-Nyquist Encoding was proposed by NHK for DBS HDTV transmission. The signal is derived directly from the 1125/60 studio system. The luminance and color-difference signals are band limited then sampled. One out of every four samples is transmitted each field, and after four fields, every sample is transmitted. During each line 373 actual luminance samples are transmitted. The minimum horizontal spacing of samples is about 1/1,500 of the picture width. The minimum vertical spacing of samples is about 1/1,035 of the picdture height. This process, depicted in Figure 14, produces high resolution still pictures but the resolution of objects in motion is lower than the resolution of stationary objects.

Receivers require a frame store. Motion detectors are used in the encoder to fully compensate for some types of motion such as a camera pan. This information is transmitted to the receiver as a digital signal. The transmission includes digital stereo sound. Luminance and color-difference signals are separate in a MAC format. The full signal requires a baseband bandwidth of 8.1 MHz.

The MUSE system was designed for FM transmission. However, the MST-

FIGURE 17



DBS HDTV 2-Channel system — CBS

patibility.

The NAP proposal can be implemented in two forms, a two-NTSC channel system or a MAC system. The first form contains NTSC in one channel and has Level 3 compatibility. The second form has Level 2 compatibility. The Scientific-Atlanta proposal is based on the B-MAC system

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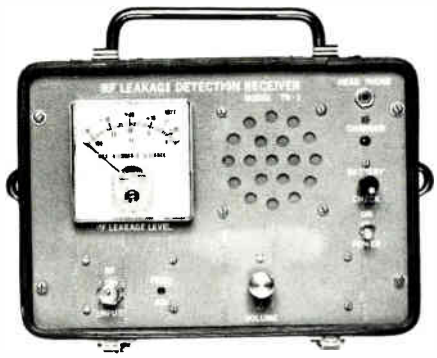

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Plans are being made in Japan for a DBS service, starting around 1990.

NAB demonstration (Washington, DC, January 1987) used the MUSE system with VSB-AM transmission occupying two UHF channels (58 and 59). The picture carrier was set 3 MHz into the 12 MHz channel.

Consumer electronics manufacturers in Japan are designing consumer equipment to operate with this system. Plans are being made in Japan for a DBS service, starting around 1990, using this system.

Bell Laboratories proposal. Bell Labs proposed a two-channel system in which the first channel contains an NTSC signal derived from a high definition signal with 1,050 lines. The 1,050-line signal, after vertical filtering, is scan converted into the 525-line format. The horizontal resolution of the signal transmitted in the first channel is normal NTSC. The second channel contains higher frequency luminance and color-difference signal information. Horizontal resolution of the combined signals is essentially two times NTSC resolution. Bell claims an NTSC receiver recovers the signal in the first channel with only slight degradation. An HDTV receiver recovers the signals in both channels and combines them in a frame store scan converting the output to 1,050 lines to produce a high definition picture.

Bell Labs claims the second channel has sufficient capacity to transmit multiple channel sound. They have also described several methods for obtaining wider aspect ratio pictures.

Figure 15 shows the transmitted spectrum. This figure shows two adjacent channels. However, two non-adjacent channels can be used. Figure 16 is a block diagram of the encoder. The decoder uses the inverse function.

CBS proposal. CBS proposed a two-channel transmission system for an HDTV service using two DBS channels. Each channel carries a time multiplex component signal. In this paper, the TMC signal should be considered the same as a MAC signal. The CBS system first converts the HDTV studio signal into a 1,050-line interlaced format with a 5:3 aspect ratio. Every second pair of lines of the 1,050-line signal is averaged to generate a 525-line interlaced signal with a 5:3 aspect ratio. The central 4:3 aspect ratio portion of this signal is transmitted in the first channel, shown in Figure 17. The second channel carries every other line of the 1,050-line signal in a 5:3 aspect ratio format. It also carries the "side panels" of the first channel.

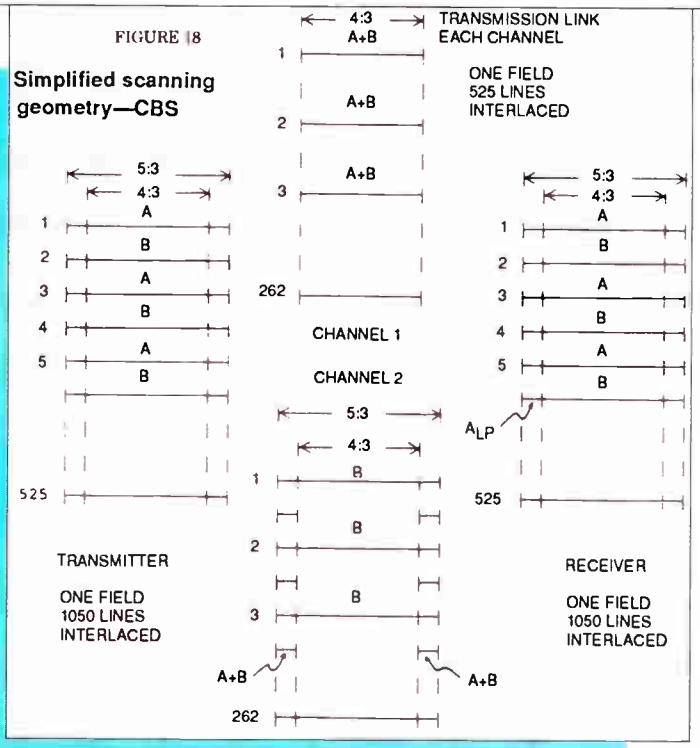

FIGURE 18
Simplified scanning geometry—CBS

Vertical filtering is applied to the first channel (averaging each two lines of the 1,050-line signal) so there will be no loss in the single channel receiver. The "side panels" have lower horizontal resolution than the central portion of the picture since they are transmitted in the second channel which is compressed by a greater factor. This is illustrated in a scanning format in Figure 18. The horizontal spatial resolution of the resulting high definition picture is the same as it is for the signal in the first channel which, it should be noted, is about 50 percent higher than an NTSC signal since the DBS channels permit transmission of a wider bandwidth signal. The vertical resolution of the high definition picture is two times the vertical resolution of an picture.

An NTSC receiver, with an adapter box, uses the signal in the first channel to display a 525-line picture with 4:3 aspect ratio. An HDTV receiver combines the two signals to display a 1,050-line picture with 5:3 aspect ratio. This system can be implemented without using a frame store in the receiver. The TMC format for each channel is illustrated in Figure 19.

Glenn proposal. William Glenn of the New York Institute of Technology proposed a system using one NTSC signal and an auxiliary signal which occupies about one-half an NTSC channel. Dr. Glenn made studies of human vision and found that humans have two types of vision receptors which have different functions for spatial resolution and temporal resolution. One type of vision receptor has high spatial resolution but low temporal resolution while the other type of vision receptor has high temporal resolution but low spatial resolution. His system takes advantage of these properties of human vision to reduce the transmitted band-

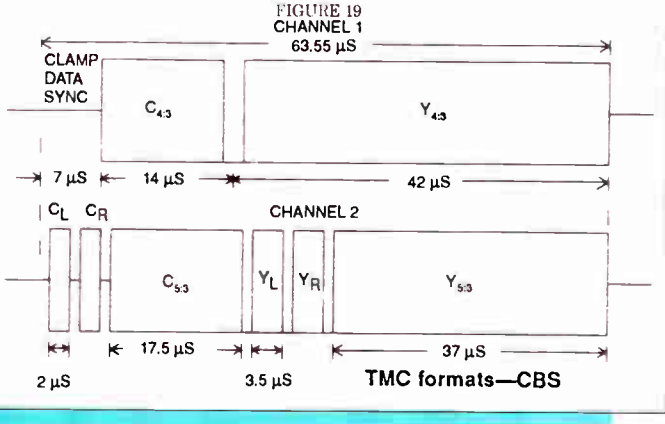

FIGURE 19
TMC formats—CBS

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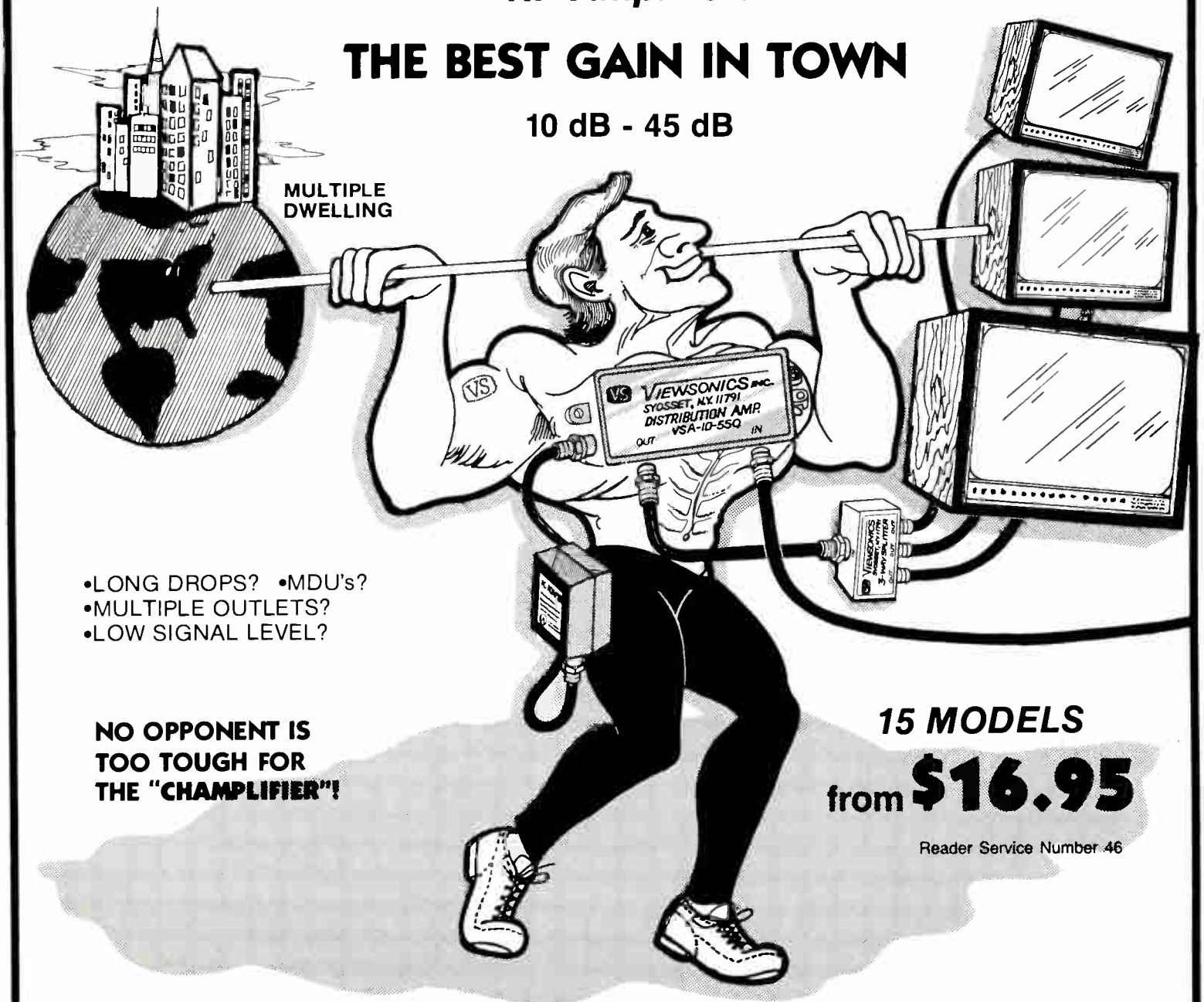

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North American Philips proposed a concept for HDTV transmission which can be implemented in two forms.

width. High temporal resolution information is transmitted using the NTSC signal and high spatial resolution information is transmitted in the second channel at a lower frame rate.

The NTSC signal is subjected to improvements using techniques described in the improved NTSC section of this paper. The auxiliary signal contains high frequency, low temporal rate luminance information and high resolution color information. The high frequency luminance information consists of 862 picture elements per active line and 1,024 active lines in a quincunx (checkerboard) pattern. All this information is transmitted in a MAC format to the receiver. The receiver uses a frame store to reconstruct the picture. A block diagram of the encoder for this system is shown in Figure 20. In this diagram the high resolution luminance signal is derived from a separate camera tube. This is not a requirement. The transmitted signal could be derived from an HDTV studio signal.

A wider aspect ratio is accommodated in the NTSC channel by reducing horizontal blanking by 10 percent and decreasing the number of active lines by 10 percent.

Del Rey Group proposal. The Del Rey Group has proposed a 525/60/2:1 high definition transmission system using a single NTSC channel. The sampling pattern is illustrated in Figure 21. The transmitted signal can be derived from an 1125/60 studio output. The easiest way to examine this proposal, though, is to assume an original luminance signal with twice 525 lines and three times the horizontal resolution. Each NTSC luminance picture element (pixel) is replaced by three new pixels as shown. The pixels designated A-F are transmitted in place of the normal NTSC pixels, and, after six fields, all six pixels are transmitted. A frame store is used in the HDTV receiver to recover the full signal.

The Del Rey Group claims that this signal could be directly displayed on a current NTSC receiver with little loss compared with a conventional NTSC picture. Normal NTSC color-difference bandwidths are used in the system. The minimum spacing of horizontal samples is about 1/1320 of the picture width. The minimum spacing of vertical samples is about 1/828 of the picture height.

The Del Rey Group also proposes that 69 fewer active video lines be transmitted each frame, resulting in a wider aspect ratio picture. The Del Rey Group claims that most NTSC receivers overscan to such an extent that the loss of the transmitted lines would not be observed in a typical receiver. Those lines are then used to transmit digital sound. Figure 22 shows this approach.

North American Philips proposal. North American Philips proposed a concept for HDTV transmission which can be implemented in two forms. One form is a MAC system suitable for satellite transmission. The other form, easily derived from the first, is a two-channel system in which the first channel carries an NTSC signal and the second channel carries the wide aspect ratio panels, higher resolution information and digital stereo sound. NAP proposes that the MAC signal could be distributed by satellite and converted to the two-channel signal for local service either by terrestrial broadcasting or cable distribution.

The description given here is based on the two-channel NTSC system demonstrated in April 1987. Although the transmitted signals can be derived from an 1125/60 studio output, the easiest way to examine this proposal is to look at an original 525-line progressive scan 16:9 aspect ratio signal as shown in Figure 23.

The NTSC signal for the first channel is obtained by selecting a 4:3 aspect ratio portion of every other line of the source signal. The second channel carries four signals during each "line scan." The first signal is the left panel for the wide aspect ratio and the second signal is the right panel for the wide aspect ratio. These two signals are processed as a normal NTSC signal. The two panels are not necessarily of equal width since provisions are included for a pan and scan feature. The third signal is a "line difference" signal necessary for a progressive scan display in the receiver—the average value of two adjacent lines transmitted in the first channel is subtracted from the lumi-

FIGURE 20

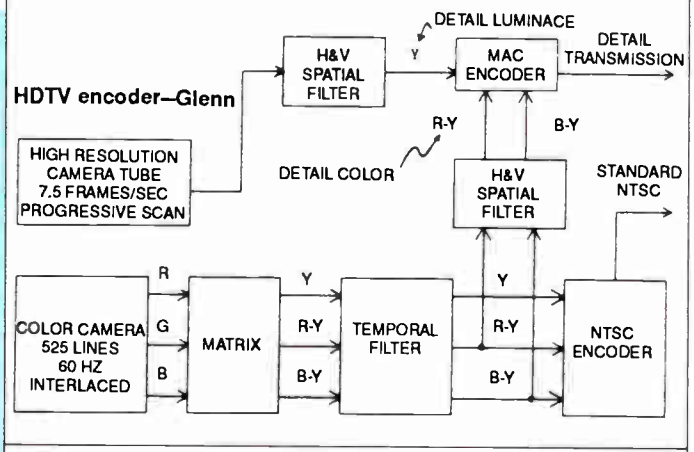
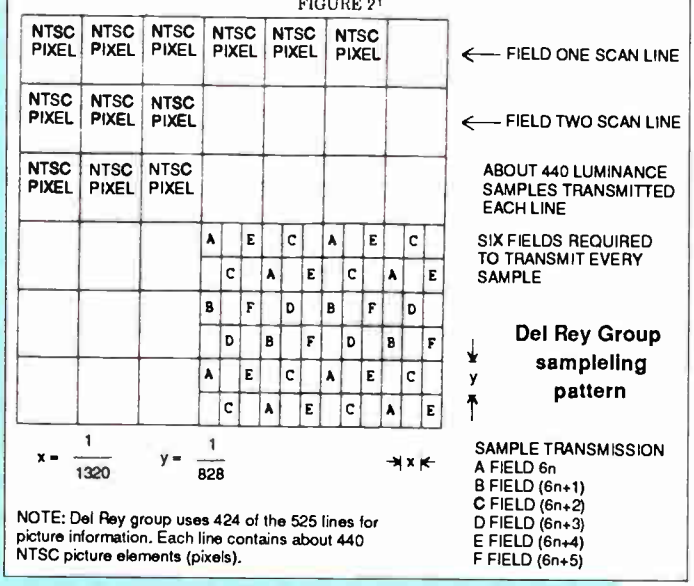


FIGURE 21



NOTE: Del Rey group uses 424 of the 525 lines for picture information. Each line contains about 440 NTSC picture elements (pixels).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Scientific-Atlanta has proposed that the B-MAC system could be used to carry an HDTV signal via satellite.

nance portion of the lines discarded for generating the NTSC signal and compressed by a factor of 8/3. The fourth signal contains "bursts" of a Dolby digital encoded 16 bit stereo sound signal.

