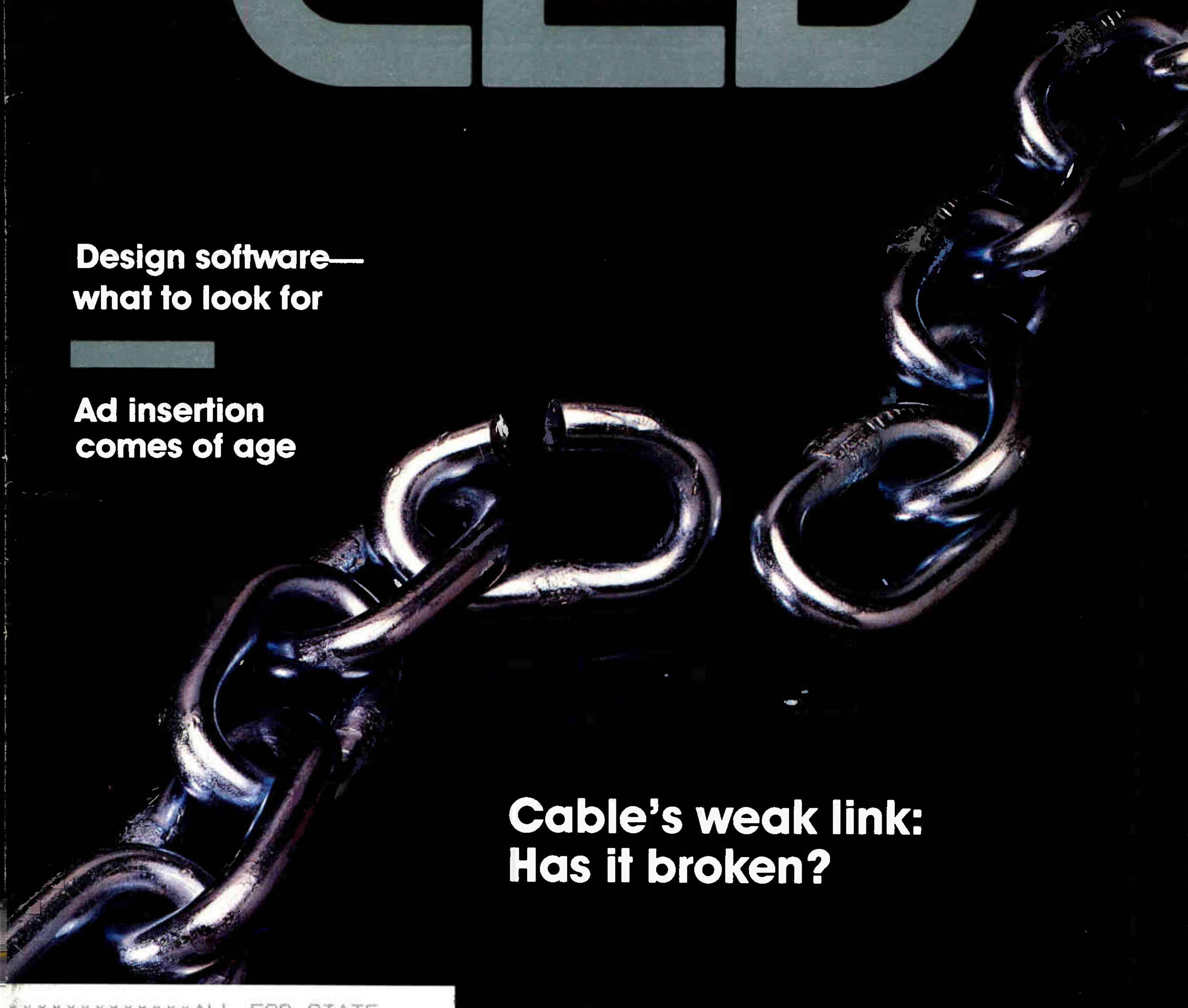
MARCH 1988

COMMUNICATIONS ENGINEERING AND DESIGN
THE MAGAZINE OF BROADBAND TECHNOLOGY

# CED



## Design software—what to look for

## Ad insertion comes of age

## Cable's weak link: Has it broken?

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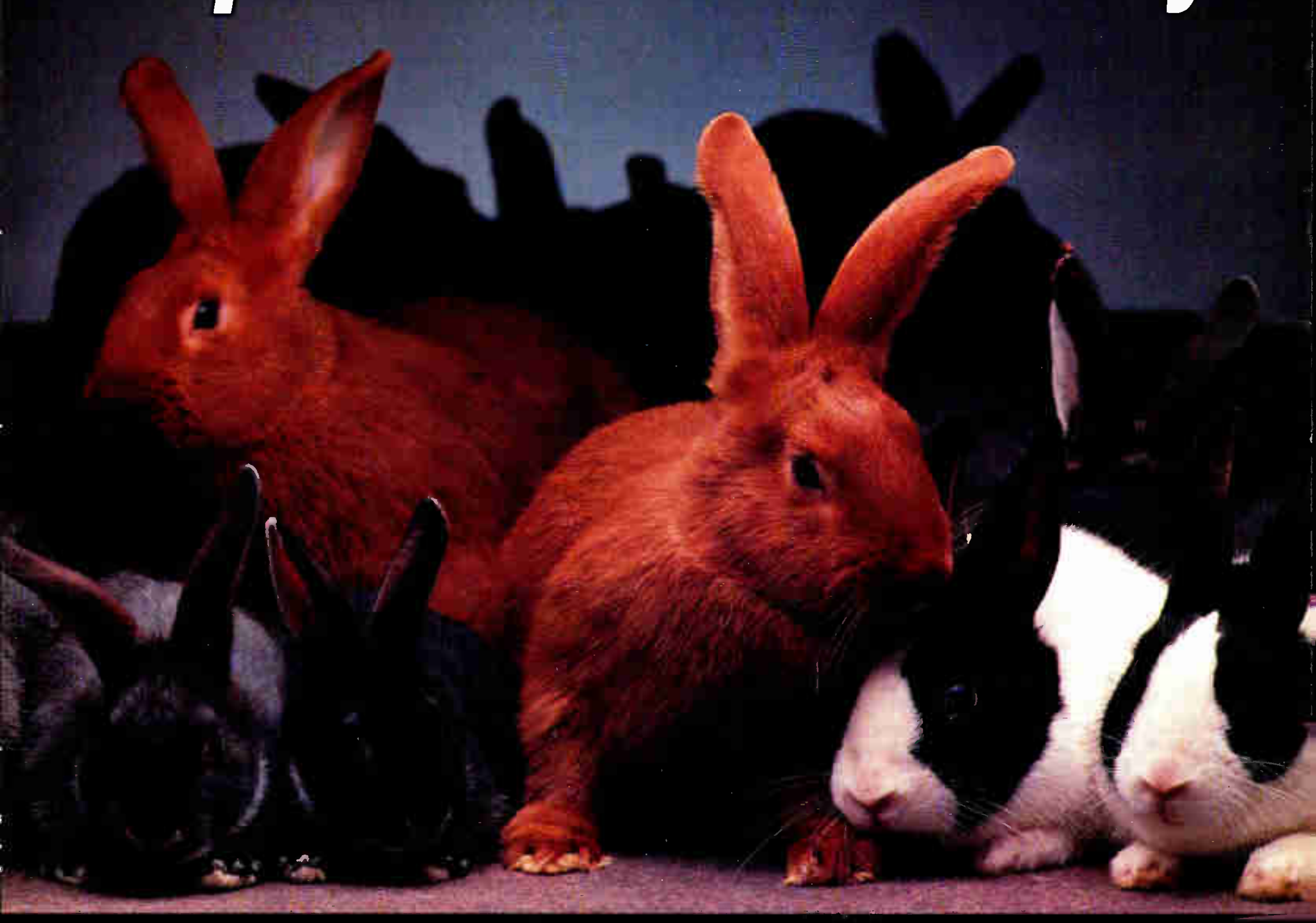

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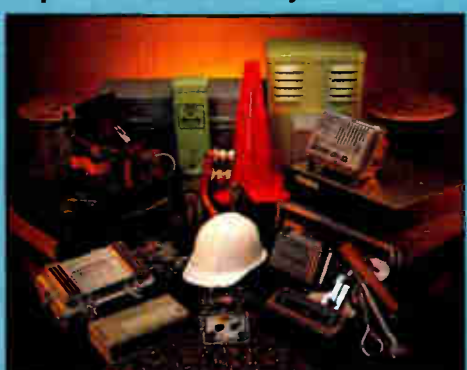

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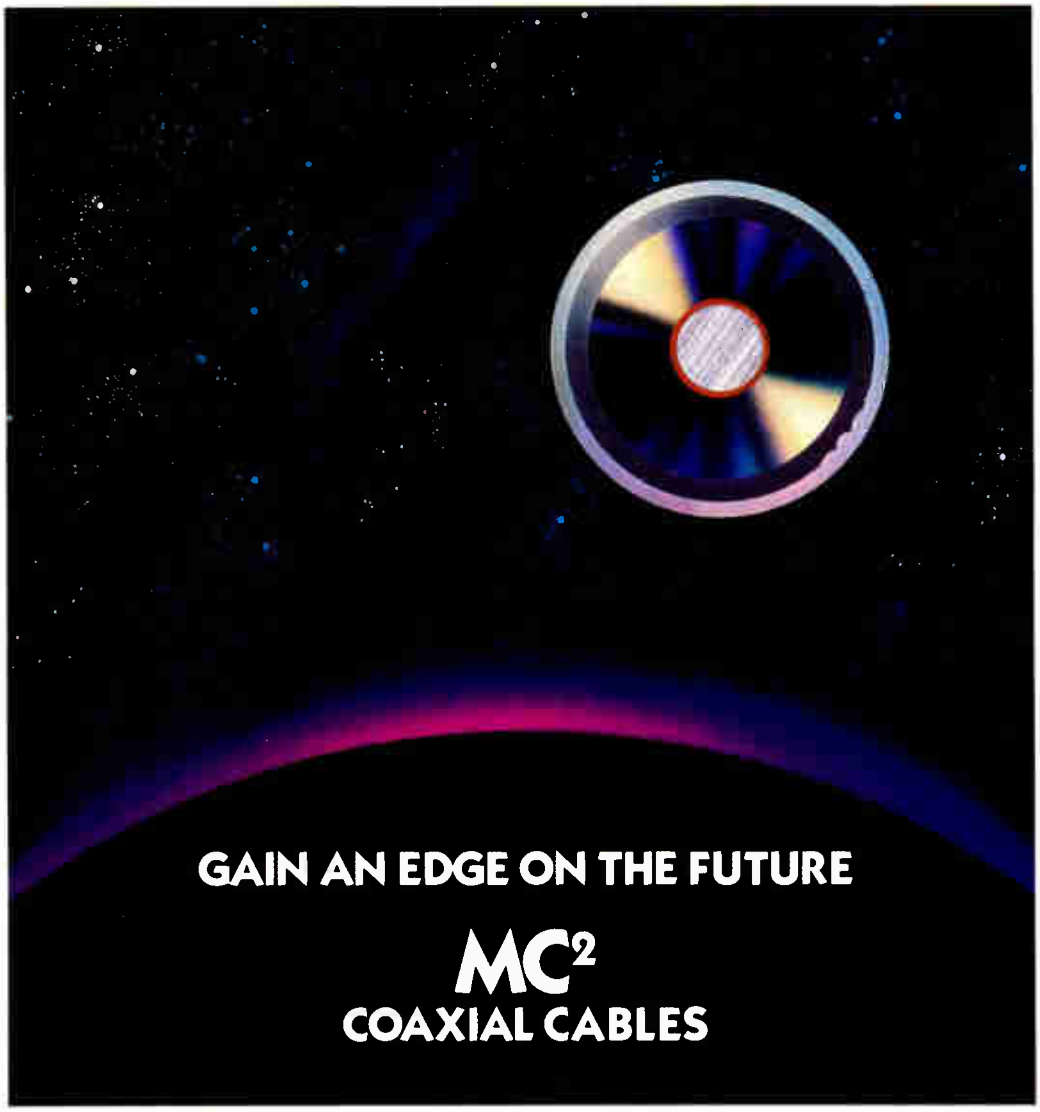