An NTSC receiver would receive only the first channel and display a normal NTSC picture. HDTV receivers would receive both channels, combine the signals in an appropriate manner, and display wide aspect ratio progressive scan pictures using 525 lines. Although the horizontal resolution and color resolution demonstrated by NAP are normal NTSC resolution, they are working on techniques to increase both. The vertical luminance resolution is higher than NTSC because of the progressive scan. A frame store is not required. The picture does not suffer when motion is present.

The MAC system has not been demonstrated but is described as a four field sequence, 525-line progressive scan signal with baseband bandwidth of 9.5 MHz. In a given field, every fourth line has full luminance bandwidth of 16.8 MHz—equivalent in spatial resolution to a 6.3 MHz NTSC signal. Every second line is a "line difference" signal, as described above, band limited to about 28 percent full luminance bandwidth. All other lines are band limited to about 56 percent full bandwidth. One of the two color-difference signals is sent every other line on an alternate basis. The color-difference signal has either 14 percent or 28 percent of the full luminance bandwidth. Figure 24 shows the contents of each line and the spatial-temporal resolution.

Scientific-Atlanta proposal. Scientific-Atlanta has proposed that the B-MAC system could be used to carry an HDTV signal via satellite. The input signal could be either 1,050 lines interlaced scan or 525 lines progressive scan. This technique is used to increase the vertical resolution of the signal. The B-MAC system, described earlier in this paper, already handles wide aspect ratio pictures.

Figure 25 diagrams the encoding procedure using 525 lines progressive scan as the input. The signal is filtered in a diagonal manner decreasing the diagonal resolution. The resulting signal is sampled in a quincunx pattern to eliminate every other sample. The samples form every second line are moved into the empty spot in the line above. Every second line then contains no samples and it can be discarded. The resulting signal is a 525 interlaced scan signal which can be transmitted through a regular B-MAC channel.

The normal B-MAC receiver would display the signal in the normal fashion. A high definition B-MAC receiver would regenerate the 525 line progressive scan picture by reversing the procedure described above. The samples which were moved into the line above would be moved back into place and missing samples would be calculated based on surrounding samples. This entire procedure is accomplished with a small number of line stores.

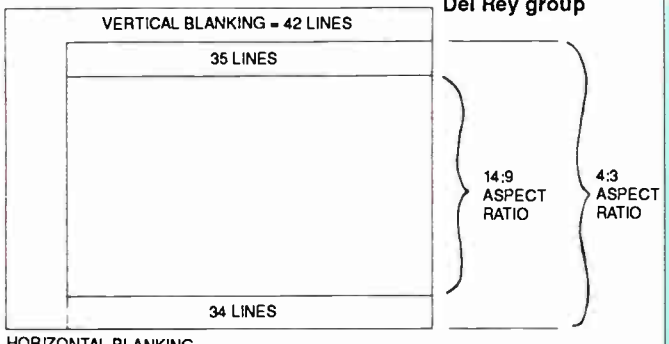
NBC proposal. NBC and the David Sarnoff Research Center have proposed a system which can be transmitted in a single NTSC channel by combining several of the concepts described in the improved NTSC portion of this paper: higher line number in the camera and the display, pre-combing, the Fukinuki procedure and the QUME procedure.

The origination signal is a high line number, wide aspect ratio signal from which an NTSC signal is derived. The wide aspect ratio is maintained in the NTSC signal by compressing the side panels to occupy about 1 μS each. NBC claims that receivers overscan and this portion of the picture would not appear in current receivers as a result. With a receiver designed to recover this signal, though, the side panels would be stretched to their proper size. This technique results in low bandwidth side panels.

The higher frequency information for the side panels, including the encoded color for the side panels, is placed on a subcarrier which uses the portion of the spectrum inefficiently used by the color information (Fuk-

FIGURE 22

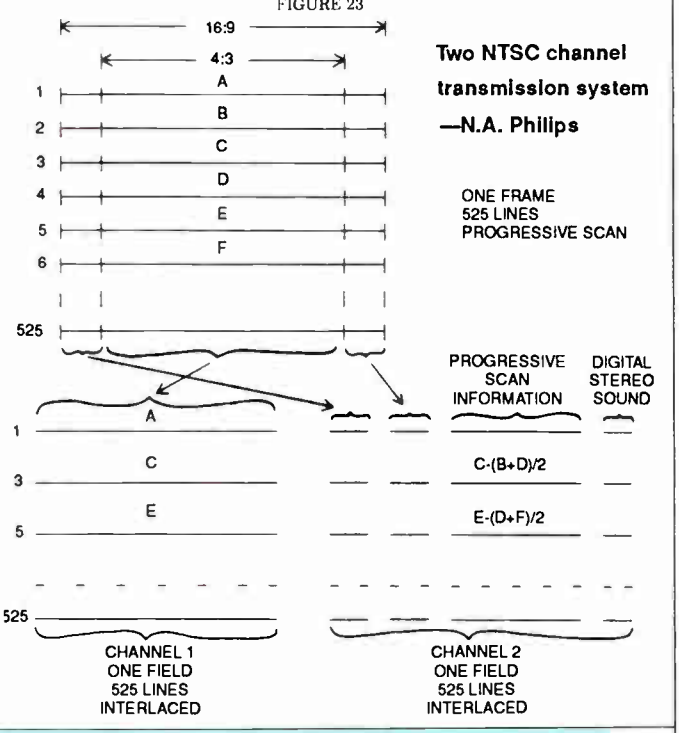
14:9 aspect ratio—Del Rey group



A total of 69 lines, taken from the top and bottom of the picture, could be used for digital sound during high definition television transmissions.

FIGURE 23

Two NTSC channel transmission system —N.A. Philips



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As a general rule, systems requiring the greatest bandwidth will probably have the best performance.

inuki). This new subcarrier, about 3.1 MHz, is modulated in quadrature by a signal containing higher frequency luminance information for the 4:3 aspect ratio portion of the picture. The main signal and these additional signals must be filtered (similar to precombing with a field delay) prior to combining them, otherwise artifacts would be introduced. The additional signals are band-limited to about 1.2 MHz each.

Vertical information, needed to reconstruct the higher line number generated by the source, is carried by another signal. That signal is band-limited to 750 kHz and then used to modulate the picture carrier in quadrature with the main signal (QUME). NBC claims that little crosstalk will be seen on current receivers for this signal since it is coherent with the information in the main signal.

A diagram of this system is shown in Figure 26. Figure 27 is a diagram of the spectrum of the transmitted signal.

Similarities and differences of proposals. It is difficult to make direct comparisons between the proposals. Demonstrating the systems side by side using test signals and program material would provide the best comparison. However, this cannot be done today since only one of the systems has been thoroughly developed. The other systems are in various stages of development.

As a general rule, systems requiring the greatest bandwidth will probably have the best performance. Likewise, systems using the least bandwidth will probably have the poorest performance. Trade-offs can be made to enhance any one aspect of system performance but, almost certainly, another aspect will be degraded. The two-channel systems require the greatest bandwidth. However, they have been designed to maintain a high level of compatibility and may have been subjected to compromises which do not use the bandwidth in the most efficient manner.

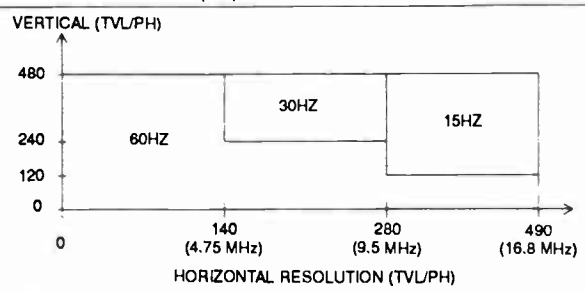
Techniques used to increase the resolution are: increase the total bandwidth, decrease the temporal resolution, decrease the diagonal resolution, or combinations of the above.

All of the proposed systems increase the vertical and horizontal resolution when compared with NTSC. However, all of them are expected to suffer in one way or another when motion is present. Systems by Bell, CBS, and S-A have full temporal resolution. However, Bell converts to higher line number which can introduce artifacts, CBS treats side panels in the second channel which can introduce artifacts, and S-A uses Sub-Nyquist sampling which can also introduce artifacts. The other systems require more than one frame to update the picture. Glenn is a 7.5 frame per second (fps) update, Del Rey is 10 fps, MUSE is 15 fps, and NAP is 15 fps. NBC uses intraframe averaging which introduces some loss of temporal resolution.

Four different techniques are used to increase the vertical resolution. CBS transmits two times the number of lines. NAP and NBC transmit about twice as many lines but remove most of the horizontal information from half the lines. MUSE, Glenn, Del Rey and

FIGURE 24

	RESOLUTION Y	U	V
LINE n	56%	14%	-
LINE (n+1)	28%	-	-
LINE (n+2)	100%	-	28%
LINE (n+3)	28%	-	-
LINE (n+4)	56%	28%	-
LINE (n+5)	28%	-	-
LINE (n+6)	100%	-	14%
LINE (n+7)	28%	-	-



To conserve spectrum the N.A. Philips MAC System transmits only a portion of the contents of some lines by first using a low pass filter. The table shows the resolution of each luminance and color-difference line. This pattern repeats every 8 lines. The luminance pattern moves up one line every frame. The color-difference signal pattern moves up two lines every frame. The signal is 525 line progressive scan. The resulting luminance temporal-spatial resolution is also shown.

Spatial and temporal resolution HD-MAC System—N.A. Philips

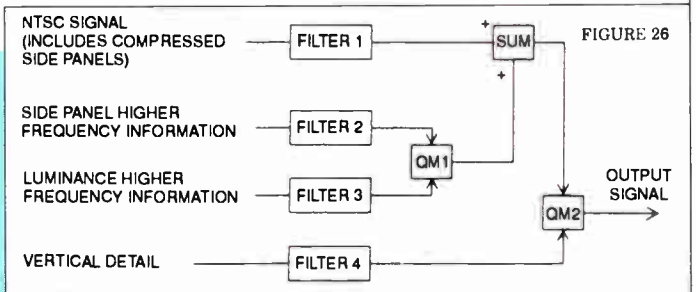


FIGURE 26

Filters 1, 2, 3 are intra-frame filters. Filter 4 is a 750 kHz low pass filter. QM1 is a quadrature modulator with the subcarrier frequency about 3.1 MHz and all sidebands "hidden" in the Fukinuki holes. QM2 is a quadrature modulator where the carrier is the normal picture carrier.

Signal encoder block diagram—NBC

The original signal is a 525 line progressive scan signal	X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X X	FIGURE 25 B-MAC has 750 samples per line
The signal is sampled in a quincunx fashion discarding every other sample	X1 X1 X1 X1 X1 X1 X1 X2 X2 X2 X2 X2 X2 X2 X3 X3 X3 X3 X3 X3 X3 X4 X4 X4 X4 X4 X4 X4 X5 X5 X5 X5 X5 X5 X5	Numbers indicate original line location
Samples in all even lines are moved into the empty space in the line above	X1 — X1 — X1 — X1 — X2 — X2 — X2 — X3 — X3 — X3 — X3 — X4 — X4 — X4 — X5 — X5 — X5 — X5	—Missing sample
The signal is filtered to remove the higher frequency diagonal components	X1 X2 X1 X2 X1 X2 X1 — — — — — — — X3 X4 X3 X4 X3 X4 X3 — — — — — — — X5 X6 X5 X6 X5 X6 X5	Resulting signal is 525 lines interlace scan —Scientific Atlanta

Encoding procedure to enhance vertical resolution with B-MAC

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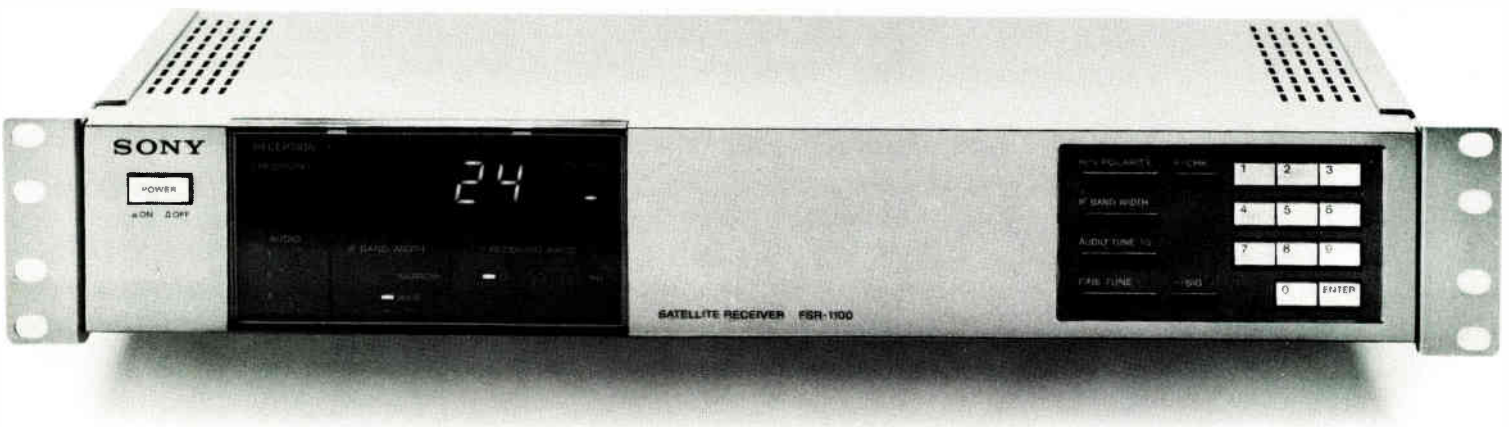

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All of the proposed systems include a wide aspect ratio picture.

S-A transmit about twice as many lines but remove half the horizontal information from every line. Bell converts to a higher line number at the receiver to increase the perceived vertical resolution.

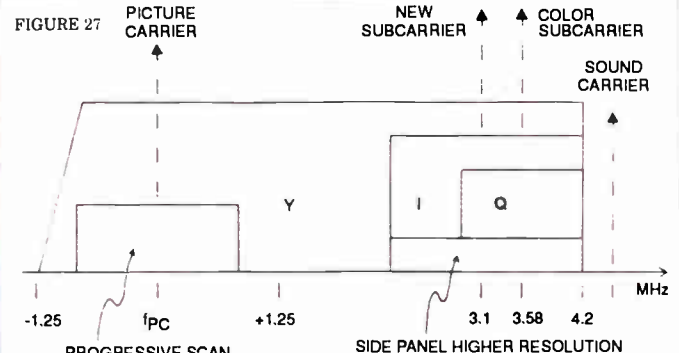
Two different techniques are used to increase the horizontal resolution. Bell and CBS increase the bandwidth. MUSE, Glenn, Del Rey, NAP, S-A and NBC transmit information from extra horizontal samples using an interleaved technique. Only CBS has full diagonal resolution.

MUSE, Bell, CBS, Glenn, NAP and S-A increase the color resolution when compared with NTSC. MUSE, CBS, NAP in its MAC system, and S-A transmit separate luminance and color information. Bell, Glenn, Del Rey, NAP in its NTSC system, and NBC use the NTSC system to transmit color information.

All of the proposed systems include a wide aspect ratio picture. MUSE, Glenn, Del Rey, NAP in its MAC system, and S-A treat the wide aspect ratio as an integral part of the system rather than send the side panels in a separate manner. Only CBS and S-A do not require a field store (or more) for full performance. The NAP system could have a lower performance option which would not require a field store. MUSE, Glenn and Del Rey have the greatest memory requirements.

The Bell, Glenn, Del Rey, NAP in its NTSC system, and NBC signals can be displayed on a current NTSC receiver without an adapter box. All of the systems could use the 1125/60 studio signal as an input signal. Figure 28 contains a table showing many of these comparisons.

FIGURE 27



Spectrum of the NBC signal

FIGURE 28 **Comparison of the various transmission systems**

	BANDWIDTH MHz	H-RES TVL/PH	V-RES TVL/PH	FULL DIAG	FULL TEMP	INTEG SIDES	SEP COLOR	FLD STOR	IMPR AUD
MUSE	8.1	555	720	NO	NO	YES	YES	YES	YES
BELL	12	600	480	NO	YES	NO	NO	YES	YES
CBS	16	500	660	YES	YES	NO	YES	NO	YES
GLENN	9	800	800	NO	NO	YES	NO	YES	NO
DEL REY	6	635	580	NO	NO	YES	NO	YES	YES
NAP NTSC	12	490	480	NO	NO	NO	NO	OPT	YES
NAP MAC	9.5	490	480	NO	NO	YES	YES	OPT	YES
SA	10.7	420	480	NO	YES	YES	YES	NO	YES
NBC	6	410	480	NO	NO	NO	NO	YES	NO

KEY: Bandwidth is the base-band bandwidth of the signal in MHz.

H-RES and V-RES are the horizontal and vertical resolution of the signal given in TV lines per picture height. Data is taken, or derived, from published information.

FULL DIAG means the signal has full diagonal resolution. Note the TSC does not have full diagonal resolution because of the presence of the color subcarrier.

FULL TEMP means the signal is fully updated every frame.

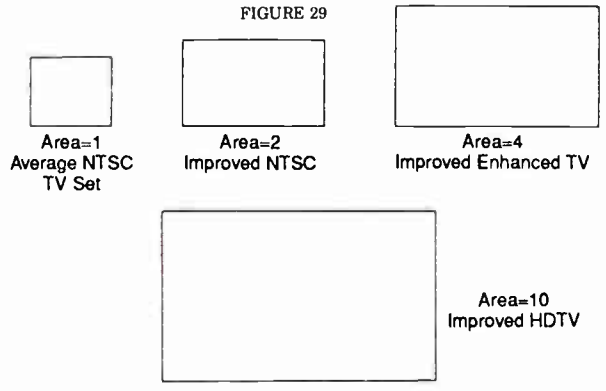
INTEG SIDES means the wide apsect ratio portion of the signal is transmitted in an integral manner with the center of the picture.

SEP COLOR means the color information is transmitted separate from the luminance information.

FLD STOR means the system requires a field store (or more) in the receiver. OPT means optional.

IMPR AUD means the system offers improved audio compared with the current NTSC system.

FIGURE 29



Relative sizes of images displayed with same resolution on viewer's retina — Glenn

Summary

The proposals range from improvements to the NTSC system to HDTV transmission systems requiring a greater bandwidth than is available in a single NTSC channel. While it seems quite likely that the 1125/60 HDTV studio system will become the 60 Hz studio standard, standard for delivery to the public are an open question.

Extensive misuse of the word "compatibility" led to a definition of a range of compatibility levels rather than a definition of the word. Systems with a high level of compatibility may result in lower levels of performance while systems with a low level of compatibility may result in higher levels of performance.

A number of alternative and innovative systems have been proposed for HDTV transmission. These systems have been developed to different levels ranging from computer simulations to developed hardware. Each is based on different assumptions regarding the most appropriate set of compromises. The HDTV delivery system that is most developed is being used by Japanese manufacturers to design consumer equipment. ■

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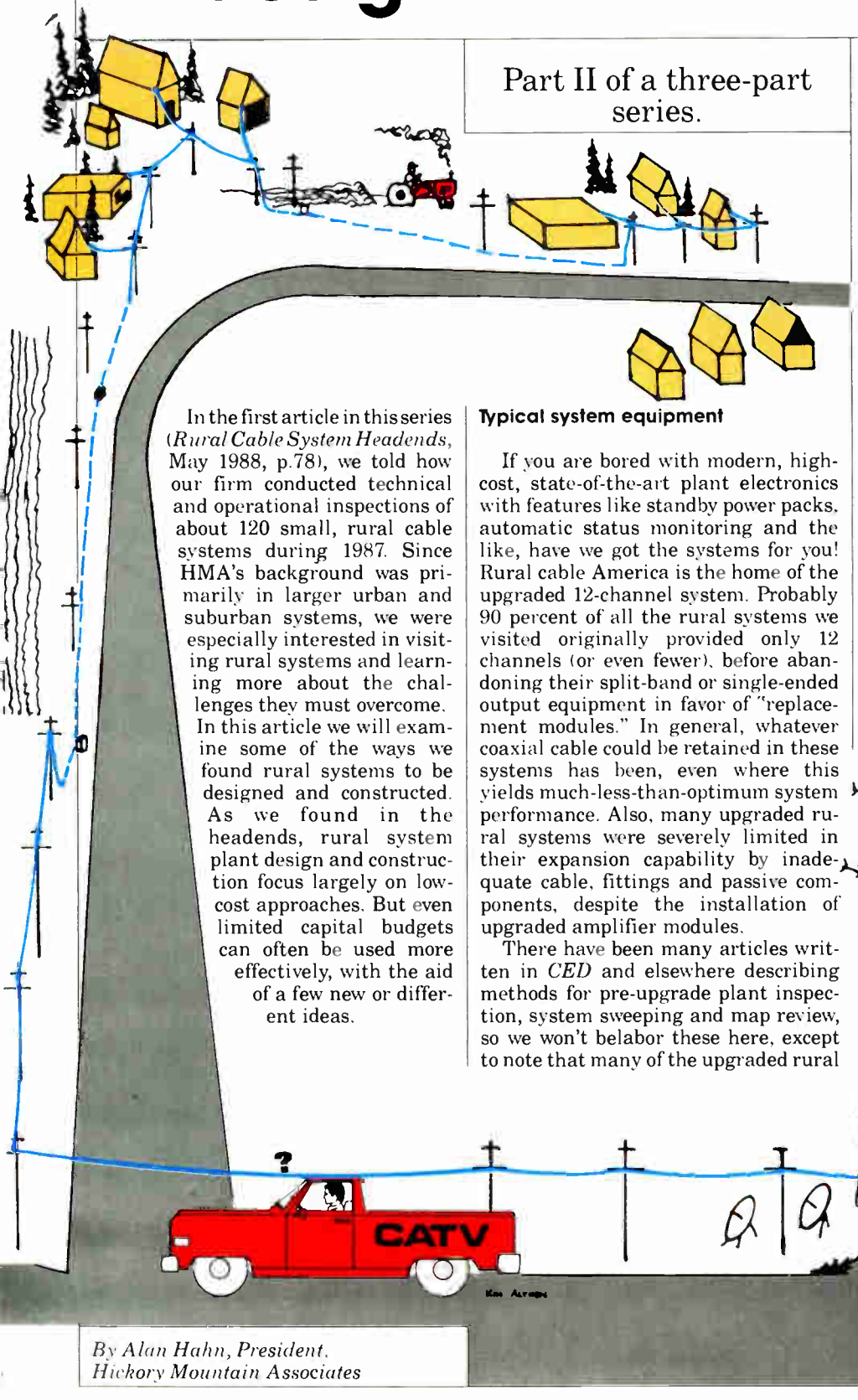
Rural cable system design and construction

Part II of a three-part series.



In the first article in this series (*Rural Cable System Headends*, May 1988, p.78), we told how our firm conducted technical and operational inspections of about 120 small, rural cable systems during 1987. Since HMA's background was primarily in larger urban and suburban systems, we were especially interested in visiting rural systems and learning more about the challenges they must overcome.

In this article we will examine some of the ways we found rural systems to be designed and constructed. As we found in the headends, rural system plant design and construction focus largely on low-cost approaches. But even limited capital budgets can often be used more effectively, with the aid of a few new or different ideas.

Typical system equipment

If you are bored with modern, high-cost, state-of-the-art plant electronics with features like standby power packs, automatic status monitoring and the like, have we got the systems for you! Rural cable America is the home of the upgraded 12-channel system. Probably 90 percent of all the rural systems we visited originally provided only 12 channels (or even fewer), before abandoning their split-band or single-ended output equipment in favor of "replacement modules." In general, whatever coaxial cable could be retained in these systems has been, even where this yields much-less-than-optimum system performance. Also, many upgraded rural systems were severely limited in their expansion capability by inadequate cable, fittings and passive components, despite the installation of upgraded amplifier modules.

There have been many articles written in *CED* and elsewhere describing methods for pre-upgrade plant inspection, system sweeping and map review, so we won't belabor these here, except to note that many of the upgraded rural systems we visited had not gone into those items, so that many future rural system upgrades clearly would benefit from more thorough planning. This is especially the case in systems where maps are either outdated or even nonexistent (nonexistent maps proved to be the rule in a significant number of the systems we visited).

Rural systems are typically design-limited by trunk amplifier cascades because the rural operator continually extends his plant to serve newly constructed "pockets" of homes. This often results in cascades of 40, 50, or even more trunk stations. And while the system carrier-to-noise buildup in such cascades may be tolerable to subscribers in poor-reception areas, acceptable system peak-to-valley ratios are very difficult to maintain. Still worse, we found that rural systems typically lack sweep equipment, so that system balancing and equalization are either seldom attempted or are put off until subscriber complaints approach the critical "fired chief tech" point. There is really no good reason for this, for rural system clusters could join together to purchase a "regional" set of sweep equipment and could readily develop the knowhow to use it effectively. Better and cheaper sweep gear is always desired, but to put off sweeping a 53-deep cascade until "the price is right," (as one operator told me he was doing) is unsound business. And besides, if the system is intended to be sold, the sweep gear cost can always be recovered.

Another issue raised by a deep cascade is that of headend noise. As we noted in last month's article, rural headends using broadband modulators (i.e., those without output bandpass filters) will themselves generate so much noise that headend outputs can look like a cascade of 30-plus

By Alan Hahn, President, Hickory Mountain Associates

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Jenkintown, PA.....200 Miles
New Kensington, PA....300 Miles
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Sandwich, MA.....200 Miles
Lauderdale Lakes, FL .....20 Miles
Pembroke, MA.....90 Miles
Fredericksburg, VA.....120 Miles
Culpepper, VA.....80 Miles
Halifax, MA.....40 Miles
Loudoun County, VA ...100 Miles
Kutztown, Pa .....50 Miles
Hallwood, Exmore, VA ..75 Miles
Chatham, NY .....100 Miles
Glens Falls, NY .....250 Miles
Manassas, VA .....75 Miles
Hanover, PA .....100 Miles
Lawrence, KS.....220 Miles
Buena Vista, VA .....25 Miles
Danville, NH .....25 Miles
Lancaster, PA.....100 Miles
Ponce, PR .....300 Miles
Londonderry, NH.....200 Miles
Marion, OH .....100 Miles
Waverly, OH.....20 Miles
Atkinson, NH.....40 Miles
Kingston, NH .....50 Miles
Rockland, MA .....50 Miles
Abington, MA.....60 Miles
Bourne, MA.....150 Miles
Hershey, PA.....100 Miles
Blossburg, PA .....20 Miles
Chitenango, NY.....40 Miles
St. Albans, VT .....50 Miles

Ottawa, OH.....50 Miles
Upper Merion, PA .....90 Miles
Brockway, PA.....10 Miles
Greensburg, PA .....200 Miles
Duxbury, MA.....125 Miles
Westfield, PA .....12 Miles
Norristown, PA .....150 Miles
Pelham, NH.....80 Miles
Plympton, MA .....25 Miles
Sandwich, MA .....200 Miles
Windham, NH.....85 Miles
St. Clair Twp., MI .....50 Miles
Bloomsburg, PA.....20 Miles
Wilkes-Barre, PA .....10 Miles
Weatherly, PA.....25 Miles
Abington, PA.....300 Miles
Algonac/Clay Twp., MI ..50 Miles
Southern, NJ.....2,800 Miles
Bolling A.F.B., MD.....5 Miles
University of Toledo, OH .5 Miles
Brandywine, PA .....100 Miles
Chalfont, PA.....12 Miles
Chesterfield Twp., MI...100 Miles
China Twp., MI.....10 Miles
Collegeville Trappe, PA ..20 Miles
Doylestown, PA .....50 Miles
Egg Harbor, NJ .....22 Miles
East Hampton, NJ.....25 Miles
Littlestown, PA .....100 Miles
Newton, NH.....25 Miles
Muncy/Hughesville, PA..25 Miles
Nassawadox, VA.....12 Miles
Lower Gwynedd Twp., PA
.....25 Miles
New Holland, PA .....10 Miles
Shamokin, PA.....50 Miles

Plymouth, MA.....25 Miles
Knoxville, PA .....5 Miles
Nanticoke, PA .....15 Miles
Onancock, VA .....15 Miles
Mays Landing, NJ.....50 Miles
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White Marsh, PA .....20 Miles
Lower Providence Twp., PA
.....75 Miles
Eastown, PA .....50 Miles
New Britain Twp., PA....30 Miles
Hamilton, NY.....50 Miles
Tredyffrin, Twp., PA....150 Miles
Memphis, MI .....6 Miles
Northampton Twp., PA
.....150 Miles
Whitpain Twp., PA .....50 Miles
Springfield, PA.....30 Miles
Skippack Twp., PA .....45 Miles
New Baltimore, MI .....25 Miles
East China Twp., MI.....25 Miles
Newtown Sq., PA .....50 Miles
Harrison Twp., MI .....100 Miles
Ira Twp., MI .....20 Miles
Worchester, Twp., PA ....50 Miles
Marine City, MI .....30 Miles
New Haven, MI .....10 Miles
Sharon, PA .....12 Miles
E. Whiteland, PA .....25 Miles
Romeo, Washington,
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Reader Service Number 52

In rural areas, pole spans can grow to distances unheard of in areas like the urban Northeast.

especially prone to failure in electrical storms? Could a really congested part of the aerial plant be bypassed at reasonable cost with a short underground "dip"? The system maintenance tech can make life a lot easier if he provides the upgrade designer with answers to questions like these. He can prevent future problems, instead of solving them over and over. And he should try to do so, since he will have to live with the upgraded system.

Construction methods

In rural areas, pole spans can grow to distances unheard of in areas like the urban Northeast, and "traditional" numbers (like 40 poles per mile) must be disregarded. Rural America will show the visitor 300-foot or even 350-foot spans, and pole densities of only 18 or 20 per mile. When HMA's Yankee inspectors viewed this, they felt that the clear poles and long, open spans would be pure heaven for the construction contractor. But this is only partly so.

One of the most curious sights we saw was a series of towns, all served from a single headend, containing sufficient numbers of utility poles to serve all the homes aerially. But between each town the aerial cable dropped out of sight into a farmer's field, only to reappear as a pole riser at the next town line. I asked the local system tech, who was a newcomer, how this arrangement had come to be, but he had no idea. I found out that a previous system owner, confronted with what he considered to be unfair utility pole rentals in unincorporated areas, had elected to "do it in the dirt" between the town borders. But the local farmers in these underground areas were expanding their planted acreage, and cable system damage caused by the sharp plow blades was making the utility poles look awfully good, even if a bit more expensive than expected. It's a rare opportunity for the system designer to be able to go from underground cable to aerial cable along the same run, so it was easy to make our recommendation in this case!