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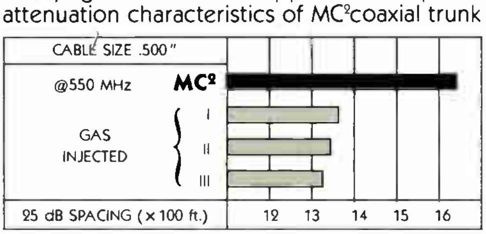


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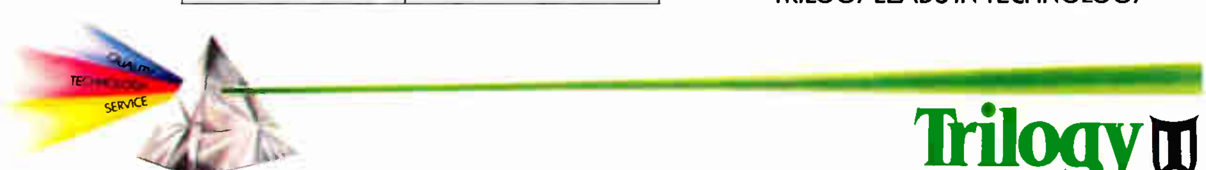


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CED

March 1988 Volume 14, Number 3



**About the Cover:**

*This month we look at how to eke out better performance in the cable plant. What we've found is that the distribution system is the weak link.*



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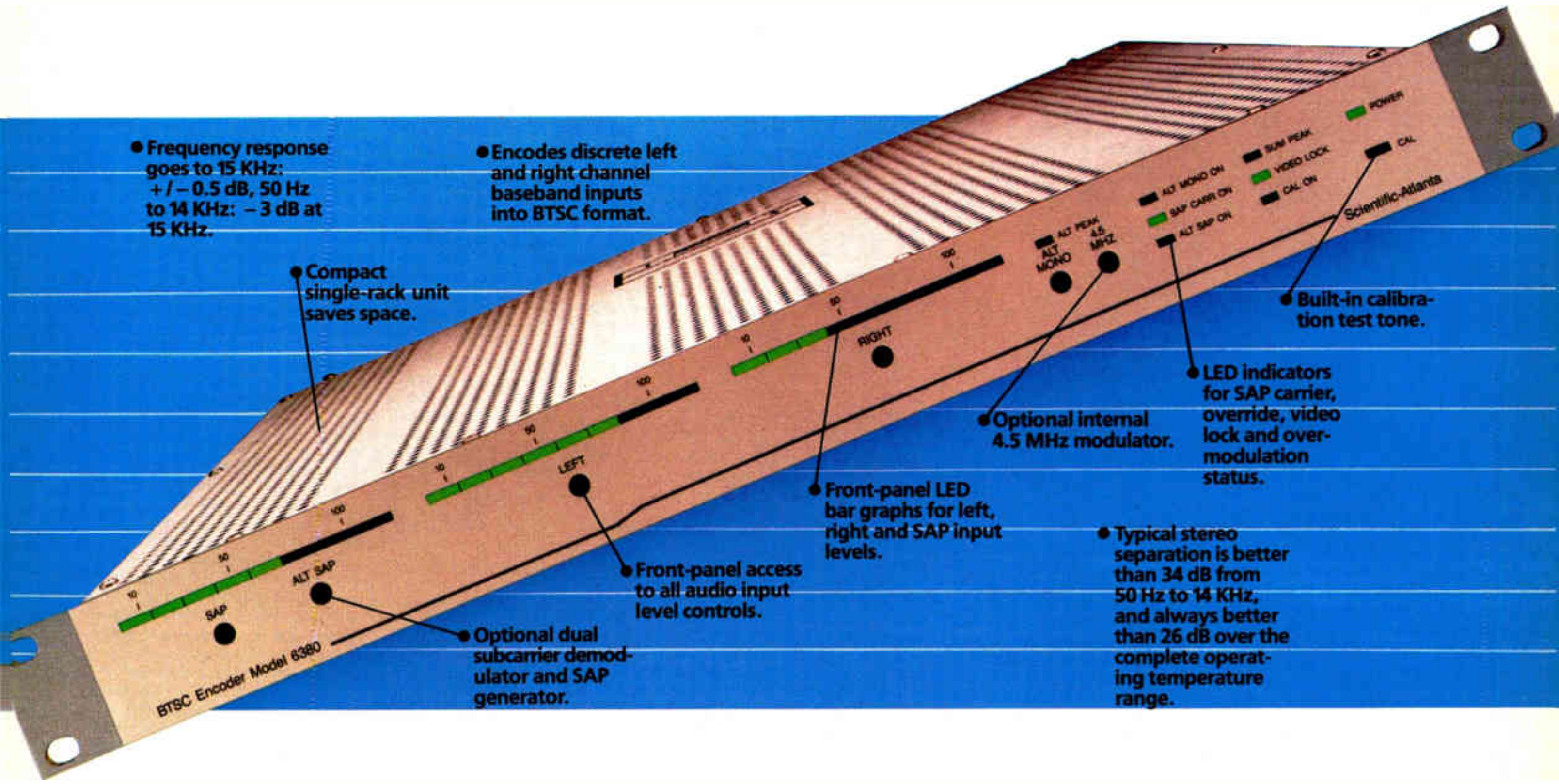
# THE STEREO ENCODER SO ADVANCED, IT SOUNDS GOOD EVEN IN PRINT.

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spotlight

*Frank Ragone*

# The more things change....

Those in the cable business who have witnessed firsthand the changes the industry has gone through over the last 30 years will tell you the technological advances have been astounding. But, like many things over time, the more things change, the more they stay the same.

For Frank Ragone, now vice president of engineering for Comcast, that is certainly true. When he started in cable in 1950 with Jerrold, his first big project was a three-channel system. Who would ever need any more than that?

"The first plateau after that was five channels," he said, "and the first reaction was that it couldn't be done. Going from three to five was pretty dramatic."

And now, well, the changes since then are almost mind-boggling.

There's the "discussion about fiber and it's unlimited channel capacity and then you ask the same question, 'What are you going to do with all that capacity?' And here I am back to 1952 and what are we going to do with five channels. Things keep repeating themselves in that regard."

Ragone's first job was for the U.S. Navy doing test equipment maintenance after graduating from the University of Pennsylvania along with classmate and friend Mike Jeffers. It wasn't the greatest job in the world, he now admits, but back then, "jobs were tough to get in 1949."

In 1950 a friend told him about an engineering job that was available at Jerrold. It was his first crack at design.

"Designing equipment sounded so great I didn't care what the field was," he said, and that was his big break into cable, even though at that time it was called MUL-TV for apartments and motels.

While there, the native of New Jersey worked his way up through various levels of technical responsibility, became director of engineering and then vice president of engineering at Jerrold, which by then was General Instrument.

"It's been very interesting and certainly a continuing changing technology, with tremendous growth," he said. "I've met a lot of wonderful people over the years, too."

During Ragone's career, he has worked for two different companies, Jerrold and Comcast. "That doesn't take you through many transitions," he said, but that hasn't kept him from enjoying himself. His motto: " 'Never had a dull day.' "

The 63-year-old resident of Cherry Hill, N.J., and his wife spend as much time as possible with their family, which includes six grandchildren, most of whom live close by. When he's not doing that, he said, he enjoys getting out on the links, weather permitting, of course.

In 1982, Ragone went to Comcast and a new side of technology—operations. "Here in operations it is different," he said. "The growth of Comcast in itself and the things that go with that growth, like upgrades and rebuilds and modifications of existing systems and introduction of IPPV. It's all been very challenging. It's wonderful."

Ragone found his way to Comcast quite by accident. A recruiter who often called him contacted him about this certain position that was available locally. "The more he talked about it the more I was interested," said Ragone. When asked who he would recommend, Ragone recommended himself.

"And that started the whole ball rolling," he added. "I was just attracted to it, and a couple of interviews later I was hired."

Since he joined Comcast, the company has grown enormously. "When I joined Comcast in '82," he continued, the company had 250,000 subscribers "and the major strategy was to get to 300,000."

About a year and a half ago Comcast literally doubled in size with the acquisition of a portion of Westinghouse. "To bring the Westinghouse systems into our fold and to convey to people our standards and our proceedures and our guidelines, was another dramatic period," he recalled.

The company went from roughly a half-million subscribers to over a million with the Westinghouse acquisition. And now Comcast is looking at Storer. "We're looking forward to it (the Storer acquisition) as part of the Comcast master plan to grow," he said. That plan, he added, is "controlled growth."

Ragone didn't want to take a stab at predicting where cable is headed, since it's had so many changes in the past.