As in urban or suburban systems, system configurations in rural areas seldom begin with a selection of underground or aerial plant areas. These are typically predetermined in any event. A more significant decision concerns the choice of construction methods, and we found a lot of areas for concern here. For example, in many rural communities we inspected, we found that conventional, lashed-cable construction had been ignored in favor of self-support (aka "figure-8," integral messenger, "over & under") cable. While such cable may be adequate for short spans in ice-free areas, it is going to present some real problems in rural, long-span territory where ice storms are frequent. Since ice storms are fairly common as

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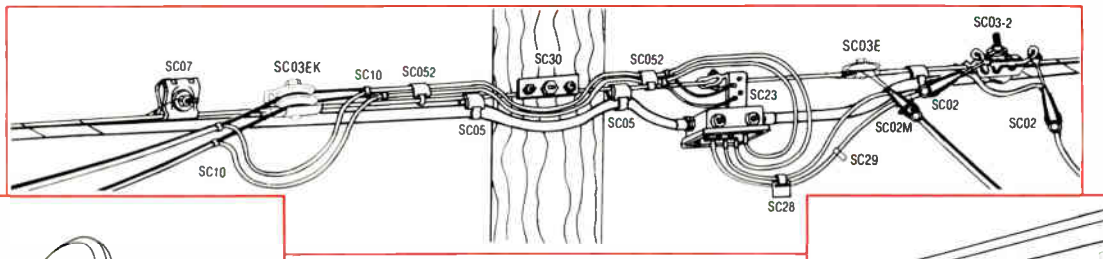

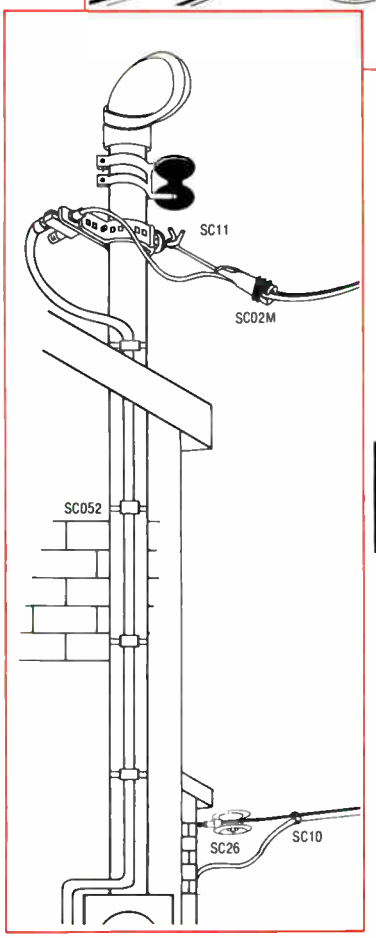

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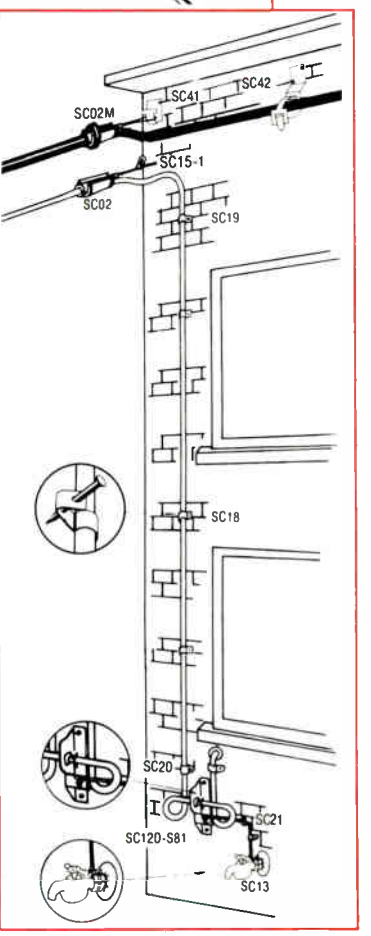

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FP-03

The self-support cable systems we saw were, in general, the leakiest of all.

far south as Dallas or Atlanta, for example, the range of rural areas where self-support cable would seem advisable is pretty small.

And strand strength isn't the only consideration, either. The self-support cable systems we saw (and there were quite a few) were, in general, the leakiest of all. This is not surprising, since the ice-loaded messenger has to transmit part of that load somewhere, and the cable connectors will take their share. To be safe, choose strong, lashed construction; that is, make it properly guyed, anchored, grouded and bonded, and—always—well spliced. You'll be glad you did, especially on those 350-foot spans. (And at the time of system sale, a better cable plant is a more valuable cable plant.

In none (repeat, none) of the 120-plus systems we visited did we see a "Megger" ground-quality test set, or anything similar. Not surprisingly, many of these systems also had special trouble spots which acted up regularly in thunderstorms. Well, troops, the two topics are related. The lightning discharges and the static electricity build-ups have to dissipate somewhere, and an inadequately grounded or bonded amplifier station will often suffer because of it. A megohmmeter and a pickup truck full of ground rods isn't a recipe for the most fun in the world, but it can make those sultry summer nights a lot easier for you the next time around.

The last topic to discuss is construction approvals and permitting. This seems like an easy one, but rural systems cover wider areas than those in the cities, and they often involve more permitting jurisdictions, too. Unincorporated county areas and incorporated towns are the seas and islands in rural areas, and must usually be permitted separately. Never forget the railroads—especially the "abandoned rights-of-way" that are now coming back to life in many areas—nor the U.S. Army Corps of Engineers, if you're crossing waterways. And collect those FCC licenses and construction permits that are scattered about. We encountered a lot of problems regarding permits, and most of them ended up complicating the system sale in one way or another.

As an engineering professor once told us, engineering is a "problem-solving discipline," so he advised us to be grateful for our problems—without them we'd have nothing at all to do! Well, the rural system technician, operator, designer and construction crew certainly have their share of problems, as these first two articles indicate. But in nearly all cases, solutions can be found that are cost effective and that will make the burdens lighter for everyone.

The final article in this series will look at rural system technical operations. ■

Merging broadband test and monitor systems

The dividing line between broadband status monitoring products and field test equipment has become blurred as each type of equipment has incorporated more and more features normally offered only by the other. Spectrum analyzers and field strength meters offer remote control ports to access their measurement capabilities over a serial interface. Dedicated status monitors provide more measurement features then ever, including system frequency response testing normally reserved for field sweep sets or spectrum analyzers.

A logical step in this progression is to combine the features of field test gear and status monitoring in a package that can withstand the extreme environmental conditions required to become an integral part of a CATV or LAN distribution system. This product will allow detailed frequency response measurements to be made at multiple points in the system without the expense of sending a truck to each location. System maintenance will be improved and down time reduced. The Magnavox Line Monitor (MLM) is the first product to combine these features with ruggedness in a single package.

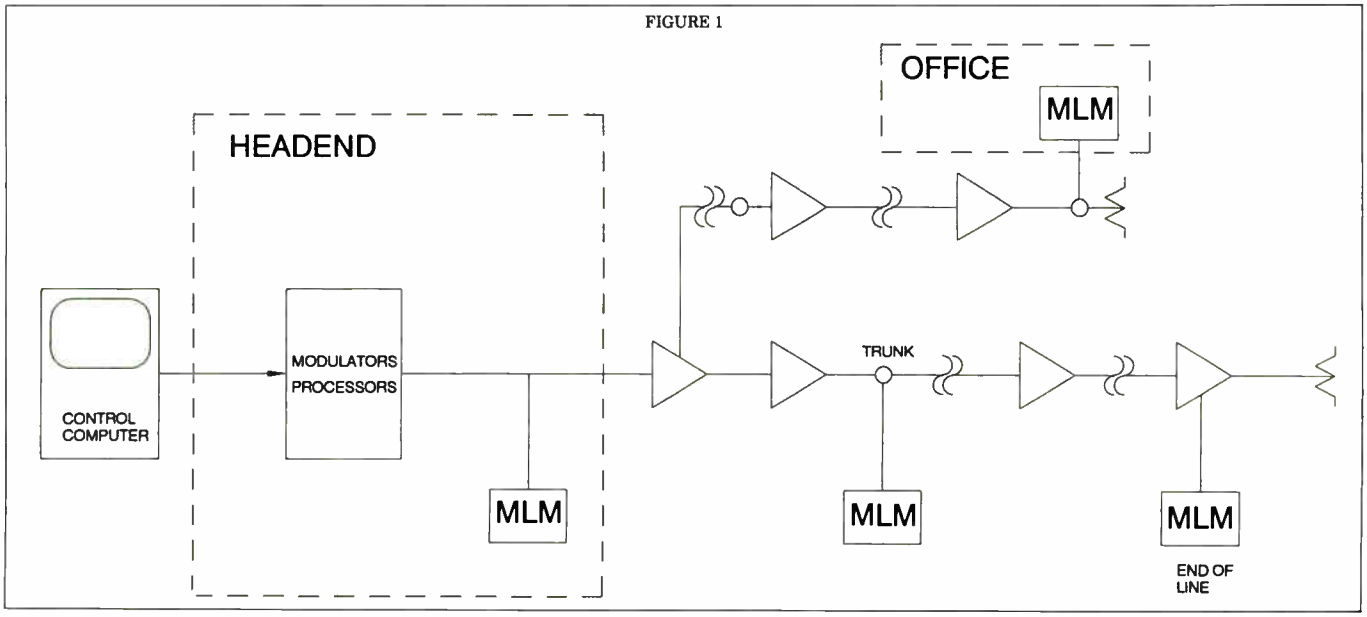
By Jeffrey Cox, Manager of Engineering Control Systems, and Aravanan Gurusami, Project Engineer, Magnavox CATV Systems Co.

The features of field test gear and status monitoring devices have finally been combined.

The Magnavox line monitor

The MLM is a stand-alone device that can be installed anywhere in the cable system: on the main trunk, in the headend, at the end-of-line, on feeder legs, or on tap outlets (see Figure 1). The rugged, weather-proof construction allows it to survive in the same environment as the distribution gear. The MLM measures the level of each carrier between 40 MHz and 550 MHz with direction from a personal computer located in the headend or office.

FIGURE 1



Measurement hardware

The heart of the MLM is a microcomputer that controls a synthesized tuner, a calibration reference circuit, the return data transmitter and the analog-level-processing circuits (see Figure 2). Non-volatile memory within the microcomputer contains factory programmed calibration data, allowing each unit to be individually calibrated during the production process. In addition, an internal calibration circuit ensures that measurements made by the system remain accurate over a wide operating temperature range. SMD technology makes it possible to provide many functions in a small, line-extender-type housing. Tuner technology makes it possible to measure carriers anywhere in the forward band of a cable system, while an external interface provides the expansion necessary to perform measurement and control functions that do not exist within the MLM enclosure.

The communications system, an extension of the existing Magnavox status monitoring protocol, allows the MLM to co-exist in a system with mainstation-based monitors. Since the MLM is a self-contained, stand-alone device, it can also be installed in systems that previously had no status monitoring gear. A 16-bit device address can control up to 65,000 units over a single data link. Power can be acquired from the cable or from an external 110/220 VAC source, which allows the unit to be mounted almost anywhere in the cable plant.

Control software

The measurement hardware's capa-

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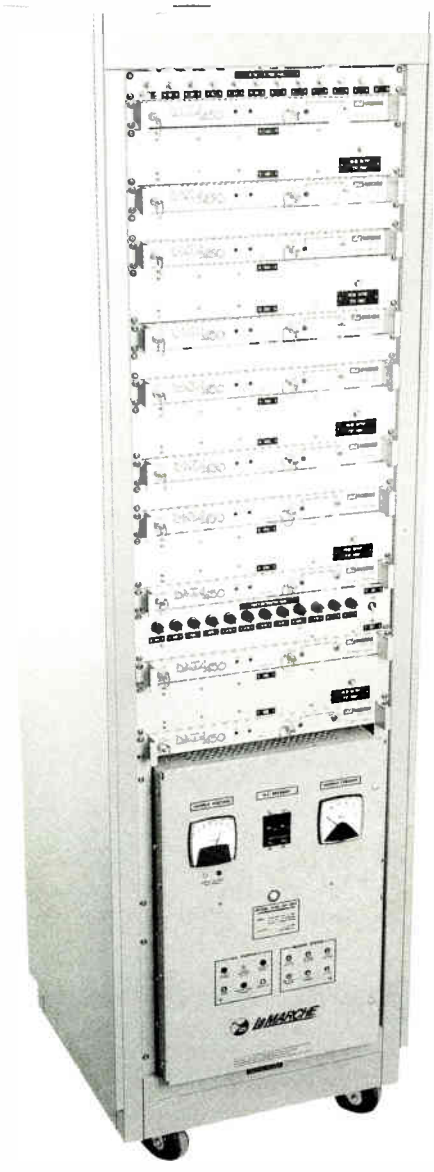

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The history of the system is maintained by storing samples of the measurements periodically.

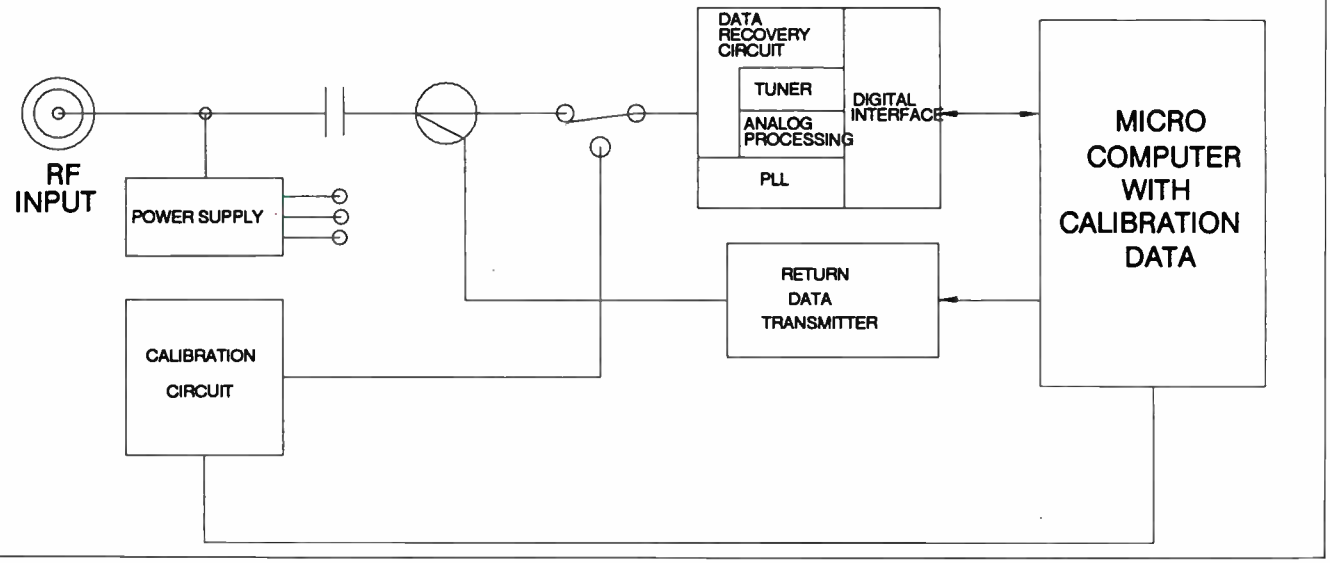
bilities are available to the user through the system software. This software uses the graphics capabilities of the IBM PS/2 series personal computers to provide a user-friendly interface that emulates the look and feel of equipment already familiar to many CATV technicans: the spectrum analyzer, sweep receiver, and field strength meter. Measurements that once required sending a trained technican to the field can now be made from the comfort of the office. It then becomes easy to monitor the performance of a CATV network and to spot any degradation before it becomes severe enough to affect subscriber satisfaction.

The system software performs real-time monitoring functions that are similar to other status monitoring products. The MLM, however, measures and reports the levels of all carriers in the system instead of one or two pilot frequencies. The MLM control software stores initial response characteristics in the computer and then analyzes changes in the response, comparing the changes to allowable limits the user enters into the system. If the limits are exceeded, visual and audio alarms go off, alerting the operator to a potential problem before it becomes a real problem.

The spectrum analyzer display provides as much detail as the operator desires. Generally, a plot of the video carrier levels provides sufficient detail. In some cases, the studio carriers are desired.

In the FM band, even more resolution is required in order to see each carrier. When more detail is necessary, a zoom function allows the user to select a frequency of interest and expand the display around that point. The MLM provides resolution down to 125 kHz, with a vertical scale 10 dB or 2 dB per division.

FIGURE 2



Application examples

In a typical application, the MLM monitors a few selected carriers on a continuous basis. The entire system can be polled quickly, typically under one minute for as many as 1,000 monitoring stations. The history of the system is maintained by storing samples of the measurements periodically. An alarm sounds when limits set by the user are exceeded.

At preset intervals, the system captures a complete frequency response measurement for each MLM. This is compared to base data that was stored when the system was initialized. For example, if the frequency response changes beyond limits the operator set, then the software stores the response and activates an alarm. The frequency response at various trunk depths are measured by strategically placed MLMs. Thus, changes in response are pinpointed to the system sections in which they occur. It is no longer necessary to check every amplifier to find the one with a problem.

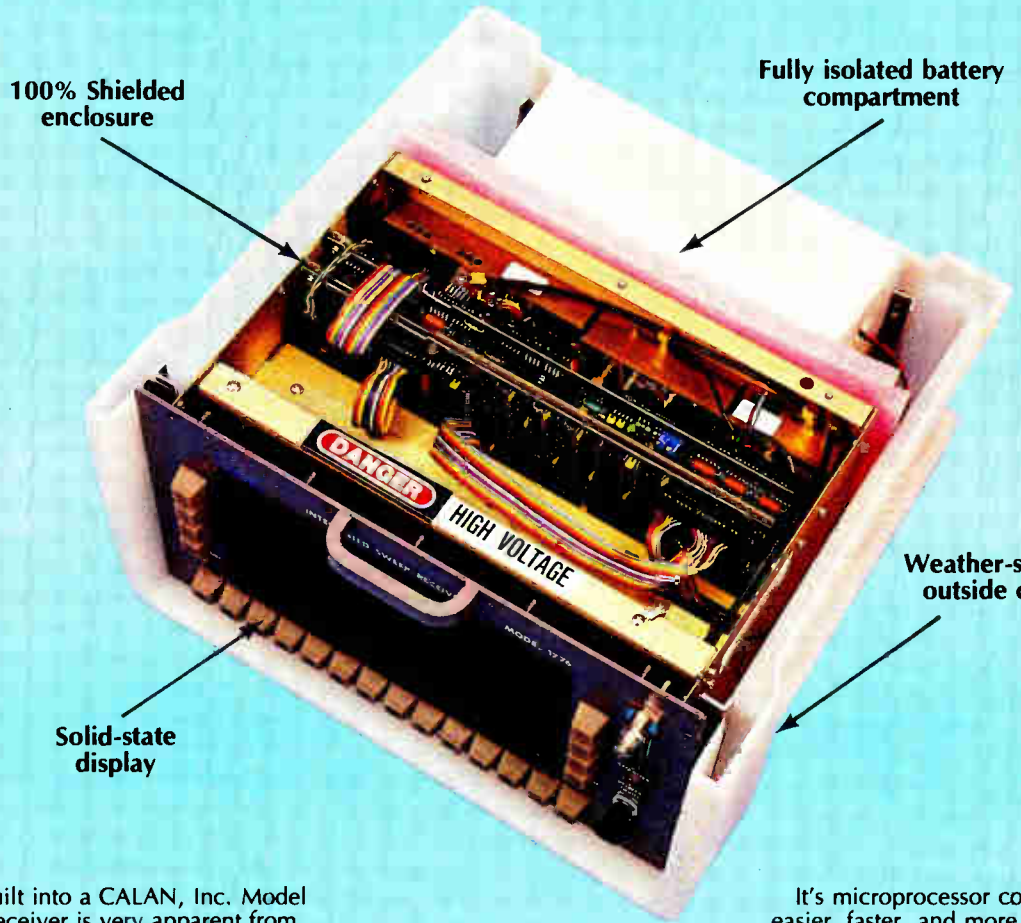
The basic operation of an existing status-monitored system is still verified by the amplifier-based monitor modules, while the broadband MLM monitors provide additional details from key locations within the trunk. Monitors can also be placed on feeder legs and in hub sites, allowing complete system coverage.

The external interface allows the MLM to monitor and control standby power supplies. The connection can be made through a parallel port, which provides up to four inputs and four outputs; it can also be made through a serial interface, which communicates to the standby power supply through a dedicated data link and reports back as much data as the power supply can provide.

In either case, the MLM reports when the power supply enters the standby mode, and it also exercises the self-test capability of the power supply.

Recent advances in hardware and software provide detailed, broadband, frequency response testing from a status monitor device permanently mounted in the cable plant. By integrating this test capability into a CATV system, operators can perform more detailed maintenance measurements. ■

The Inside Story on Reliability



Reliability built into a CALAN, Inc. Model 1776 Sweep Receiver is very apparent from the outside: the totally weather-sealed case; the ruggedized overall construction; the moisture-sealed key covers on the front panel.

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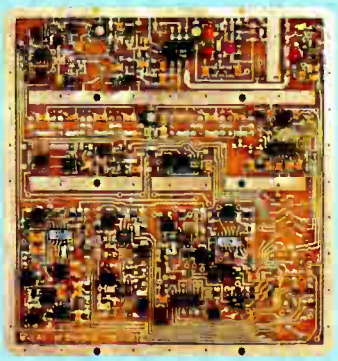
It's a solid-state Electro-Luminescent display, replacing the outdated CRTs.

It's new Surface-Mount RF Technology, making critical RF boards more reliable and more accurate than ever possible before. And a battery compartment that is totally isolated from the electronics, for absolute protection of the unit.



CALAN Surface-Mount RF Technology

It's microprocessor control, making testing easier, faster, and more accurate.

But all of these careful design criteria would be useless without the 75 years of CALAN engineering experience that went into the unit, making it the most reliable test equipment available today.

But if you ask a CALAN user, he'll most likely tell you that he hasn't seen the inside of his unit...just the outside, improving his system performance with no interference, and allowing more with his limited maintenance budget.

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Reader Service Number 58

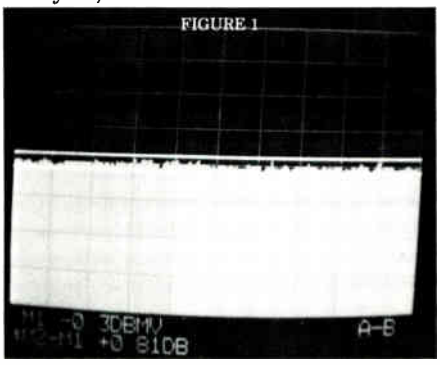
A high level and Sweepless Sweep comparison

In last month's article, we discussed the different methods of performing a system frequency response test. A new method, called Sweepless Sweep® analysis, was introduced. A direct comparison between the high level sweep (Wavetek 1855B/1865B) and the Sweepless Sweep (Wavetek 1882) was arranged with Comcast Indianapolis, who agreed to help perform the test on its Speedway system.

By Steve Windle, Senior Applications Engineer, Wavetek

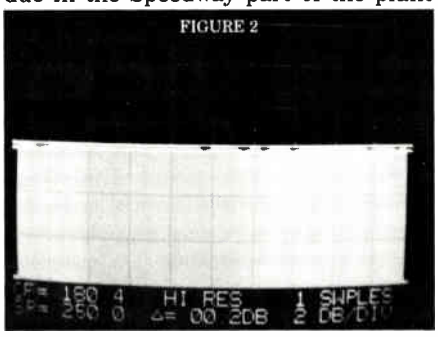
Dave Wenzlick, who normally takes care of sweeping this portion of the system, pointed out that a sweep was due in the Speedway part of the plant because it had been recently damaged by a severe ice storm. The damage was repaired quickly, but the system was short handed and when modules were replaced they were only "roughed in." This seemed like the ideal situation for the comparative sweep test.

FIGURE 1



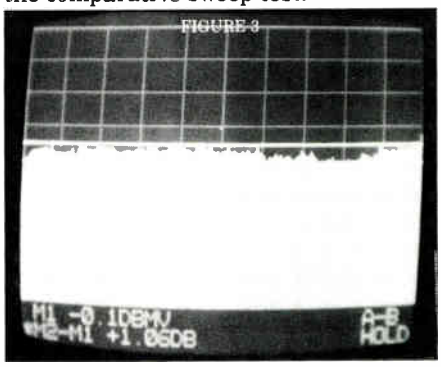
Normalized high level response at headend test point.

FIGURE 2



Headend Sweepless Sweep® response display.

FIGURE 3



1st amplifier high level response display.

Speedway is one of four hubsites for Comcast Indianapolis. Signals are microwaved from the Castleton headend and reprocessed. The high level sweep is inserted at 17 dB above video carrier

Notice that there are some variations in the sweepless response that aren't present in the high level response.

level. The response was measured and stored at the headend test point, which matches the level and response expected at each amplifier test point.

The 1882 Sweepless Sweep Analyzer was then connected to the headend test point. The channel plan was stored, and a reference sweep was taken. When we looked at the response, we noticed that there was an abnormal amplitude fluctuation at 191.7 MHz. When we zoomed in on this, and cleared out of the sweepless mode into the spectrum analysis mode, we discovered that channel 9 video modulation was riding over the peak of the audio carrier. This is something we couldn't have seen with the conventional high level sweep. We edited the channel plan so the 1882 would tune to the video carrier on this channel instead of the audio carrier.

Notice that the high level response at the headend test point (Figure 1) is about 0.6 dB higher peak-to-valley than the sweepless response (Figure 2). This is attributable to the variation in high level response due to uncancelled video modulation.

At the first amplifier test point the response was still quite flat and, as seen in Figures 3 and 4, the displays correspond well.

Notice that there are some variations in the sweepless response that aren't present in the high level response. This could be attributable to the difference in display dynamic range. The high level display has eight vertical divisions at 2 dB per division, where the sweepless display has six vertical divisions at 2 dB per division. This will cause any variations in response to appear more radically on the sweepless display, but the peak-to-valley measurement results are within 0.14 dB.

At the sixth amplifier some signature is beginning to develop. The peak-to-valley measurement still compares well between the two sweep methods (Figures 5 and 6).

At the 11th amplifier the variations in the response display (signature) are much more prominent on the sweepless display than on the high level display due to the difference in display dynamic range (Figures 7 and 8). The peak-to-valley measurement is very close (within 0.05 dB).

The 19th amplifier shows a pronounced signature buildup (Figures 9 and 10). The high level response display shows a little more of the high end response, since the 1855B is set to sweep out to 320 MHz, and the highest reference frequency in the sweepless response is 301.25 MHz. The peak-to-valley measurement results are within 0.32 dB.

The last amplifer in this cascade was number 23. The response by this time has degraded severely (Figures 11 and 12). This last section of plant is newly built and had not been swept before this date, but it did survive the ice storm.

A suck-out comparison

Since we didn't find a suck-out in our system tests, I created a tunable one in the lab. The suck-out was made using a return loss bridge (Wavetek FB40-75), a tunable bandpass filter (Wavetek PP-75) and a 75-ohm terminator (comes with the bridge). These instruments were configured as in Figure 13.

An RF bridge is designed to permit measurement of reflected RF from some device. In this case, the device is the bandpass filter with one port 75-ohm terminated. Any RF reflected from the device will be seen on the sweep receiver or analyzer. The 75-ohm terminator will absorb the RF passed by the filter. The RF outside the filter's bandpass will be reflected and appear at the output port of the bridge (minus the bridge insertion loss).

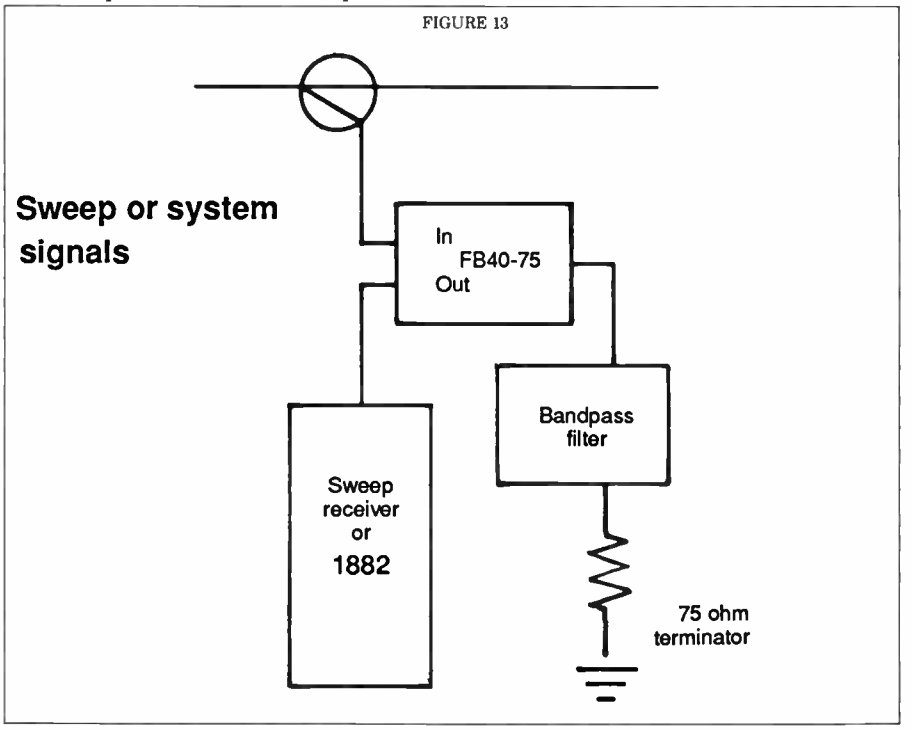
Figure 14 shows the notch (6.4 MHz bandwidth) created using this method.

The center of the notch was placed at 130.2 MHz, right between two sweepless reference points—the worst possible case. Figure 15 shows how the response would be seen if sweeping a system to 300 MHz.

Even though the suck-out is at a frequency between two reference points, the 2 dB per division sensitivity of the sweepless makes the suck-out easily apparent.

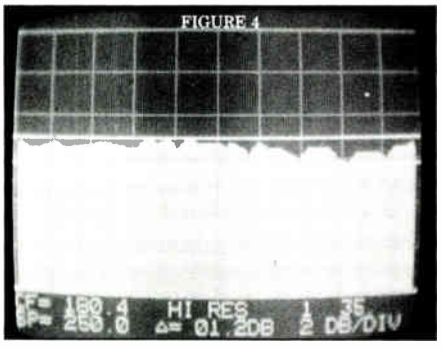
As the pictorial evidence shows, there isn't much difference between the displayed measurement results of the high level and the Sweepless Sweep methods. The addition of the spectrum analysis test functions, non-interference, no transmitter requirement and display storage and print-out capability makes the Sweepless Sweep System Analyzer a viable sweep response test alternative. ■

FIGURE 13



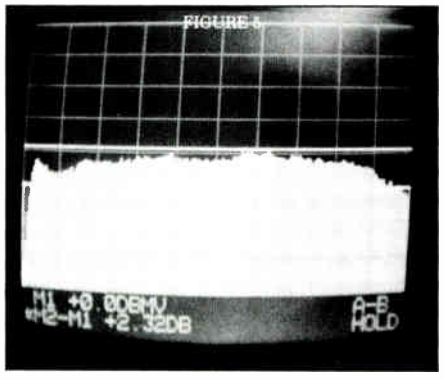
Since we didn't find a suck-out in our system tests, I created a tunable one in the lab.

FIGURE 4



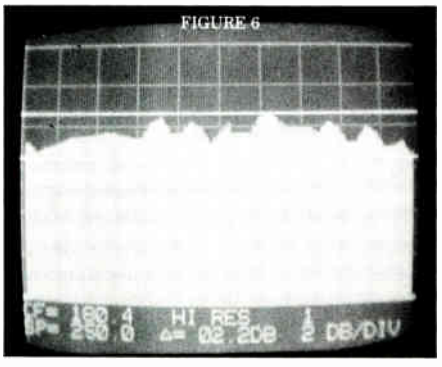
1st amplifier sweepless response display.

FIGURE 5



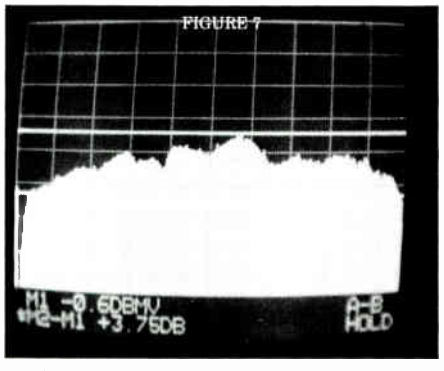
6th amplifier high level response display.

FIGURE 6



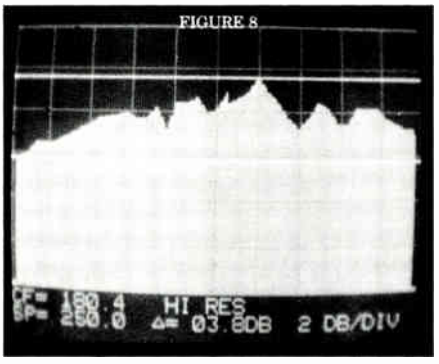
6th amplifier sweepless display.

FIGURE 7



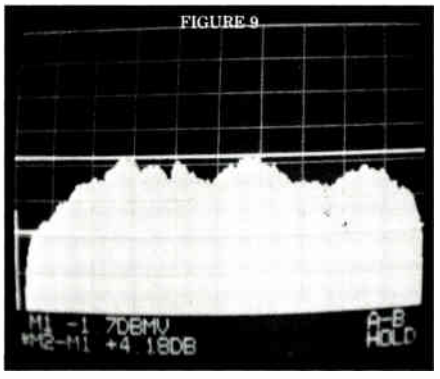
11th amplifier high level display.

FIGURE 8



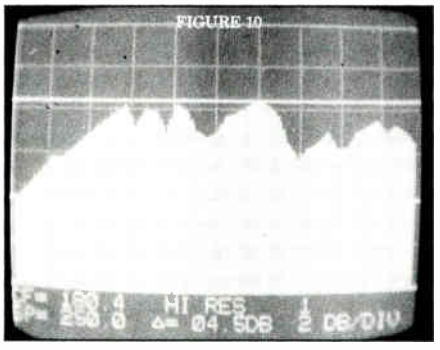
11th amplifier sweepless display.