"There have been times that it's appeared that there was no place for cable to go, and then something like a satellite would bring it back to life, or some FCC rules would change and inject some new life into cable," he said. "Then there's always the interactive services lurking in the background. There is HDTV, fiber, are other emerging technologies, and you say 'Gee, where is it going to go?' and I don't know the answer myself. But I know something is brewing and we'll have to watch its development and its applications to our systems."

For the future, Ragone says it "continues to be a most interesting and challenging job," with the goal of meeting "our growth projections, and have an efficient and productive operation," he said.

"I see many interesting issues, challenges and opportunities created by IPPV, HDTV, fiber, MMDS and overbuilds," he added. "The opportunities in CATV are unlimited."

*—Linda J. Johnson*

# Advanced TV compatibility

The concept of "compatibility" came into the glossary of television in the late 1940s. The premature authorization by the FCC of the incompatible field sequential color system, developed by the late Dr. Peter Goldmark at CBS, so alarmed the television engineering community that, in 1950, Dr. W.R.G. Baker, then vice president of General Electric, reconvened the National Television Systems Committee which he had chaired so successfully 10 years earlier. In the January 1954 Proceedings of the IRE, shortly after the FCC had approved the color standards recommended by the NTSC, Dr. Baker wrote as follows:

"The compatibility between monochrome and the color service means that the transition will require no sacrifices on the part of either broadcaster or viewer. The owner (or prospective buyer) of a monochrome set is insured against obsolescence even though all his stations convert to color transmission, while the color set buyer will be able to receive monochrome programs from local stations that have not yet converted. Then, in addition, the broadcaster can gain an additional color audience without inconveniencing his monochrome following."

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

Compatibility is a more complex concept than one might think, with a number of subtle variants. In fact, five levels of compatibility were identified in a recent tutorial monograph by Robert Hopkins, executive director of the Advanced Television Systems Committee, paraphrased below.

*Level 5:* A system whereby a current receiver accepts advanced television transmissions and displays the picture in high definition.

*Level 4:* A system whereby a current receiver accepts advanced television transmissions and displays the picture with the same quality as normal transmissions.

*Level 3:* A system whereby a current receiver accepts advanced television transmissions and displays the picture with somewhat reduced performance quality compared with normal transmission.

*Level 2:* A system whereby an inexpensive adapter box must be provided in order to display advanced television transmissions on current receivers, with normal or slightly reduced performance quality.

*Level 1:* A system whereby the adapter box required to enable a current receiver to display advanced television, even with normal performance quality, is so expensive the consumer would prefer to purchase a new advanced system.

Level 5 is, like perfection, unachievable. The NTSC color system falls in Level 3, with slight reduction in monochrome performance. Level 2 describes the situation when UHF transmissions began, and cable TV reached beyond the 12 standard VHF channels. The degree of compatibility of advanced systems that provide an augmentation channel to enhance the performance of a standard NTSC channel would probably qualify as Level 3 or 4. The Japanese MUSE standard, and most other truly "high definition" systems appear to fall in the Level 1 category.

There should be another classification for a system whereby a receiver designed to receive advanced television transmissions accepts current standard transmission and displays the picture with the same quality as a current television receiver, or only slightly degraded.

The purpose of compatibility, of course, is to provide for the transition period, perhaps up to 15 years, during which television programs would necessarily be transmitted according to both the current and advanced standards, to both types of receiver. This purpose could also be served by a system in which a program would be simulcast in separate transmissions, one according to current standards; the other, an advanced, non-compatible standard. Whether or not this would qualify as "compatibility," it would protect the public investment in NTSC television receivers and allow time for the changeover.

The British transition from 405-line, vertically polarized VHF monochrome television to the 625-line, horizontally polarized, UHF PAL system I provides significant precedent for such a system. The 405-line transmissions were continued until two or three years ago, at least 25 years after the start of PAL system I transmissions. It must be recalled, however, that during this period, financial support was provided almost entirely by the British government, through annual license fees collected from the owners of TV receiving sets.

Whether advertising support would be available for dual-standard transmissions in the United States is, at best, arguable. Perhaps the growth of Super VHS cassette players, and the anticipated introduction of a high definition, wide screen VCR, will promote a sufficient demand for advanced TV programs and displays to warrant advertiser support. But until concrete evidence is produced that such support will be forthcoming, broadcasters are not likely to make the enormous investment in new plant, terrestrial or DBS.

Most engineers seem to agree that compatibility at levels 2, 3, or 4 necessarily would require more or less compromise, not only with performance on current type receivers; but also, and more seriously, with performance of the ultimate advanced TV product. The broadcasting dilemma, then, is that a dual-standard transition may be the only way the broadcasting industry can avoid submitting to "inferior technology" in the interest of compatibility.

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Reader Service Number 5

# Customers could be ally against competition

There will come a time in the not too distant future when industries which have been poised for some years to take over a portion of the wire line delivery of video signals to the home will feel that the time to act has come. When these, our competitors, begin to approach our customers, they will come prepared in many ways. They will come promising to deliver programming of interest to our customers, quality signals and carrying service. These promises will mean little or nothing if our customers have been receiving these things from their current suppliers. If, however, a case can be made that our customers have not been receiving these things, then our competitors will have an easier sell.

In our battle to retain primary control over our business, we have many tools with which to compete. We have legislative tools and regulatory tools. We have some of the smartest entrepreneurial and business minds in the industry. We have some of the smartest engineers and technicians and some of the most creative and talented programming people. But all of this may not be enough if we don't also have committed and loyal customers who will stand in the door and help fight our battles when our competitors attempt to sell around us.

This message and this scenario frequently run up against the fact that we have a division in the important areas of responsibility in most cable systems. The engineering and technical work at a system tends to be just one of many components which the system's manager has to concern him or herself with while developing a record which will be judged at the end of each year and to a large extent determine whether that manager continues in that job.

Most of the measurement criteria applied by corporate headquarters to the system manager are monetary in nature. They want to know how much money they have put into that system and how much money has come out and the result is influenced greatly by such things as marketing and efficiency of operations. As long as most customers are reasonably happy the impetus to spend money (expenses) on the technical side of the business can come under great pressure.

Some of the more innovative and enlightened MSOs in this country have dealt with this problem in creative ways. When the criteria is established at corporate headquarters for judging system manager performance, the corporate chief engineer develops his own set of measurements with which the system manager is required to comply. Meeting that set of criteria has equal weight as a component in the measurements taken of the system manager.

In order to ensure even and effective implementation of those criteria the engineering department frequently retains control over the measurement of the ability of the system manager to meet the stated objectives in the technical and operational side. The key is that the criteria which measure the goal of meeting technical quality are dictated from headquarters and are rigorously enforced as a vital component of measurement on how well the system and its personnel are performing.

Local people, for whatever reason, cannot subvert these criteria. This type of setup obviously puts a burden on the system management personnel. It also places a burden on the corporate personnel because, in order to get this level of input into the quality assurance program, they have to be willing to provide the measurement capability needed to make it effective.

This concept strikes directly at the issue of whether or not a company is managed in a centralized or decentralized way. You can find in the cable television industry companies that are intensely centralized and every decision, every activity is either formulated, instituted or blessed by corporate headquarters. It's just as easy to find companies that are equally intensely decentralized, where corporate headquarters may have only a dozen people, and leave the complete running of each system to the local personnel, a degree of autonomy that makes each cable system a profit-and-loss center with all of the divisions, activities and concerns of any modern business.

It's also safe to say that you can find examples from both camps that are exceptionally well run and well respected MSOs with reputations for high quality and outstanding service, By the same token, you can find examples of both camps that allow the particular attributes of their style of overall management to adversely affect their performance in almost every area.

This simply means that the form of a corporation does not dictate whether or not it is successful. The management ideals, the spirit of the employees, the commitment of the company at every level to quality service and other similar criteria is what matters.

I hope the idea that only activities that can be measured directly by financial performance will lose favor. In its place should be an understanding of the importance of the activities engaged in by the CSRs, QC technicians, installers and engineers. If these ideas are taken into consideration by more companies not only will the MSO have a loyal ally in the fight to maintain a share of a highly competitive business, but the system's financial performance will exceed any target that has been set.

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

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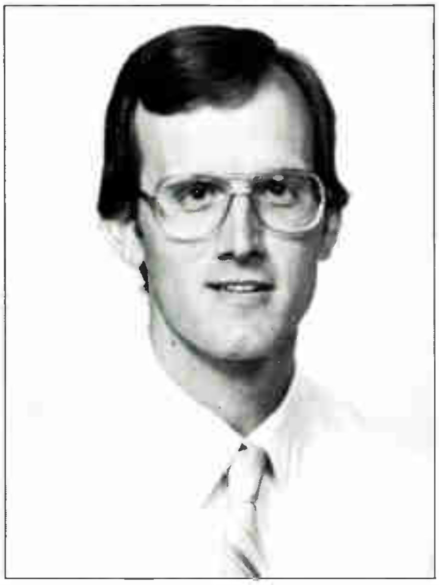


# Chrominance-luminance delay inequality

Chrominance-luminance delay inequality is a measure of the relative delay through a transmission system, between the higher frequency (3.58 MHz) chrominance information, and the lower frequency luminance information. Ideally, the television transmission system would provide equal delay to all signals from as low as 30 Hz up through 4.2 MHz. Unfortunately, due to a variety of imperfections in the system, such is not always the case.

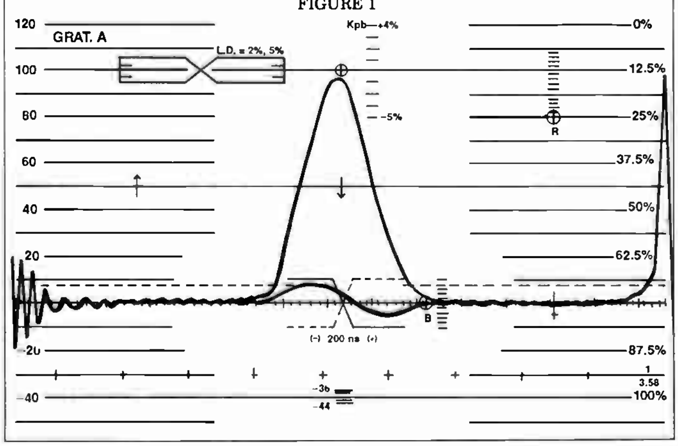
Various pieces of electronics throughout the signal path, including the television set, will all have a tendency to affect the relative delay between chrominance and luminance signals. Certain circuits, like narrow band filters that are not "equalized" especially tend to create relative delays between a signal's spectral components. In fact, when the NTSC color system was first established, it was recognized that the "typical" TV set, because of its RF and IF filter selectivity (including sound trap), would produce about 170 nanoseconds of relative delay between the chrominance and luminance information. It was also recognized that it would place an unnecessary burden and cost on the TV set manufacturer to eliminate that 170 nanoseconds of typical delay by requiring equalization networks in the TV receiver.

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

Therefore, instead of burdening the TV receiver with such cost and complexity, the FCC established a requirement for TV transmitters to "precorrect" the video signal by establishing an "equal and opposite" delay of the signal at the transmitter. This is the reason that most manufacturers provide "delay predistortion" networks in their CATV modulators.

The most common method of measuring chrominance-luminance delay inequality today is the use of the modulated 12.5T pulse (shown in Figure 1 ).The 12.5T pulse consists of a 100 IRE sine-squared pulse with a half-amplitude duration of 1.5 microseconds (12.5 × T, where T = 125 nanoseconds) which is modulated with a 3.58 MHz signal. The pulse therefore contains both low frequency information (640 KHz), as well as the higher frequency chrominance signal.

FIGURE 1



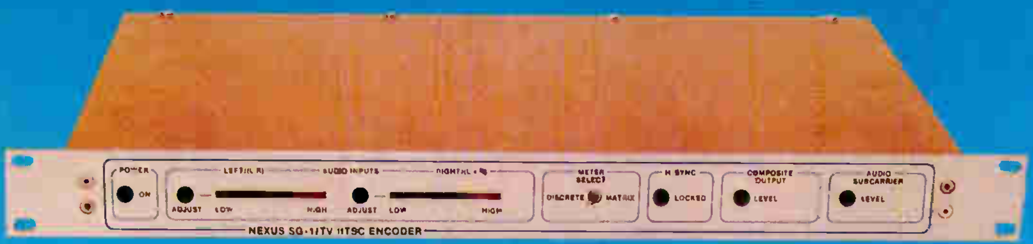

Ideally, if there were no delay inequality between the chrominance signal and the lower frequency luminance information, the base of the 12.5T pulse would be perfectly flat. In the case shown, however, there is about 90 nanoseconds of relative delay between the two components with the luminance information being "advanced" relative to the chrominance signal. Delayed or advanced chroma, relative to luminance information, produces a phenomenon which has been called the funny-paper effect. This is the effect that you might have seen in many of the older comic strips where the color was actually misregistered from its associated character's line drawing. This was perhaps the result of a two-step process in which the line-drawing was imprinted first, followed (not very accurately) by the color information. This same type of effect can happen with video when chroma is advanced or delayed relative to lower frequency luminance information. The amount of delay inequality which may become visible depends not only on the individual, but also on the size of the TV screen.

Since it takes about 63.6 microseconds (1/15,734 Hz) for one complete scan line of video information, and since the horizontal blanking interval occupies about 11.1 microseconds of that time, the active video occupies about 52.5 microseconds (52,500 nanoseconds) of each video scan line. Using that information as our base, it isn't difficult to calculate that on a standard 19-inch diagonal TV (a screen width of 16 inches), 200 nanoseconds of chrominance-luminance delay would misregister the color information from the luminance information by about 1/16th of an inch. Now, if you double the screen width by using a projection TV system, imagine a full 1/8th of an inch of color misregistration! Such misregistration is typical of what you might see when using a modulator that does not meet FCC recommendations.

The funny-paper effect is very noticeable on color text, and especially noticeable with highly saturated red lettering on a white background. Delayed chroma would show up as a very dark leading edge for each red letter. The effect under normal active programming is a bit more difficult to describe, but in the extreme, could begin to look like the old comics.

# Finally!

# AFFORDABLE STEREO

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# R&D at the crossroads

There is increasing support within the CATV industry today for an industrywide research and development effort. There are a number of reasons for this. It is correctly pointed out that the telephone industry, a potential competitor, spends hundreds of millions for dollars each year on R&D. The government has passed laws and regulations which encourage R&D and provide relief from anti-trust liability when such activities are undertaken by an industry. There is a perception that the resources devoted to development activities on the part of CATV's traditional suppliers have decreased and there has been some consolidation of the number of suppliers we have.

All this comes at a time when our industry is increasingly concerned about competition, some of it technology driven. Ike Blonder, Dick Leghorn and others have been sounding the warning for several years that our business is at risk if our industry does not begin to reinvest more of our profits against the future.

It is my opinion that in some areas such efforts are desperately needed, and they could prove highly useful in others. I am concerned, however, that if CATV industry R&D is approached improperly there is potential to not only waste a substantial amount of money, but to actually do some harm.

I would like to step back a pace and take a look at how our industry got where it is today. We have built a business over the last 40 years by meeting consumer needs, largely through the application of existing basic technology. While we added some fine tuning for our applications, we certainly did not invent coaxial cable and connectors, heterodyne processors, broadband directional couplers, or broadband RF hybrid amplifiers. Those were largely developed by other industries, including telephone, electronic components and military contractors.

We have, however, been quick to adopt and refine. This has been true not only of efforts to make our basic signal delivery business work better, but also to seek new applications. The CATV industry, with its hundreds of operators and thousands of systems, has, in its own chaotic way, been highly innovative. Hundreds of millions have been spent on new technologies and new businesses: some have been highly successful, some have been exceedingly expensive failures.

Cable operators have been quick to try new ideas of their own and nearly every new idea that some vendor has come up with has found at least one operator willing to give it a go.

Why not continue this Darwinian model of development if it works so well? I believe that there are several reasons. First, in a more competitive future we may not be able to afford the hit-or-miss nature of this process. Second, there has been consolidation in ownership and management in the CATV industry and the entrepreneurs and fairly independent managers who were willing to try new things in the past may be becoming more of a rarity. This may be particularly so in an industry which is being asked for financial caution and accountability.

Finally, there are issues which simply do not lend themselves to a haphazard approach. Our industry came fairly close to developing a major consumer problem several years ago when BTSC stereo was introduced. That technology was developed and promoted by the consumer electronics and broadcast industries, and a standard was very nearly adopted which would have created significant problems for CATV. Fortunately, due largely to the efforts of the NCTA Engineering Committee and its members, the BTSC standard was modified and made far more rugged in a CATV environment.

We see similar, yet enormously more powerful forces at work today. While the behavior of HDTV in CATV systems is not yet well understood, the potential exists for the consumer electronics industry, working through new delivery systems such as video disks and DBS, to create standards which do not hold up well in a CATV environment and impair our ability to compete as a high quality delivery system for this new medium.

While individuals within the industry and at the NCTA are active in looking at the implications of HDTV and working on FCC committees, there does not currently exist an industry group capable of massive funding for testing and transmission format development for HDTV.

Why, if this is all true, shouldn't we dig deep and fund an ambitious CATV R&D activity? We should but there are a number of issues which should be thought through if such an effort is to be productive. First, we should remember that there are a number of vendors who served us and who are willing to fund significant amounts of development related to new products for which they believe there is a market. R&D activities undertaken by an industry group need to be carefully targeted so as not to interfere with this process. The cable industry has gotten better in recent years at working with vendors to make sure that they are tuned in to product needs. If development projects which are presently being addressed through this mechanism becomes supplanted by an industry effort, we will have lost the benefit of millions of dollars of work by highly motivated parties.

It is important that we fill in gaps in existing work and encourage development most naturally done by vendors if we are not to lose as much as we gain.

*By Jim Chiddix, Vice President, Technology and Engineering, ATC*


# We're out to convert the cable industry.

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Reliability. It's what you demand from CATV converters. It's how you avoid costly service calls and replacements. It's what you expect from Panasonic.

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For product or dealer information, call (201) 392-4709. Panasonic's new PC 140/170 series cable converters: the means to end-user satisfaction.

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Reader Service Number 8

## RL vs. SRL

Your article "Time Domain Reflectometry" in the December '87 issue is very confusing—right from the very first sentence. "Structural return loss" and "return loss" are different. "Return loss" is the ratio of reflected to incident signals. Structural return loss refers to reflections due to structural imperfections in a cable, usually due to manufacturing problems, e.g. unwanted periodicities in the mechanical structure of the cable.

Put briefly, a return loss test, e.g. use of a return loss bridge, will indicate a potential transmission problem caused by impedance mismatches in the transmission line. The return loss bridge shows "frequency domain" information—reflection magnitude as a function of frequency. A time domain reflectomer (TDR) will help identify where the problem is and tell you something about its nature. The TDR displays reflections as a function of time. The time parameter can be easily translated to distance in the cable. TDRs can be used in coaxial cable, paired cables or even optical fibers.

Ken Simmons wrote the original papers on structural return loss measurements for cable-TV. I wrote the original papers describing application of TDR techniques to cable-TV systems. Ken's papers were written about 25 years ago; mine were written about 15 years ago.

**I. Switzer, consulting engineer**

*"Sruki" is right. We're only discussing SRL.—Ed.*

## Extra considerations

I wish to respond to Raymond Perrin's comments ("Coax inadequate to stop leaks,"*CED*, Jan. '88, p. 28) through this letter and hopefully inform him of some additional concerns he may not have considered.

First off, I wish to share his concerns regarding signal leakage, from any source. I am, as he is, an amateur radio operator, W2QUU, and a member of the American Radio Relay Leaque. I have been, by profession, a cable TV engineer for the past 25 years and have viewed signal leakage from both sides of the fence.

Although fiber optics does offer the potential to reduce signal leakage from CATV cable plants, he should realize the following. My experience has shown that most of the signal leaks, from cable plant, in the form of RFI, generally do not originate from the hard aluminum sheath coaxial cables but rather from the subscriber drop cables. Further, much of the source leaks are from subscribers tampering with their drop cables, attempting to split the cable for additional set connections, and from direct consumer electronics interface such as cable-ready TV receivers. New properly installed subscriber drops, protected from moisture effects, connected to a properly shielded subscriber set-top converter will not cause interference.

I am not saying that cable plant does not leak, but rather that new techniques and equipment used today are designed and installed with a design concept of avoiding RF interference. The cable industry today knows much more and is more sensitive to RFI.

Fiber optic plant may not eliminate RFI unless light is brought right up to the TV receiver. If an RF interface occurs and if consumer electronics, such as cable-ready TV receivers or VCRs, are utilized, interference will exist.