FIGURE 9



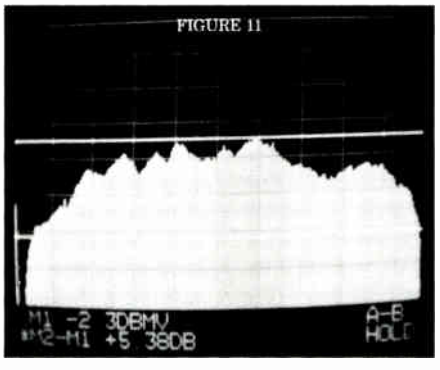
19th amplifier high level response.

FIGURE 10



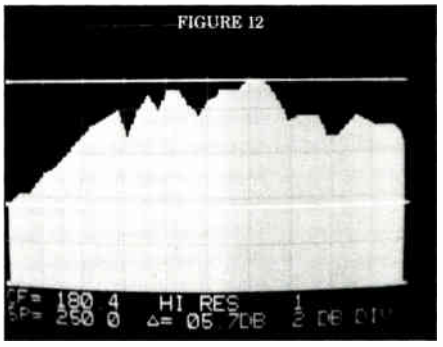
19th amplifier sweepless response.

FIGURE 11



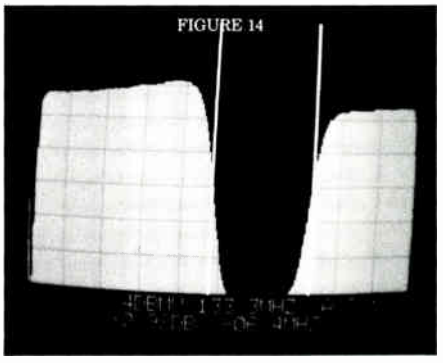
23rd amplifier high level response.

FIGURE 12



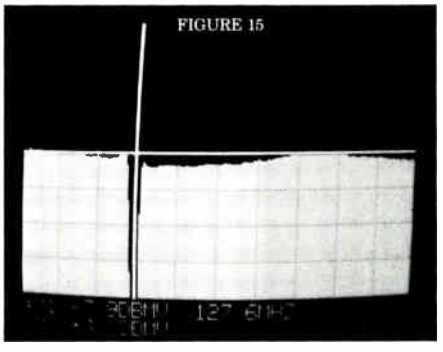
23rd amplifier sweepless response.

FIGURE 14



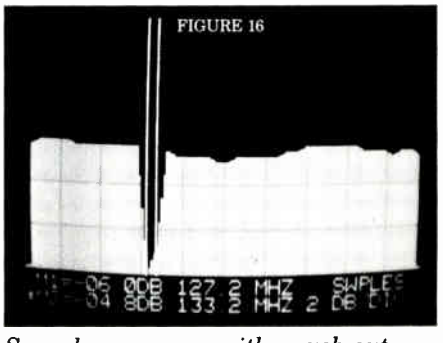
Swept response of notch filter (6.4 MHz suck-out).

FIGURE 15



High level response with a suck-out.

FIGURE 16



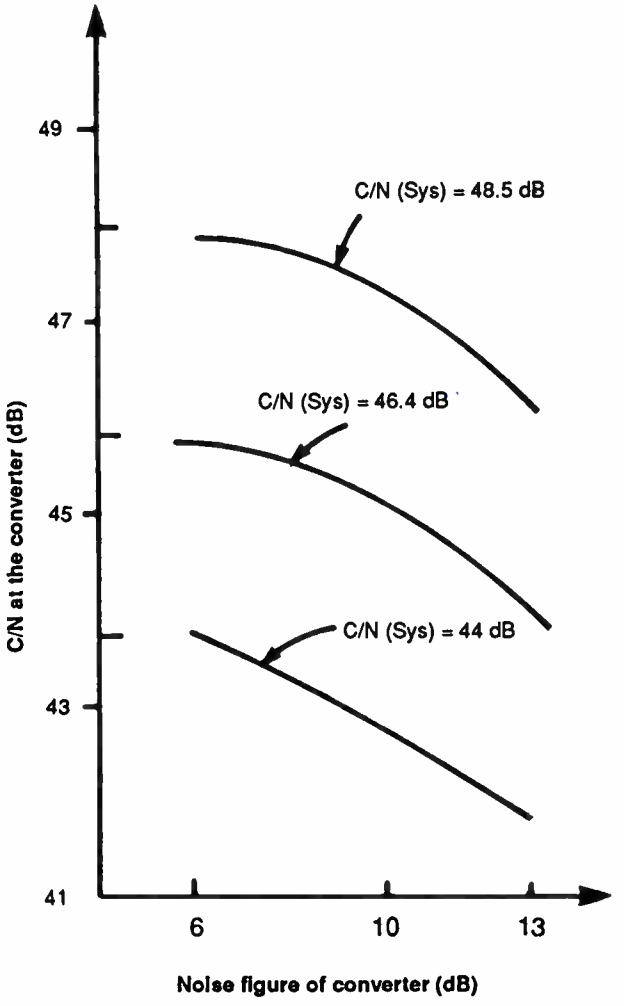
Sweepless response with a suck-out.

Keeping current with system design

There are several major urban CATV construction projects in progress on the East Coast (New York, Philadelphia, Washington, D.C.). An enormous number of new subscribers will be first exposed to cable TV, receiving their local VHF and UHF stations on cable, comparing the "old" (off-air) and the "new" (cable) picture quality. Despite the fact that the pictures arriving from the rooftop TV antenna may have been full of ghosts and suffering from smearing or misregistered colors, the input levels were still so high that the TV set's carrier/noise ratio exceeded the 55 dB level. The pictures were free of background noise.

Now, here comes cable, delivering a picture without ghosting (we hope), smearing and color distortion, but with a 43 dB C/N ratio (still 7 dB higher than the FCC mandated level for CATV systems). The first thing the new urban CATV subscriber probably asked the installer was, "What is that snow doing on channel 5 (or channel 7)? They were absolutely free of noise before."

FIGURE 1



Random noise is the most perceivable picture impairment for the untrained eye.

In a metropolitan area, the system design should aim for a 46 dB to 47 dB C/N ratio *at the subscriber drop*. Furthermore, designers cannot overlook the fact that the cable signal does not stop at the drop; there are two additional active devices in the signal path—namely the converter and the TV receiver.

Consider the following situation. The system exhibited, after a cascade of 22 trunk amplifiers plus one bridger and one line extender, a C/N ratio of 46.4 dB. What will be the well balanced system's *combined* C/N ratio at the output of the converter with a noise figure of 13 dB?

The problem is solved in two steps. First, assuming theoretical noise-free input signals, calculate the C/N at the output of the converter, while increasing the input signals from 0 dBmV to +10 dBmV. Second, using the standard power addition formula of

$$C/N_{(comb)} = -10 \log \left(10^{\frac{-C/N_1}{10}} + 10^{\frac{-C/N_2}{10}} + \ldots + 10^{\frac{-C/N_n}{10}}\right)$$

calculate the *combined* (distribution system plus converter) C/N ratios.

A converter with a 13 dB noise figure will yield the following C/N ratios:

At 0 dBmV input, the C/N ratio = 46 dB; at +3 dBmV input, the C/N ratio = 49 dB; at +6 dBmV input, the C/N ratio = 52 dB; and at +10 dBmV input, the C/N ratio = 56 dB.

Applying the power addition formula:

At 0 dBmV input the combined C/N ratio will be 43.19 dB; at +3 dBmV input the combined C/N ratio will be 44.49 dB; at +6 dBmV input the combined C/N ratio will be 45.34 dB; and at +10 dBmV input the combined C/N ratio will be 45.94 dB.

The 45.94 dB C/N ratio, at a +10 dBmV level seems impressive. However, the majority of the homes could have two or three outlets, plus a VCR. Consequently, the +6 dBmV converter input looks more realistic than the +10 dBmV, and the 45.34 dB C/N ratio closer to actual conditions.

Selecting another converter with an *improved, 10 dB noise figure:*

At 0 dBmV input the theoretical C/N ratio is 49 dB; at +3 dBmV input the theoretical C/N ratio is 52 dB; and at +6 dBmV input the theoretical C/N ratio is 55 dB.

Applying again the power addition formula:

At 0 dBmV input the new combined C/N ratio will be 44.49 dB; at +3 dBmV input the new combined C/N ratio will be 45.35 dB; and at +6 dBmV input the new combined C/N ratio will be 45.84 dB.

At +6 dBmV input level the 45.84 dB C/N ratio looks like an attainable and respectable improvement, and close to our objective of 46 dB.

However, the signal has not passed through the 10 dB noise figure TV receiver yet, fed by a +10 dBmV input. (The converter has 4 dB gain).

According to the power addition

By Steven Biro, President, Biro Engineering

A 3 dB lower noise figure converter provides less than 1 dB improvement in C/N ratio at the detector of the TV.

equation:

$$C/N_{(total)} = 10 \log (10^{-46.4/10} + 10^{-55/10} + 10^{-59/10}) = 45.63 \text{ dB}.$$

The reduction is an insignificant 0.2 dB.

Figures 1 and 2 are graphical presentations showing how the C/N ratios are affected by the converter and the TV receiver. Figure 1 shows conditions at the converter, while Figure 2 shows conditions at the detector of the TV receiver, or the the real C/N ratios observed by the CATV subscriber.

It is interesting to note that a 3 dB lower noise figure converter provides less than 1 dB improvement in C/N ratio at the detector of the TV receiver.

Worst case scenarios

Manual gain trunk amplifier suffers 10 dB loss in gain. Our "model" distribution system should operate with a cascade of 20 trunk amplifiers, each characterized by a 59.5 C/N ratio, plus one 68 dB C/N ratio bridger and one 69 dB C/N ratio line extender. The distribution system is fed from a 60 dB C/N ratio headend.

The combined C/N will be:

$$10 \log (10^{-60/10} + 20\text{x}10^{-59.5/10} + 10^{-68/10} + 10^{-69/10}) = 46.25 \text{ dB}.$$

Consider a situation where amplifier number 4, a manual gain unit, suffers a 10 dB loss in gain. Consequently, the input at station number 5, which is an AGC module, drops 10 dB. Amplifier number 5 can compensate only for 5 dB of loss, thus the input at amplifier number 6, a manual gain station, the input will still be 5 dB below normal, and the same conditions apply to station number 7.

Using the C/N power addition formula:

$$10 \log (10^{-60/10} + 17\text{x}10^{-59.5/10} + 10^{-49.5/10} + 2\text{x}10^{-54.5/10} + 10^{-68/10} + 10^{-69/10}) = 44.12 \text{ dB}.$$

The 2.13 dB deterioration in C/N ratio is much less than expected, considering an almost catastrophic failure at a trunk station.

Let's turn now our attention of the subscriber, located at a cascade of eight trunk amplifiers plus one bridger plus one line extender from the headend. How is that customer going to be affected?

Under normal conditions the combined C/N ratio is:

$$10 \log (10^{-60/10} + 8\text{x}10^{-59.5/10} + 10^{-68/10} + 10^{-69/10}) = 49.88 \text{ dB}.$$

Due to the malfunction (10 dB drop) at station number 5, the reduced combined C/N ratio is calculated as:

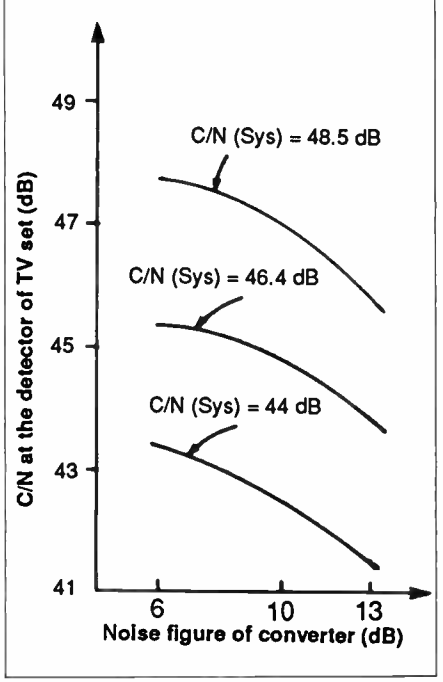
$$10 \log (10^{-60/10} + 5\text{x}10^{-59.5/10} + 10^{-49.5/10} + 2\text{x}10^{-54.5/10} + 10^{-68/10} + 10^{-69/10}) = 45.98 \text{ dB}.$$

The 3.9 dB reduction in C/N ratio is considerably higher than the 2.13 dB found at the end of the system. The customer may or may not notice the increase in background noise.

Line extender suffers severe loss in gain. Consider the situation in another "model" cable plant, where the gain of the line extender drops by 10 dB.

The combined headend, plus trunk, plus bridger and line extender C/N ratio is 46.4 dB.

FIGURE 2



The converter, with a 13 dB noise figure and a +6 dBmV input signal, should yield a 52 dB C/N ratio. The TV receiver, fed by a +10 dBmV input signal operates at a 59 dB C/N ratio. The TV receiver, fed by a +10 dBmV input signal operates at a 59 dB C/N ratio.

According to the power addition rule:

$$C/N_{(comb)} = 10 \log (10^{-46.4/10} + 10^{-52/10} + 10^{-59/10}) = 45.16 \text{ dB}.$$

Because the 10 dB loss in line extender gain, the converter's C/N is reduced to 42 dB, as well as the TV receiver's C/N ratio, from 59 dB to 49 dB.

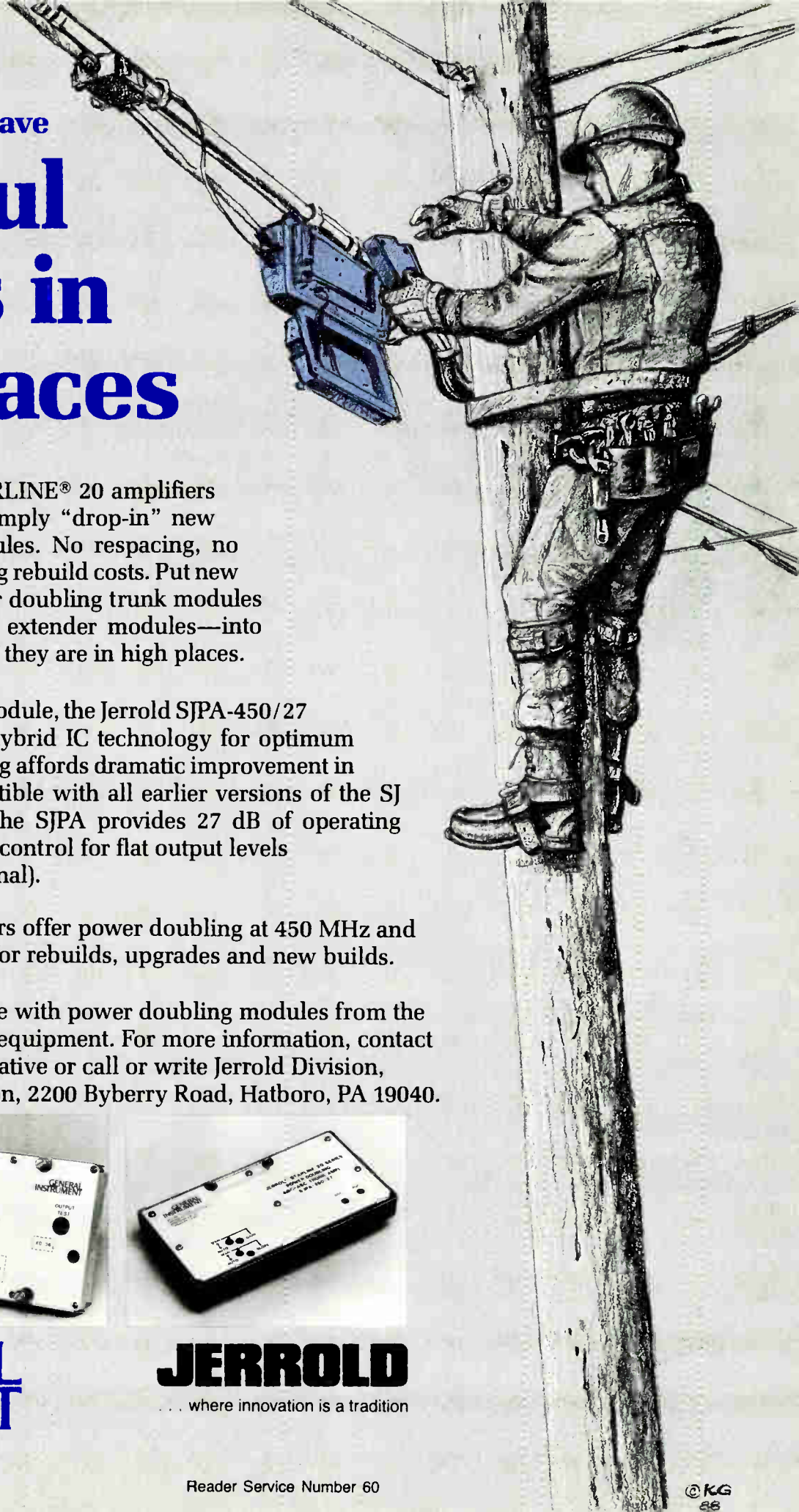
Applying the power addition formula:

$$C/N_{(comb)} = 10 \log (10^{-46.4/10} + 10^{-42/10} + 10^{-49/10}) = 40.06 \text{ dB}.$$

The 5.1 dB drop will be noticed.

Single, UHF channel difficulty at the headend. The wind shifted the channel 24 antenna-array on the tower, reducing the signal level at the input of the processor from +14 dBmV to -2 dBmV. This, in turn, lowered the processor's C/N ratio to 44 dB.

While the headend plus the cascade of 20 trunk amplifiers remained at a



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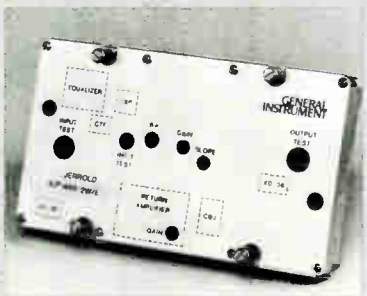

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Reader Service Number 60

C/N ratio of 45.98 dB, the combined C/N ratio was reduced on the troubled channel 24 to:

$C/N_{(Ch\ 24)} = 10 \log (10^{-44/10} + 20 \times 10^{-59/10}) = 41.87$ dB.

This represents a loss of 4.11 dB from the 45.98 dB C/N ratio, calculated for the rest of the channels.

How will that subscriber be affected on channel 24, who is only five trunk amps plus one bridger and one line extender away from the headend?

Before the channel 24 difficulty developed the combined C/N ratio was:

$C/N_{(comb)} = 10 \log (10^{-60/10} + 5 \times 10^{-59/10} + 10^{-68/10} + 10^{-69/10}) = 51.2$ dB.

After the antenna shifted:

$C/N_{(Ch\ 24)} = 10 \log (10^{-44/10} + 5 \times 10^{-59/10} + 10^{-68/10} + 10^{-69/10}) = 43.33$ dB.

The difference is 7.87 dB, which is a substantial increase in background noise and should be observed by the average subscriber.

Input signal level and noise figure variations. Under practical system operating conditions not all trunk amplifiers will be fed by the same signal level, nor would every amplifier exhibit the same noise figure.

The amplitude of the input signal can easily drop by 1 dB at the trunk amplifier, because:

a. A poorly calibrated signal level meter was used.
b. The amplifier was replaced under emergency conditions.
c. The equalizer and/or input attenuator was replaced, without confirming their proper values.

Then, conventional system trunk C/N ratio calculations, which assumed identical input levels, are not valid anymore. The mathematically correct C/N ratio calculation should use the noise power addition formula.

Of course, the same rule applies to a situation with a number of misbalanced trunk amplifiers driven by 1 dB higher input signal levels.

Statistically, these input level "errors" should compensate for each other. Most of the time, the conventional system trunk C/N ratio calculation provides predictable testing results. ■

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Reader Service Number 63

product profile

Need to 'sniff' out leaks or 'trace' their source? The gear's all here

Thinking about setting up a ground-based leakage detection/control program for your cable system? You better be, the July 1, 1990 deadline for *compliance* with the Cumulative Leakage Index rules set up by the Federal Communications Commission is approaching quickly. In fact, operators who already have programs up and running say it takes about a year or so to get a system in shape. So with just two years to go, if you haven't started or at least planned out a program, it may be too late already.

Don't expect your techs to be able to grab a dipole antenna and begin making highly accurate measurements the first time out. It takes practice and diligence to do a good job, says Mike Berry of Wavetek. And not all available gear measures leaks in microvolts, so conversions are tough.

There are a number of different ways to find RF leakage. The most common and enduring method is to use a transmitter in the headend to inject a carrier on the system. Special receivers, tuned to the transmitted frequency, are used in the field and if the carrier is detected, the egress is located.

Another, newer method, is to use a receiver that detects existing video carriers on a system. If a video carrier is detected, signal leakage is likely to be present. This type is system is less expensive (no headend transmitter is necessary, cannot create interference on video channels and there is no need to locate "room" to place a separate carrier. A drawback is attached, however; just because the receiver detects a video carrier isn't proof that a leak exists, it could be picking up an over-air signal.

Tunable signal level meters can also be used not only to detect leaks, but to quantify them as well. By hooking them up to a dipole antenna, leaks can be located; and by tuning through the spectrum of channels offered, leakage can be detected on all frequencies.

Texscan Instruments

Texscan offers a full line of detection equipment. The FDM system consists of a headend transmitter (FDM-5) and both a portable receiver (FDM-3) and mobile receiver (FDM-4) designed for vehicle mounting.

The FDM-5 synthesized transmitter

Texscan's full line of equipment

allows for easy reprogramming for offsets or different frequencies in 25 kHz increments. A phase lock loop is include to assure the unit is operating at the proper frequency. If the phase lock loop breaks, the unit shuts down the RF output level and the front panel LED flashes.

The receivers operate from 104 MHz to 120 MHz and include as standard frequencies 107.997 MHz and 108.625 MHz. Aural and visual alarms notify the operator of detected leaks and both feature one-half μv sensitivity.

More specifically, the FDM-3 portable receiver clips on the belt and weighs just 13 oz. Low and high volume controls and an alarm test function are also included. The FDM-4 is a dedicated vehicle receiver that operates using the vehicle's 12V battery.

The FDM system is priced at about $1,500, said Brenda Bangle-Gentry, marketing manager of CATV products at Texscan Instruments.

The Searcher line of gear monitors a video carrier already existing on the system. It's available for channels 14 through 18 and 12.5 kHz offsets are available. The unit is simple to use, so virtually every employee can help control any leakage problem. Searchers are priced at $255 each for belt-clip models, $334 for vehicle use (price includes a magnetic antenna).

According to Texscan's application note, the Searcher is primarily designed to detect leakage at the drop, where most leaks are found. When a leak is detected, the Searcher activates a visual (red LED) and audible (tone) warning. Increasing signal strength causes the tone to increase in pitch. A "gain lo" button allows the unit to operate properly in the presence of strong signals that exceed -50 dBm at the antenna input port by reducing the sensitivity by about 30 dB.

Wavetek

Another Indianapolis-based company offers two leakage test signal generators. The ST-1 "Cuckoo" provides a tunable signal that can be received with an ordinary FM radio. The ST-1C generates a crystal-controlled signal that is received with the CR-1B receiver. Both generators have warble tone modulation and five-step, 5 dB per step amplitude variation to help locate leaks.

Wavetek's ST-1C transmitter

A specially designed scanning receiver, the CR-6, is also available. The receiver is tuned to receive video carriers already present on the system. The AGC of the receiver is tied to a locator tone which varies in pitch with the strength of the signal. The CR-6 can be set to scan six different frequencies or be fixed on one single frequency.

To help determine the strength of leaks, the RD-1 tunable dipole antenna is offered by Wavetek.

A "sync buzz" mode allows the operator to listen to detected audio to determine if the received signal is actually a cable leak or an over-air transmission. The CR-6 can be used with the antenna removed to pinpoint exact leak locations.

To help determine the strength of leaks, the RD-1 tunable dipole antenna is offered by Wavetek. A built-in amp brings low-level leakage signals up to a level readable via a SLM, such as the Wavetek SAM I or SAM III.

Despite the range of available gear, measuring leaks and calculating CLI isn't easy, says Mike Berry. Correction factors have to be added if the measurement wasn't taken at the proper distance, equipment has to be recalibrated, strength measurements have to be converted to μv/m, etc. Consequently, the company is planning to roll out new equipment that has been described as much more "friendly" to technicians in the near future.

ComSonics

The Sniffer System from ComSonics is probably the most popular unit used in the industry. The system works with a transmitter that places a special precoded carrier on the cable system

LRC Electronics' Tracer Unit

and receivers are used in the field to detect the transmitted carrier.

By using fixed tuning, receiver bandwidth can be made very narrow, the company said, which reduces power line masking problems and assures accurate detection of egress. This way, the possibility of receiver mistuning is eliminated.

(A further description of the hardware and prices were unavailable by press time.)

Augat/LRC Electronics

Augat's TR-1 Tracer leakage detection receiver uses a dual-meter scale to indicate relative field strength and maximum allowable distance. The 0dB

point on the field strength scale indicates the maximum allowable leakage when measured at a distance of 10 feet from the CATV cable.

The Tracer operates with any one of the standard TV video carriers and emits an audible tone when leakage is found.

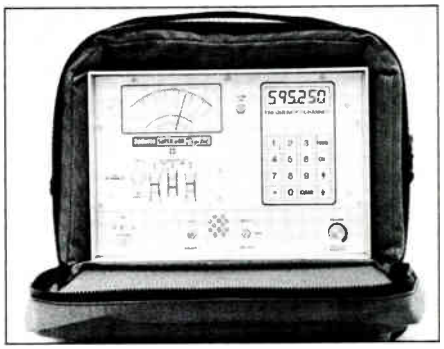
During normal use, a magnetic dipole antenna is attached to a vehicle and to the Tracer and the vehicle is driven through the system. After leakage is detected, the actual leak is found by removing the antenna from the vehicle and walking near the plant. To determine if leakage exceeds the regulations, the antenna is held a constant distance from the cable and rotated for maximum meter deflection.

If the distance indicated on the maximum distance scale is less than the actual distance from the antenna to the cable, you've failed. If you use the field strength scale and the meter passes beyond the 0 dB point, you've exceeded the maximum allowable leak.

Sadelco

Sadelco also relies on SLMs to not only detect leaks but measure their severity. A full line of units are available: from the $600 7450-B to the $1,485 Super 600.

Use of a SLM and a calibrated dipole with three-meter mast allows the user to tune through the spectrum to detect



Sadelco's Super 600 digital

leaks throughout a system's bandwidth, not just a single frequency, said Gerald Goldman, vice president of marketing at Sadelco.

New-generation 7450-B and FS4-VS units have been beefed up to handle

Continued on page 108

in the news

Seen the new identification markings on that reel of recently delivered coax? As of July 1, the revisions to the National Electrical Code that affect CATV go into effect. As mentioned in *CED* two years ago, (*More stringent plenum/riser cable rules on the way*, May 1986, p.14) the new rules require coaxial cable manufacturers to use flame- and fume-resistant jacketing. The cables are subjected to Underwriters Laboratories tests and then labeled accordingly.

Article 820-4 of the Code details the markings of cables for use in any given area, said Chris Huffman, senior applications engineer at Comm/Scope. Although the Code is subject to local interpretation, Huffman said most fire inspectors, especially those in large urban areas, are expected to be looking for the new markings. So if you're planning a rebuild, upgrade or even just repairing old drops, make sure the new cable is marked appropriately.

CATV. This classification covers cables exceeding .375 inches in diameter used to wire residential or commercial buildings other than vertical runs in shafts, ducts, plenums and other air handling spaces.

CATVD. This marking identifies cables used for outdoor service entry drops from a pole or from a support to a building.

CATVP. The "P" marking is for the high temperature cables used in air handling spaces.

CATVR. This is a new grouping for cables used in riser shafts (vertical passageways like elevator shafts) of buildings. CATVP cables can be substituted for CATVR products, according to Comm/Scope.

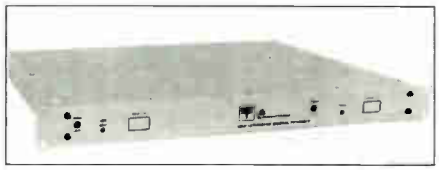
CATVX. For cables under .375 inches in diameter that are used to wire residential areas other than vertical runs, use this group.

Excluded from the rules are "jumpers"—cables shorter than 10 feet long. And so far, there has been no test set up for CATVD cables, so manufacturers are not required to mark it, said Huffman. However, operators may ask for marked cable for inventory purposes, he added.

Apparently, the new rules were triggered by a fire at a Bell operating company switchboard in New Jersey. Like any new rule, it may pose hassles to begin with, but the change will go largely unnoticed. Just make sure the cable you install for now on has the proper identification for the application you're using. Better safe than sorry.

In other news, **Multiplex Technology** has developed a new frequency agile modulator for its Channelplus line of products. The A3V/HB contains three independent analog tunable modulators and allows for three separate installer-selected RF outputs to cable channels between 37 and 64. This allows video sources such as VCRs, video disk players, satellite receivers, computers, CCTV cameras and cable decoder boxes to be assigned to selected channels.

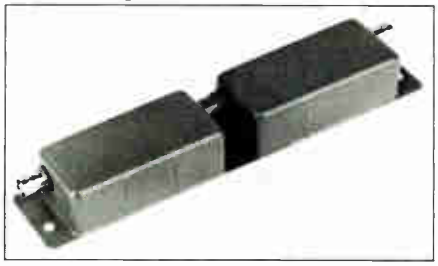
The unit was designed for use in homes, hotels/motels, hospitals and security systems where all TVs tuned to the proper channel will see the same program. It is priced at $475 with volume discounts available. Call (714) 680-5848 for details.



Blonder-Tongue's channel processor

Blonder-Tongue Labs unveiled its new ESHP high output aural/visual channel processor. It features a 60 dBmV output level and is used to put off-air VHF and UHF broadcast channels on CATV and SMATV systems.

Features include an adjustable aural carrier trap to allow BTSC transmission; an IF loop-through for spurious-free output and insertion of scrambling equipment; an optional automatic standby; and a field replaceable heterodyne converter board for input and/or output channel changes. Call (201) 679-4000 for information.



Microwave Filter's Ku-band filter

A series of new filters has been announced by **Microwave Filter Co.** The new 6367 series of tunable notch filters for 30 MHz to 900 MHz cover an approximate 2:1 frequency range with an adjustable 3 dB bandwidth. The notch filters suppress interference and can be used in CATV, LAN and other applications. A variety of tuning ranges are available and prices range from $139 to $169.

Better specs for a lower price. That's what the redesigned CCTV Coupler for hyperband channels offers. The coupler incorporates a 3217SHY channel deletion filter to block the hyperband channel to be used for closed circuit. A new channel is inserted through a selective bandpass filter and a built-in directional coupler mixes the new channel with on-line channels. Price is $1,495.

The 6207 Channel Deletion Network is used at the headend to pass channels 2, 4 through 8 and 11 through 13 and deletes channels 3, 9, 10 and 92 MHz to 168 MHz. This allows systems to remove existing channels for reinsertion of different programming. Price is $2,695.

Multiple dwelling units that want to combine CATV and their own programming can use the Model 6211 low pass filter to distribute the programs. The unit passes channels 2 through W and removes channels AA to 550 MHz.

A new bandpass filter, Model 6209, protects Ku-band digital information from interference by other satellite signals at the input to the receiver. Passband is 43 MHz to 97 MHz and loss is 2 dB max. Price is $225.

Model 6024 notches out intermodulation carriers. A 15 dB minimum notch is located at 760.75 MHz and 774.25 MHz. Passband is 764 MHz to 770 MHz. Price is $950. For information, call (315) 437-3953.

Two new four-channel mixing networks are now available from **Pico Macom**. Both the MX-4U and MX-4V combine single channel antennas for use with broadband amps. They also separate signals coming from a broadband antenna and balance signals on

Continued on page 107

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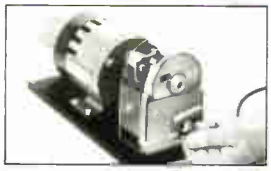

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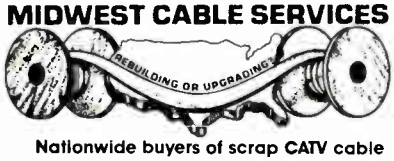

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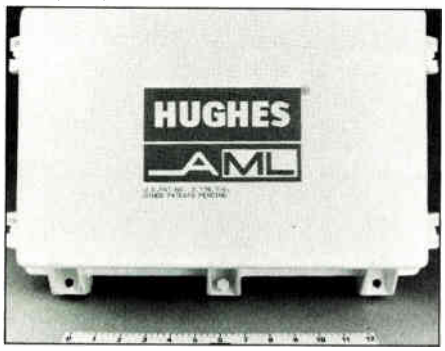
Dave Large and Abe Sonnenschein received Vanguard Awards during Cable '88.