The answer, I believe, is to press consumer electronic manufacturers to shield their products better and enforce fines to prevent subscribers from tampering. Just these changes would make a noticeable difference in RFI, even on an all-coaxial cable plant.

**Steven R. Raimondi**
**Vice President/Engineering**
**United Artists Cablesystems Corp.**

## Taking exception

*CED* has usually treated our company and its products very fairly and well, however, I must take exception to the way our products were portrayed in the "Small Systems" story on page 50 (see "More Money Savings Tips," *CED*, Jan. '88).

Clearly implied in the wording "non-standard format" is that our stereo modulator is not compatible with standard stereo TV sets. This is not true. Furthermore, our stereo format is identical to the BTSC format. That is why stereo from the FMT633S can and is being received on stereo TV sets.

The difference resides in the companding algorithm, which is quite different, yet also produces a very strong stereo perception at the TV set. In fact, our companding system will not only produce strong stereo through RF set-top converters, but also on cable systems with stereo-compatible baseband set-top converters over the normal remote control volume control range, while BTSC systems only produce stereo at the full volume setting. Cable systems with baseband converters have the greatest problems converting to stereo in large part because the BTSC companding process wipes out stereo when the subscriber tries to use his remote volume control. It's hard to sell remote volume controls when the subscriber can't use them on stereo programs without losing the stereo.

We feel our equipment was completely misrepresented and furthermore, the use of the phrase "non-standard format" is both untrue and inappropriate since it leads to substantial misunderstanding on the part of the reader, who is thereby induced to presume that some sort of special or different TV receiver is needed to decode this supposed "non-standard format."

Furthermore, it is implied that not only is the FMT633S a "non-standard" format, but that an ADM-1 deviation meter is required to set it up. This is also untrue. The FMT633S needs no other equipment to set it up at all, since it has a built-in VU meter to set audio levels. The writer mixes oranges with potatoes by implying any unique linkage between these two products. In fact, the ADM-1 is used by cable operators to set TV audio deviation to equal volume on every channel, either monaural or stereo.

**F.F. McClatchie**
**President**
**FM Systems**

*We never have said it wouldn't work. It just isn't BTSC. Frank's right about the ADM-1.—Ed.*


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Reader Service Number 9

# Getting better S/N and better pictures

Here's the problem in a nutshell. Current VHS machines and typical metropolitan-area broadcast stations deliver pictures with 53 dBmV S/N to the TV receiver. Super-VHS will do even better. But ignore for the moment the possibility that the new consumer standard of comparison for home video will soon be S-VHS or that, at some point, HDTV will surpass S-VHS.

How does CATV stack up? Not very well at the moment. Assume that, as an industry, cable operators get about 54 dBmV C/N off most satellites; modulator performance of 57 dBmV C/N and about 43 dBmV at best for distribution system performance. Assume that the typical converter is somewhere in the 12 to 14 dB noise figure range and that currently available TV sets have about 7 dB or better noise figure (which leads your customers to ask why their pictures look better when the converter isn't hooked up).

Assuming that supertrunk or microwave hops range from 53 to 62 dBmV C/N and will tend to have relatively little effect on system C/N, the typical subscriber might get a C/N of about 41 dBmV.

## Distribution dBs are easier to get than headend dBs

And there's the rub: 53 dBmV off-air or from VHS; only 41 dBmV over cable.

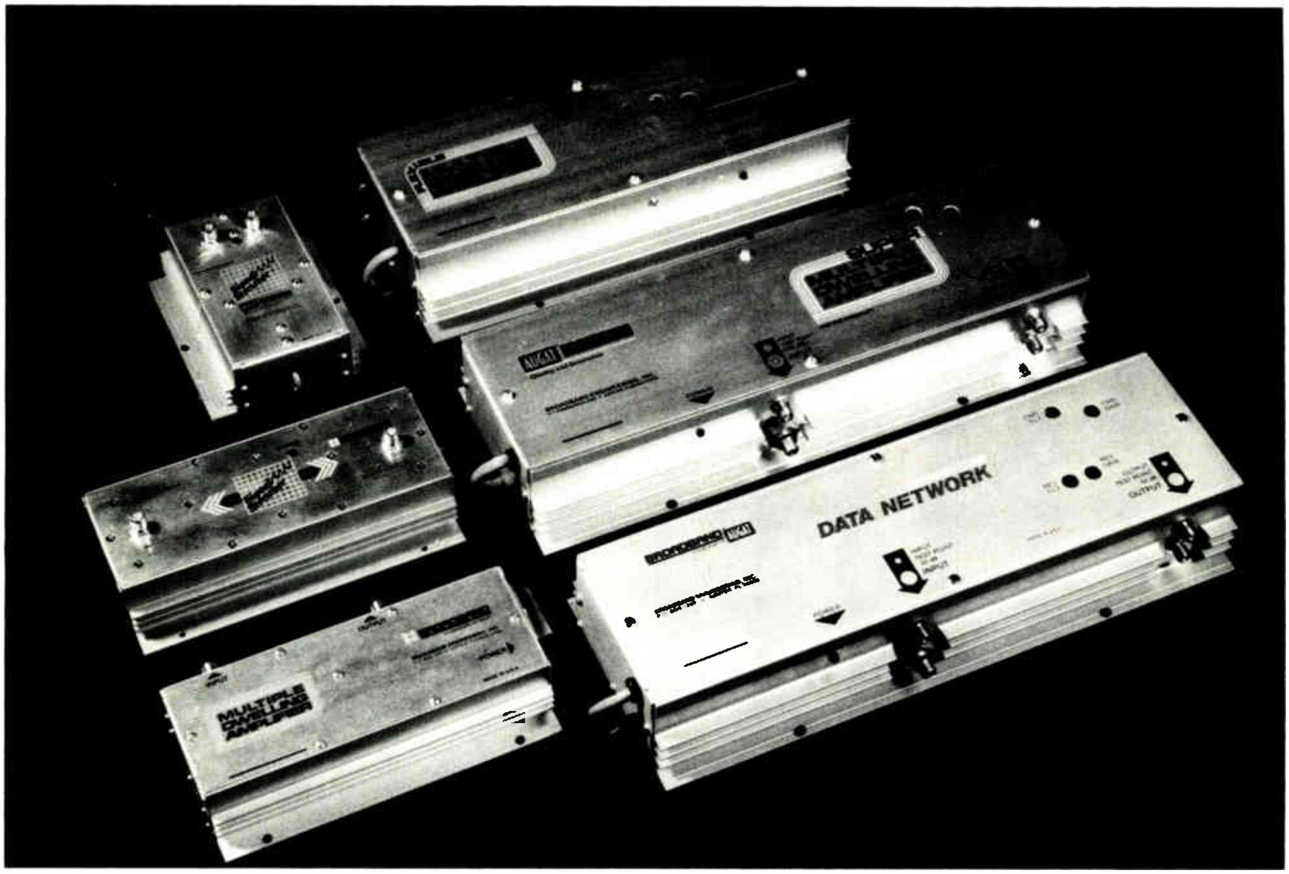
Now, unless we miss our guess, some metropolitan-area operators may already be running into situations where plant has to be redesigned to a higher standard of S/N performance than is generally the case today. About 3 dB more headroom would seem the minimum investment.

And make no mistake: picture quality will be even more critical as the installed base of S-VHS machines grows. The reason: they need to see about 45 dBmV to properly record video delivered over a CATV system.

Nobody knows for sure yet, but HDTV might need to see 49 dBmV at the set. For a CATV system to deliver that kind of performance the satellite receive signal might have to be 57 dBmV; the distribution system at 55 dBmV. That would be possible only with shorter cascades. Hence the relevance of ATC's proposed fiber/coax distribution system that runs home-run fiber to distributed nodes and jumps back to RF only for the final two or three amplifiers.

The question is, can any of the required headroom come from the headend, given that most system noise and distortion is contributed by the distribution system? Possibly, but it's debatable. "There isn't much you can do other than possibly fiddle with antenna size," says Joe Van Loan, formerly Viacom Cablevision's vice president, engineering. "If there's any reserve on the satellite link, we tend as an industry to go with smaller reflectors."

Receiver choice can make a difference though. "Some receivers are better than others—especially under marginal signal conditions," Van Loan says. LNA switch-outs also can make a difference. Viacom recently has been

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Reader Service Number 10

**Overall, what ATC will be looking for is better operations that deliver better video performance.**

replacing older LNAs with newer low-noise devices, gaining a dB or two for about $100 a box.

Splitter networks in front of the receivers also make a difference. "Eight-way doesn't work so well unless you compensate with line amplifiers," says Van Loan. And backfeed from character generators has to be watched.

Off-air signals can be a problem at times. Cracked insulators on power transmission lines can really be a nuisance—especially when the problem isn't a single insulator but many insulators on an old system, as Viacom has had to grapple with on Long Island, N.Y. The solution? "Viacom plans to direct feed from the ABC affiliates to the headend by microwave. We've done the same thing in Chicago and in Marin County, Calif., where the unusual weather patterns cause fade and severe multi-path," Van Loan says. In general, ABC seems to be quite willing to consider such direct feed situations on a wide basis. "It makes the local affiliates pretty unhappy when an Atlanta station at a hotel looks better than the local off-air," Van Loan says.

ATC, in fact, is undertaking a major study of 80 to 90 headends to find out just what can be done on the operations end to improve current signal quality, says ATC Senior Project Engineer Perry Rogan. In some cases, where earth stations have been in place 10 to 13 years, "dishes might warp, fungus, moss or mold grows on the dishes or paint deteriorates," Rogan says. Under certain conditions it might be possible to pick up 1 to 3 dB by cleaning up some of these operational details. Rogan thinks receivers and LNAs/LNBCs, on the other hand, have really come far in the past few years and doesn't expect to pick up much improvement there.

Overall, what ATC will be looking for is better operations that deliver better video performance. "We've been concentrating on RF. We need to look at video as well," Rogan emphasizes.

But short of going to broadcast-quality equipment in the headend—which would definitely be expensive—Heritage's Doug Truckenmiller isn't quite sure what the industry can really do in the headend. "Bigger antennas would make a difference in some locations but to really get 3 or 4 dB (improvement) you'd almost have to step up to more expensive broadcast gear. And even then you'd find any improvements contingent on better signal from the earth station," he says.