Continued from page 99

a broadband system. MX-4U allows separation or combination of up to four UHF non-adjacent channels; MX-4V allows the same of up to two low-band and two high-band non-adjacent VHF channels. For details, call (800) 421-6511.

The development of a new signal level meter, the Super 600 Digital, was announced by **Sadelco**. The new unit features illumination for both the LCD panel and microameter, a digital keypad for frequency/channel selection and a weatherized cases with foam padding.

Tuning range is 4.5 MHz to 600 MHz. Built-in NiCad total discharge protection is included. For information, call (201) 569-3323.



Hughes' outdoor receiver

A new compact outdoor receiver was announced by **Hughes Microwave**. The new 550 MHz receiver is compatible with all Hughes AML receivers operating in the CARS band. When used with a Hughes transmitter, the receiver serves as a complete multichannel headend. Receiver output is used directly to drive the conventional cable plant from remote hubs, thereby reducing amplifier cascades and the need for supertrunk.

It's available with or without a low-noise amplifier. For information, call (213) 517-6233.

Head over to the **Viewsonics** booth when you attend the SCTE Cable-Tec Expo in San Francisco this month. A series of new products will be introduced, including precision terminators priced at $15; detectors ($15); return loss bridges ($100); metered power supply testers ($345); and amplifier products.

If you don't get there and want more information, call (516) 921-7080.

Multi-fiber plenum and riser cable has been added to the product line available from **Pirelli Cable Corp.** The cables contain up to 24 strands each. Routing and connecting is facilitated by the cables' breakout design, which utilizes individually jacketed and protected 900 micron tight buffer fibers in a single sheath. For info, call (201) 687-0250.

Several new products were announced by **Siecor Corp.** The company has entered the connector market with its new field-assembled unit. It is an ST compatible termination. The connector can be assembled faster than other designs, said company officials.

The new OT-100 optical tester tests optical power in fiber optic communications line, field and bench applications. It is designed for use in LAN and data communication applications. Features include a digital readout; measurement range of 10 dBm to -60 dBm; one-touch selection of relative or absolute level; autoranging and a relative-mode buzzer alarm.

The new SeeSplice is a mechanical splice featuring a unique fiber alignment method for both single- and multimode fibers. The design provides positive visual and tactile feedback to assure fiber mating.

Finally, a new attenuation test set is available. The CME 1000 consists of a software driven mainframe with two universal plug-in ports designed to accept and configure any combination of detector and light source modules. For details on any or all the products, call ((704) 327-5000.

Creative Management Systems' new software Release 7.0 contains enhancements designed to speed order processing and improve productivity of customer service and dispatch functions. For info, call (415) 362-1345.

Quick Alert Version 4.0 software was released by **C-COR Electronics**. The broadband status monitoring software employs pull-down menus, color graphics and on-line help messages. Other features include: a horizontal bar graph display in various colors; automatic loading of nominals; and color selection of screens by the user. For details, call (814) 238-2461.

Detecting and locating power line sparks that cause interference just got easier with the introduction of the Vehicular Locating System by **Radar Engineers**. The system can reportedly identify most multiple sources of power line sparking by the unique wave shapes or signatures. The system consists of a rooftop antenna that can be hand manipulated and the Model 227 amplifier. Call (503) 256-3417 for info.

A new software program to help monitor the level of signal leakage is available from **Telecommunication Products Corp.** The software, known as "CLIDE," uses accumulated data to calculate Cumulative Leakage Index. It is menu-driven and several report functions are included. For details, call (717) 267-3939.

Two new products were announced by **Zenith Electronics**. A new automatic phone dialer speeds impulse pay-per-view ordering and can be used with just about any automatic number identification system, including Zenith's Phonevision. The new unit allows the subscriber to order with the remote control because authorization prefixes are stored in the box's PROM. A four-digit program code is all that is necessary. The stand-alone box is connected to the phone, not the cable converter.

The company's first non-addressable converter made its debut, too. The Model ST-300 RF device is designed for the replacement market and for consumers without cable-ready TV sets. It tunes 84 channels and features channel scan, channel mapping, BTSC compatibility, last channel recall and a remote control. For details, call (312) 391-8181.

Improved VCR switches are now available from **Qintar Inc.** Model 4006A (amplified) and 4006B (passive) have increased shielding and higher isolation specs. They also have new black cases to complement consumer electronics. Prices are $36 for the amplified unit, $26 for the passive device. For details, call (714) 756-8501.

Dave Large and **Abe Sonnenschein** received Vanguard Awards during Cable '88, the NCTA's National Convention and Exposition. Large, former senior vice president of engineering at Gill Industries and now with **Raynet Inc.**, won the award for science

Sadelco also relies on SLMs to not only detect leaks but measure their severity.

and technology. He was recognized for his leadership in signal quality and consumer electronics compatibility.

Sonnenschein, AML manager for **Hughes Aircraft Microwave Products Division**, was given the award for Associates for his pioneering work in the use of microwave to deliver CATV signals. *CED* congratulates both men.

Bob Price was named senior vice president of **BradPTS**. **Ron Michelson** was named vice president of finance and **Harold Petrie** will serve as vice president of data processing for the firm, formed as a result of mergers between PTS Corp., Brad Cable Electronics, RF Analysts and Katek. **Jack Craig**, former president of PTS Corp. now serves as president of BradPTS.

Robert Lemming has been named executive vice president of **Western Tele-Communications'** microwave subsidiary. He was formerly director of corporate administration at WTCI.

Larry Stewart has been appointed vice president of marketing and sales at **Radyne Corp.** He was previously senior product manager at LNR.

Tom Jorgenson has been named manager of sales and marketing at **ComSonics Inc.** He came to ComSonics from Sperry Marine. Also, **Gary Wilson** was named Midwest sales executive and **Cindy Tasker** was named sales executive for the Northeast.

Ben Forrester has been named vice president of sales—Lightguide systems for **Anixter Communications**. He's been with Anixter since 1982. Also, **Bob Santini** was named Southeast regional manager while **Pete Wagener** was named Midwest region manager.

Ken Wood was named director of product development and **Leonard DeRenzo** was named director of sales at **LRC Electronics**. Wood will be responsible for new product development for CATV markets and DeRenzo will deal directly with sales reps, distributors, system operators and MSOs.

Nexus Engineering has made a number of appointments. **Brent Smith** and **David Reid** were named to the new U.S. CATV Sales Team; **Bud Haycock** and **John Haskins** were added to the Private Cable sales force; and **David Ilagan, Fritz Christo** and **Patricio Ibarra** were named to the international sales team.

Corrections and clarifications

In the 1988 edition of the CATV Buyers' Guide, two listings appeared with improper logos printed above them. Following are the listings as they should have appeared.

CTC
CableTek Center
PRODUCTS, INC.

Cable Tek Center . . . . .(216) 365-2487
WATS (National) . . . . . .(800) 562-9378
850 Taylor St.
Elyria, OH 44035
PERSONNEL: Tim Reilly, Director of Sales
DESCRIPTION: Manufacturer of security and protection installation products. CATV postwire products, coring tools, residential protection devices.

MIDWEST CATV
A division of Midwest Corporation

Midwest CATV . . . . . .(304) 343-8874
WATS (National) . . . . . .(800) 532-2288
723 Kanawha Blvd. East
P.O. Box 271
Charleston, WV 25321
PERSONNEL: Jerry Thompson, President; Chris Sophinos, CEO/Vice President; William Whiteley, Vice President; Jack Crouse, Vice President; Terry French, Vice President; Elijah Midkiff, Vice President; James McCauley, Vice President
REGIONAL OFFICES: Northeast, Tri-County Business Campus, 72 Robinson St., Pottstown, PA 19464, (800) 458-4524; Central, 405 N. Earl Ave., Lafayette, IN 47904, (800) 428-7596; Eastern, P.O. Box 226, Clarksburg, WV 26301, (800) 532-2288; Southern, 2697 International Parkway, Parkway III, Ste. 128, Virginia Beach, VA 23452, (800) 643-2288.

Continued from page 98

extreme weather, been given improved tuning capability and feature built-in NiCad battery packs with chargers.

Sencore

The top-of-the-line Model FS74 Channelizer Sr. TV-RF signal analyzer from Sencore is an expensive way to go, but offers a wide assortment of applications, including locating and measuring RF leakage.

Sencore makes it easy because the Channelizer Sr., which is priced at $3,495, measures RF voltage in microvolts, the same unit of measure used to define FCC leakage limits.

Remember, leakage cannot exceed 15 μv/m with the antenna located 100 feet from the cable at any frequency up to 54 MHz; 20 μv/m at 10 feet from 54 MHz to 216 MHz; and 15 μv/m at 100 feet above 216 MHz.

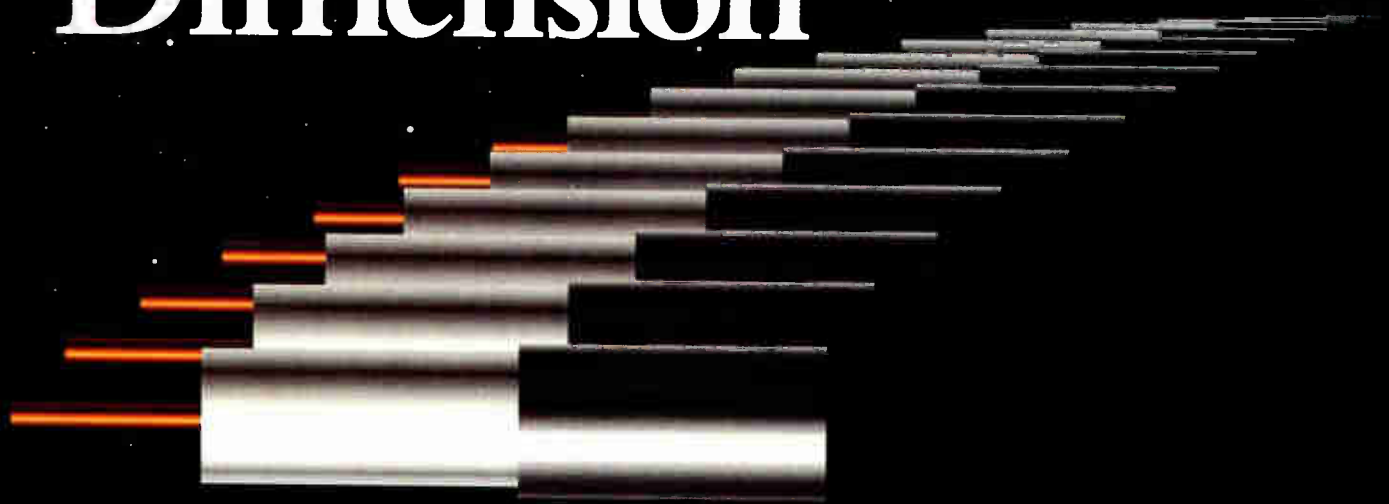
A few tips from Sencore: "Use a nonconductive rod when positioning the (dipole) antenna. This keeps the rod from acting as a second antenna and either concentrating or reflecting the signal. When making the leakage measurement, rotate the antenna in a horizontal plane."

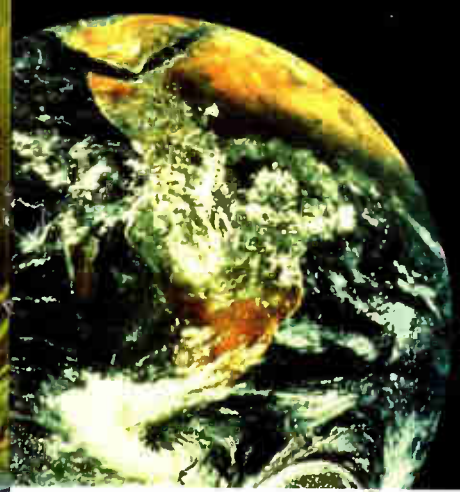
Sencore's Channelizer Sr.

To get information call or write the proper address/phone number listed below:

Augat/LRC Electronics, 901 South Ave., Horseheads, N.Y. 14845, (607) 739-0106; ComSonics, 1350 Port Republic Road, Harrisonburg, Va. 22801, (703) 434-5965; Sadelco, (201) 569-3323; Sencore, 3200 Sencore Drive, Sioux Falls, S.D. 57107, (800) 843-3338; Texscan Instruments, 3169 N. Shadeland Ave., Indianapolis, Ind. 46226, (317) 545-4196; and Wavetek, 5808 Churchman By-pass, Indianapolis, Ind. 46203, (317) 788-9351. ■

Enter the 6th Dimension





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For more information contact:
Times Fiber Communications, Inc.
358 Hall Avenue
Wallingford, CT 06492
(203) 265-8482 or 1-800-TFC-CATV

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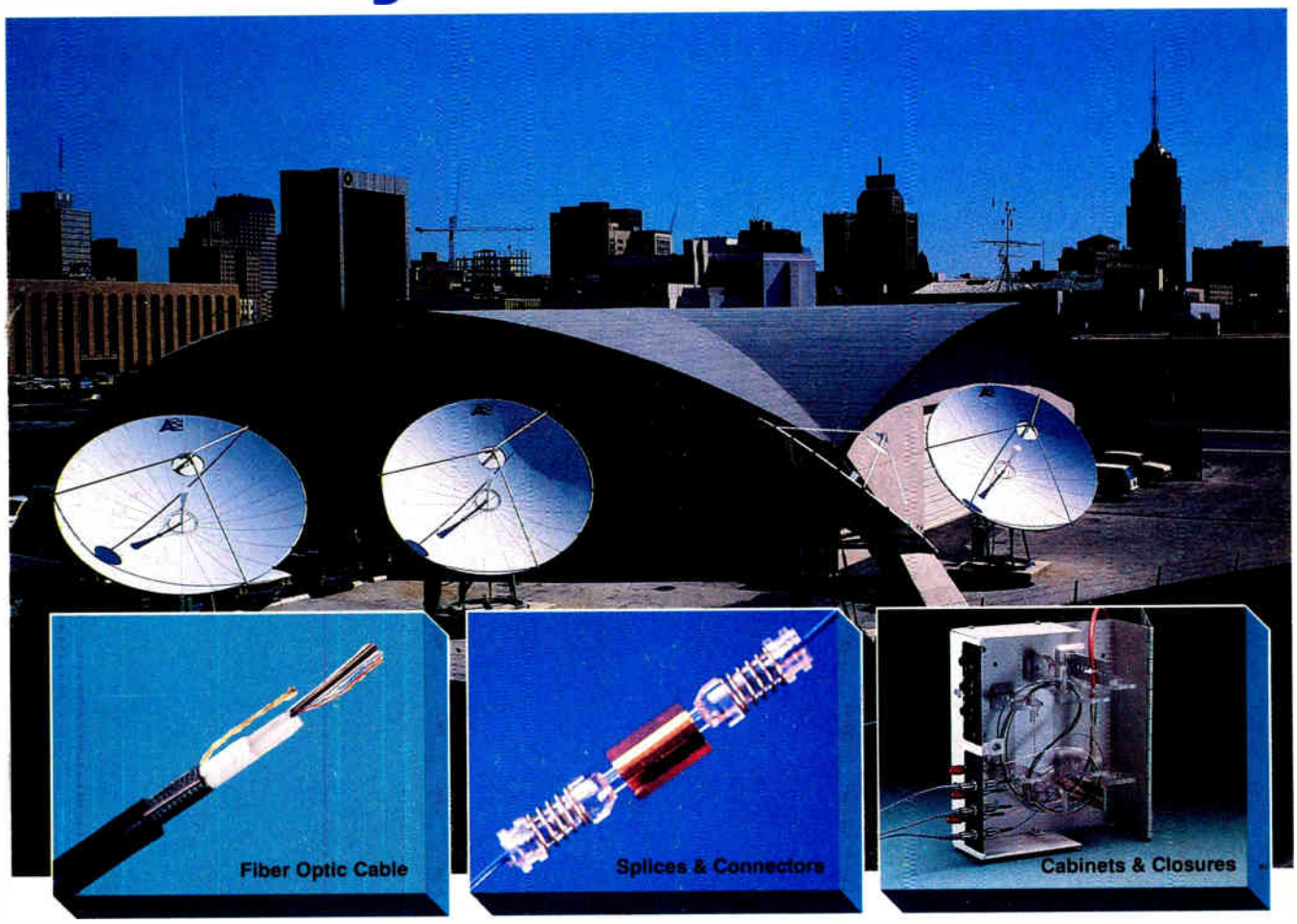

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