Gillcable's Vice President of Engineering David Large couldn't agree more. "We've got a seven-meter Simulsat pulling 52 to 56 dB S/N. The RS-250B medium-haul spec is 60 dB and we'd like to see that at the headend. But a 10-meter Simulsat isn't realistic in our situation." A fraction of a dB might be gained by using the lowest possible noise LNA in some instances, he suspects.

**There's pretty broad concensus that the distribution plant is the easiest place to get better S/N performance.**

"Possibly we could squeeze a couple more dB out of the modulators. Receivers tend to vary—the home receiver stuff just won't work. Still, you're constrained by the basic S/N coming off the earth station. Ku-band with a six-meter or seven-meter antenna gives you pretty high gain."

The satellite link is a problem. "Although I measure 52 dBmV S/N, that's luminance. Chrominance isn't nearly that good," Large says. "The problem is that NTSC never was designed to be sent through a triangular noise spectrum. MAC, for example, would deliver better S/N for both luminance and chrominance."

Large says Gill "comes out in the 50s from the headend but video S/N goes to 44 dBmV or so on our longest cascades. So even if we raise levels 3 dB out of the headend it doesn't necessarily get to the subscriber drop. We probably can get a dB out of the headend and pick up the rest in the distribution system."

Currently available technology can improve S/N by 12 dB at the studio end and companding, for example, also provides effective S/N improvement, Large argues. "I'm not sure it makes sense to try and milk an extra 5 or 6 dB out of the headend when higher levels and shorter cascades will also give you better S/N."

And upgrading headend performance without fixing the distribution plant probably is pointless. "It doesn't make sense to do much over 50 dB out of the combiner unless the distribution plant is also upgraded at the same time," Trunkenmiller says. And there's pretty broad concensus that the distribution plant is the easiest place to get better S/N performance.

"Where you're currently using push-pull you can go with power doubling or feedforward, designing a system for 48 or 49 dBmV instead of 43 dBmV," says General Instrument's Geoff Roman. "More electronics per mile will do the job when you go with power doubling and 16-amplifier cascades."

"It's pretty straightforward on the distribution system side," Van Loan says. "You have to raise levels. If you have over 25 amps in cascade you go AML and leapfrog or go with supertrunk and use feedforward." The added benefit is more than just S/N. Reliability also goes up when the system is broken up into smaller chunks.

Gill uses "nothing but FM for transmission to the headend and fiber supertrunk at $4,000 a channel for both video and BTSC audio," the thoughtful veep adds proudly.

But lots of small details can make a difference. Hank Cicconi, vice president of engineering for Sammons, reports that they've found insects building nests in waveguide used for microwave hops, for example, with a resultant decrease in signal strength.

*—Gary Kim*

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Reader Service Number 15

# RF broadband design...

## ...made PC easy.

Since broadband technology has become available for data network communications, the big question has been how will a TV-related technology blend into a data communications environment for a long term commitment? Though fiber optic networks were the state-of-the-art in the data communications field, it did not have the varied service flexibility of broadband systems. An RF broadband cable system offers substantial networking capabilities that go beyond TV entertainment. Yet many people today do not realize the full potential of this type of communication system. This article focuses on a unique cable design program called Broadband System Engineering, a CAE (computer-aided-engineering) PC-based software program.

Computer networks usually have focused on twisted pair wire cabling or low frequency (baseband) coaxial cable concepts. This type of architecture is easily designed, economical and quickly installed. It has long been the favored means of connecting computers to terminals or to other computer mainframes. But cable TV technology revolutionized data network systems.

Broadband systems have a proven track record of reliability. A broadband system can provide years of trouble-free service when coupled with a simple routine maintenance program. Broadband components have a life of more than 26 years between failures, even in harsh environments. A properly installed broadband system is highly immune to external electrical interferences, including grounding problems commonly found in baseband coaxial systems. RF broadband networks have total bandwidths in excess of 400 MHz and can be divided or segmented into many individual channels of varying bandwidths for use in data, video or voice.

The significance of this architecture is the elimination of wiring bulky cables between end devices to a control center. A broadband system uses a short wall drop cable connection to a coupling interface or tap located along the main cable routing. This method permits many devices to share the same cable medium simultaneously. Equipment can be easily relocated without major re-cabling. In this scenario, a broadband cable medium is a "wire once" concept, vendor independent, transparent to other users, multifunctional and expandable without need of re-designing.

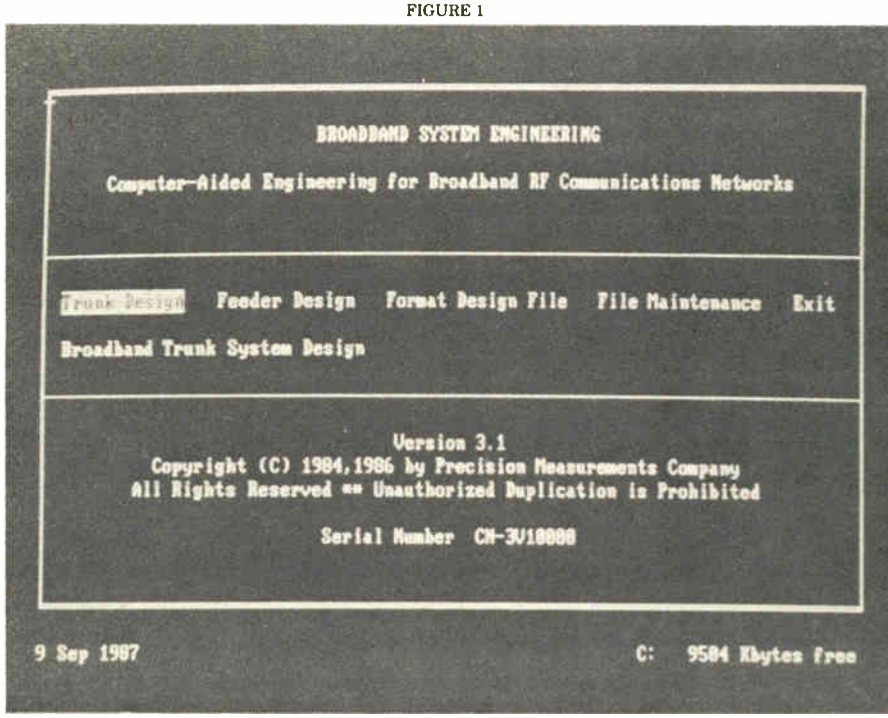
Broadband design requires careful attention to detail, and, before the PC revolution, it required much painful toil on a calculator. Designing RF cable systems was a maze of mathematical calculations and painstaking trial and error decisions of component selection. Any design modification required recalculation.

All passive components, which includes coax cables, splitters, directional couplers, taps, cable equalizers and power inserters have insertion losses that must be considered in broadband design. Cable connector losses are not considered since their insertion loss is not significant. One usually follows the manufacturer's published specifications or lab tests the components individually. The latter method is recommended for more accurate calculations, as most manufacturer's specifications provide for the worst case scenario which may yield higher system signal levels than calculated.

One of the main characteristics of coaxial cable, regardless of length, is that RF signal losses are not equal over a wide range of frequencies. Signal losses are higher at the higher frequencies. For example, the cable signal loss at 175 MHz is 6.8 times greater than at 5 MHz and at 450 MHz 1.474 times greater than at 216 MHz. The differences between the insertion losses is called tilt and is expressed in dBs. The overall total insertion loss will vary depending on the cable length, diameter and the dielectric material used. The larger the cable diameter, the lower the overall signal attenuation will be for equal lengths of cable.

Splitters are used to divide the signal. Depending on the manufacturer, each two-way splitter characterizes an insertion loss on each leg, typically about 4 dB. Some splitters operate as a three-way balanced or unbalanced output, in which one of the

FIGURE 1




*By John S. Gutierrez,*
*ComNet Engineering Co.*

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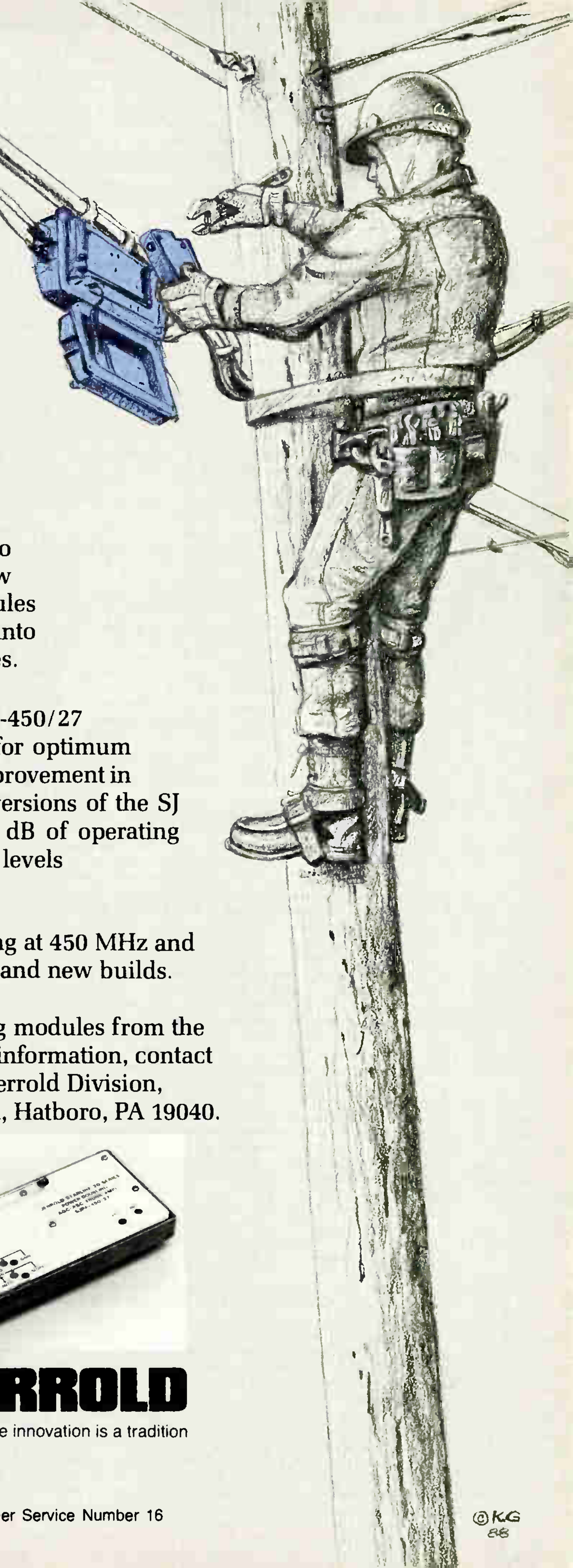

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Reader Service Number 16

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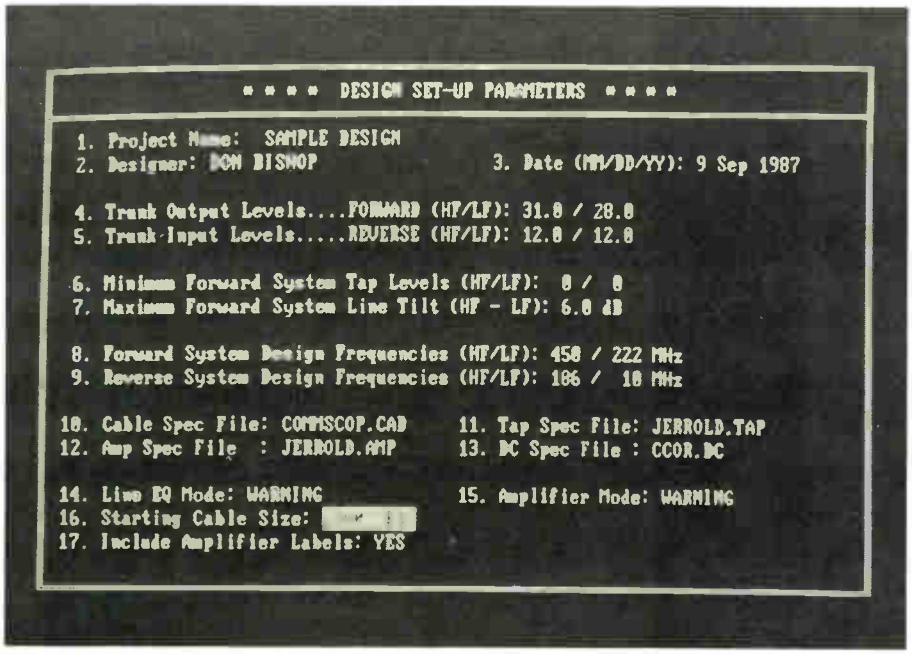
**Directional couplers have a through leg and a down leg of a typical insertion loss value 20, 16, 12 or 8 dB.**

FIGURE 2




down legs has a lower insertion loss than the other two. Losses will vary slightly with respect to the applied frequencies with higher power losses through the divided legs as the frequency increases.

Directional couplers, like the splitter, divide the signal power but unequally. Called DCs, they have a through leg and a down leg of a typical insertion loss value 20, 16, 12 or 8 dB. RF signals can travel in both directions on DCs—from the input to the down leg and vice versa. However, signals are impeded from traveling between the through-output leg and the down-leg. This isolation gives rise to the term directional. In some instances, DCs can be called directional taps, as their application is to "tap" a determined amount of signal level from a main distribution cable. Depending upon the down leg value, the through insertion loss will be less for a higher down leg value. Again, as in splitters, insertion

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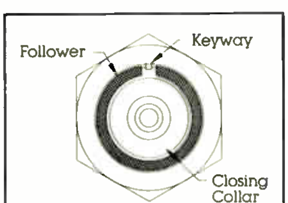


FORMER DESIGN
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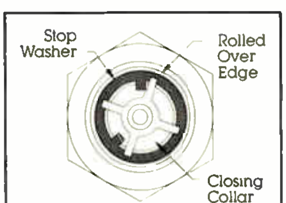


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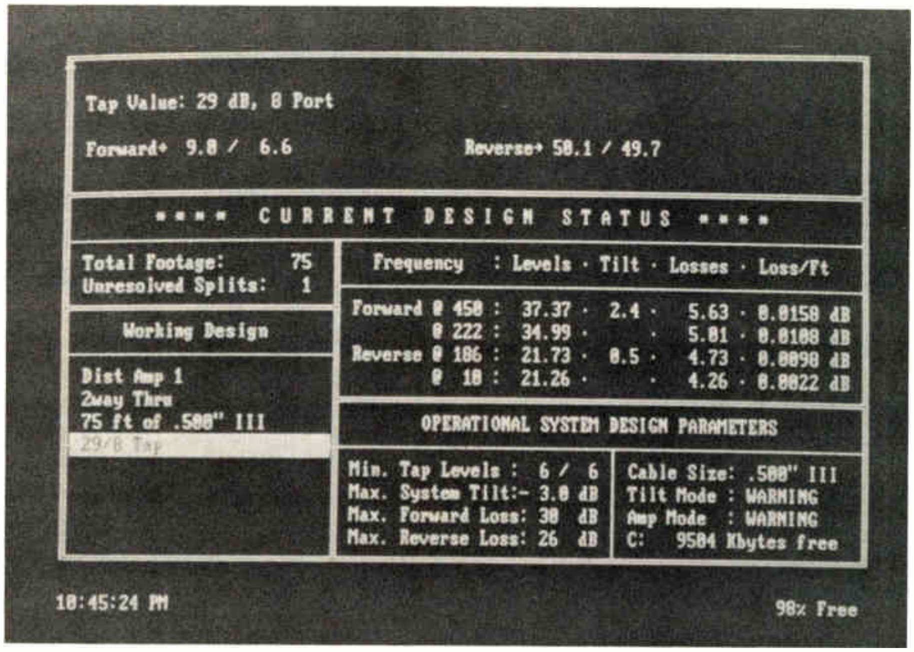
Reader Service Number 19

**The forward output of all amplifiers will be identical with each amplifier's gain set.**

frequency will have lower loss, resulting in a higher signal level to the amplifier input, an equalizer, as previously described, must be selected to equally impose the same loss at the lowest frequency band edge. Often, amplifiers cannot be physically placed at the unity gain point. In such a case, the amplifier should always be located before going below the unity gain point and to use an appropriate plug-in attenuator pad (rated in dB) to achieve the same effect. Everything now being equal, the forward output of all amplifiers will be identical with each amplifier's gain set and adjusted for the cable and component losses placed ahead. The reverse amplifier path uses a different gain principle in that its output is pre-tilted to overcome the next reverse direction cable and component losses so that all signals arrive at the next reverse amplifier input or headend at a predetermined level and flat across the bandpass.

FIGURE 3



**Tracking the component losses became time consuming and a drudgery, and many began turning to a PC for help.**

Signal losses must be calculated at the frequency band edges. In early CATV design the only frequency considerations were 54 MHz and 212 MHz. Today, the bandpass can range from 5 MHz to 600 MHz and can be partitioned into two separate bandpass configurations for bi-directional communications over the same cable. Single cable systems using a split configuration requires that four band edges, two forward and two reverse, be calculated. Tracking the component losses with a calculator became very time consuming and a drudgery, and many began turning to a PC for help.

At first, such programs were written in Basic for limited design operations. These programs operated as a screen calculator. The program would track component signal losses, insert couplers and select taps. Limitations to these programs were the inability to save the design as a file, lack of editing capacity, lack of databases, changing cable sizes on the fly, limited printer documentation, etc. Since these programs were individually prepared, the success of the program was left to the needs of the designer. For the cable TV operators who had large-scaled computers, sophisticated proprietary programs were written in languages such as Fortran. Developed as a spreadsheet format that could link to a database, these programs were "smarter;" however, they remained difficult to use and required a seasoned designer. In some cases, these programs lacked an interactive user screen to see the design in progress. The designer would have to choose the components manually, then run the program to see the results later. In addition, editing was cumbersome and time consuming.

The popularity of RF interactive networks fueled the need for PC CAE programs. These programs were generally developed in-house and were not for sale. Some have recently become commercially available, but have been priced above a comfortable cost, keeping it out of reach of a cable contractor desiring to get into broadband design or companies installing a single LAN. For many, turning to popular spreadsheet and database programs offered relief from the ball-and-chain calculator without being a skilled programmer. But spreadsheet program usefulness remained limited. In some spreadsheets, the designer chooses the tap values, then runs the program to verify the outputs. Failure resulted in the designer editing the work cells and re-calculating the design. The forward and reverse paths, in some cases, had to be calculated separately. Printing out the design analysis is generally limited to the PC's print screen function. In addition, documentation was limited.

ComNet Engineering Co., together with Don Bishop, owner of Precision

**Relying on outside help was not always free of its problems and often caused delays and unexpected overhead costs.**

Measurements Co., carefully looked at the market issues for broadband design CAE software. In the analysis, many companies and network integrators understood the basics of broadband design principles but had no desire to work behind a calculator, nor to develop a spreadsheet program or spend the money for a CAE program. Relying on outside help was not always free of its problems and often caused delays and unexpected overhead costs. A CAE program was needed that had to be both affordable and possess many of the "smart" features found in either the proprietary or high cost CAE versions.

A cable design program is generally written with several calculator spreadsheets linked to a master spreadsheet. These spreadsheets have access to database files which contain information about the individual cable component insertion losses used for the calculations. Obviously, the accuracy of the database will determine the design output. Information such as cable lengths are immediately calculated for the imposed band edge losses. Such losses are calculated from a cable manufacturer cable file by a program sub-routine, with the final output/return levels sent to the PC screen and program memory to await the next input statement. If the next statement asks the program to select a four-port tap, the program scans the pre-selected manufacturer's tap database file to select the proper tap value that will deliver the minimum tap port levels or drop levels. Anytime the signal falls below the minimum level, the program will prompt the designer that an amplifier is needed or that an alternate component selection should be made.

The first effort of a cable design is first recorded in the PC's RAM and must be saved to disk to preserve the work for recall at a later time. Separate program routines accomplish this task. Most programs provide printer printouts of the design, mostly in the form of a BOM and signal level analysis. Some go a bit further by linking to a drafting program. Be aware that programs that link to a CAD only results in a schematic, not a made-to-scale overlay of the physical layout.

So, what should one look for in evaluating a cable design program? Here are some basic suggestions:

- The program should have a frequency range from 1 MHz to 600 MHz with user defined frequency splits. It should also have the ability to design dual cable systems for LAN applications.
- The program should support multiple manufacturer databases so the designer can pick and choose from a variety of components.
- The database should be able to be

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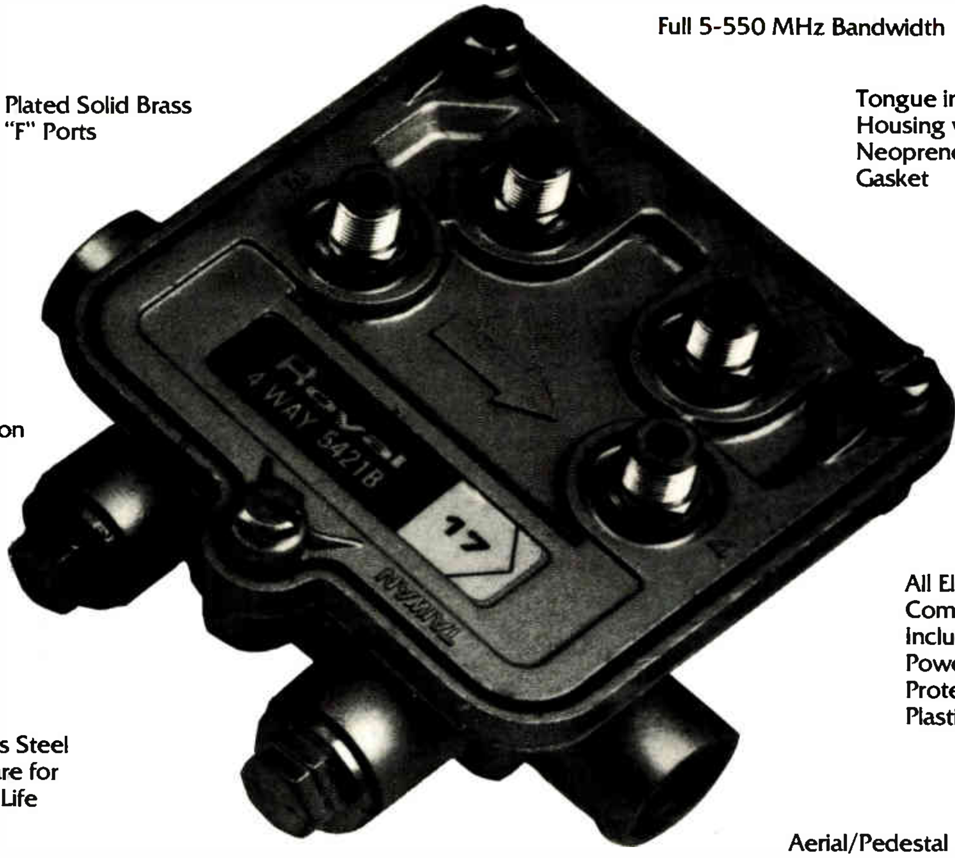


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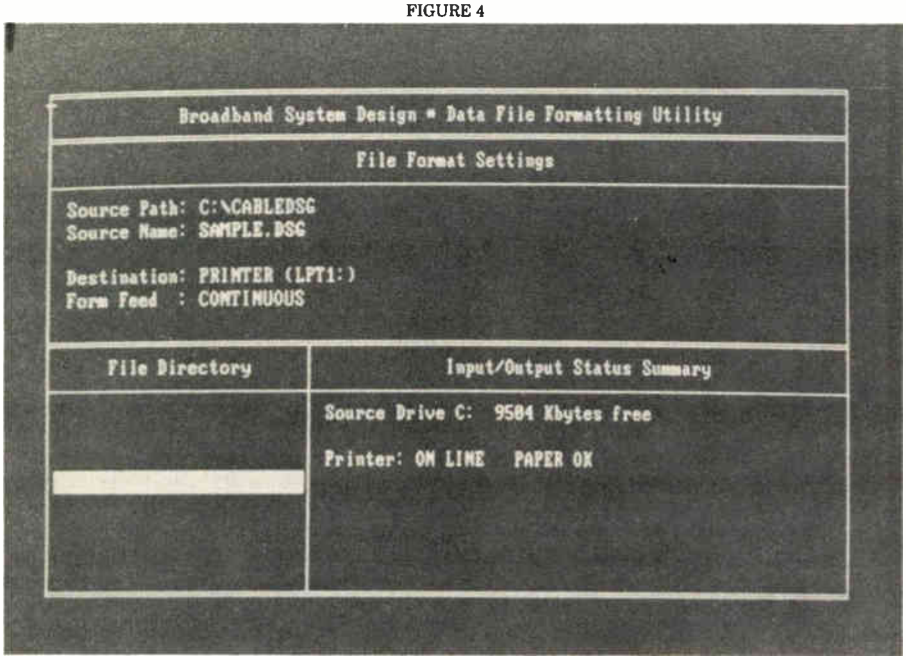
**When comparing program prices, be aware that even the more expensive programs may come with some surprises.**

user modified, edited or created with a minimum of six manufacturer files consisting of coax, taps, power passing DCs and amplifiers.

- The program should have editing features that recalculate the balance of the branch when a component is inserted, deleted or replaced. Recalculations should be of sufficient speed as to not require a co-processor.
- The program should be able to save the design.
- The program should be able to print the design to a printer or to a disk in ascii. Print-screen keyboard commands should be avoided. The program print function should operate independently using only the saved design.

FIGURE 4




Some programs require loading the program in the design mode before printing. The program printout should include a basic BOM of total number of components used (excluding pole-line equipment) and a printout of RF levels, both forward and reverse levels at the band edges located at the tap ports, cable sections, DCs and amplifiers. Information about the amplifiers should include required pads and equalizers.

- The program should provide the ability to override any of the automatic decisions used to select components, such as "hot taps."
- The program should allow "What if?" simulations and global component replacements.
- Trunk and feeder designs are often designed separately with the trunk designed first. Some programs will link the designs automatically, while others provide feeder-to-trunk linking using manual means. Automatic is nice, but comes at a price.
- The program should select tap values automatically based on either levels at the tap port or at the drop.
- The program should provide automatic or manual insertion of in-line cable equalizers and provide a warning that tilt has been exceeded.
- The program should track and screen display real RF levels as components are inserted or as the design is reviewed. Total insertion losses from the previous amplifier should also be shown and tracked.
- The program should allow the designer to start with any signal level for a beginning reference.

Some may measure a program performance by the number of miles or nodes it can design within a file capacity. It is recommended that cable designs be limited to the area served by the power supply or trunk station and feeder distribution. Large design files can lead to long recalculations, searches or outright confusion.

When comparing program prices, be aware that even the more expensive programs may come with some surprises. In order for these programs to be a useful design tool, extra program modules may be required and will add to the basic price. Some of the more expensive programs can do RF distortion analysis while doing a design, but these programs can be purchased independently at a savings. It is important that one evaluate and select a cable design program that meets the basic needs, as outlined above, while not getting carried away with the extra gold plating.

ComNet Engineering markets a cable design program called Broadband System Engineering. The software is intended for everyone who engages in broadband networks or CATV systems. Without any special hardware requirements, the program operates on any IBM, XT, AT or 100 percent compatibles. The program was developed for those who were inclined to design their own RF system and for network integrators or cable installation companies interested in getting into broadband design with a minimum investment in software. BSE uses familiar command conventions used by popular word processor and spreadsheet programs.

The program comes with a file maintenance program which allows the user to create and edit up to 10 manufacturer files for each of the following categories: coaxial cable; tap; directional coupler (including balanced and unbalanced splitters, an equalizer and one power inserter); and amplifier. The program comes listed with Comm/Scope, Times Fiber, Trilogy, C-COR, Scientific-Atlanta, RMS, Jerrold, Magnavox and Eagle manufacturers.

Before designing from the program, it is important that a cable routing be prepared. Using architectual blue line drawings, line out the cable routing showing the planned cable locations. Define the cable that is to be used according to type and size. Account for all distances including any elevation changes. Using schematic symbols, mark the locations of taps and couplers to be used without any attention to their values. Also be sure to account for

**The Set-up Parameters screen is a fill-in-the-blanks form where the designer can enter the project name, his name and the date.**

the distances between all passives. Amplifiers need not be located but for the starting location, such as, the headend.

After loading BSE into the PC, a main access menu allows a choice of modes: trunk design, feeder design, file formatting (printing) or utility file program (used to create or edit the manufacturer database) as shown in Figure 1.

Using the Tab key moves the highlight to the command function desired followed by pressing the Enter or Return key. Selecting the trunk design (or feeder design) will initially bring up a blank status design screen indicating the "System is clear" in the operating design window.

(For clarity, entries between the bracket signs represents a keyboard entry.) The [/] key pops up the command request line on the lower-left hand of the screen. The [/] command trees through a multitude of options for editing, change commands, file functions and printing. The user enters [/], Option and Start-up commands to get to the Set-Up Parameters function illustrated in Figure 2.

The Set-up Parameters screen is a fill-in-the-blanks form where the designer can enter the project name, his name and the date. These three entries will print on each header page on the bill of material and design printout. In addition, the other entries will tell the program what kind of system architecture the user will be designing by entering the frequencies of the band edges for the designated split frequencies for the forward and reverse direction. For dual cable, both directions would have identical frequencies entered. Other selections are the maximum cable tilt, initial RF output and required minimum reverse input, minimum tap port RF level specifications, selection of the manufacturer's for taps, etc. One changes the manufacturer file selection by pressing the [Tab] key as required to get the desired selection. Also, one can select automatic insertion of amplifiers/EQ or set them in the warning mode. The amplifiers can be labeled individually from the keyboard. For convenience the set-up can be saved if the same parameters will subsequently be used again.

After setting the system parameters, the program can be started by pressing the keys [Ctrl][Enter] at the same time. The Current Design Status, Figure 3, will be the operating screen for designing. Five windows which show the current status of the design calculations are from the top clockwise as follows. The top window displays information about the tap selected automatically by the program along with the operating forward and reverse signal levels. This same window will display the program's calculated pad and equalizer requirements for amplifiers se-

*Continued on page 56*

**The cost of the fiber optic cable is somewhat variable, based on the number of fibers and the cable construction.**

The costs of an AML for several configurations are shown in Table 1.

The major cost factors for a fiber optic system are: the central headend electronics; the optical transmitters; the fiber optic cable; installation of the fiber optic cable; and the hubs. Whereas several modulation/multiplexing schemes (e.g. digital, VSB-AM and FM) have been described for formatting multiple television signals for transmission over fiber optic systems, the only cost-effective equipment available on the market today uses frequency modulation. The cost of the modulation/multiplexing equipment at the headend is $2,000 per channel. Only one set of this equipment is needed per cable television system, independent of the number of hubs and the number of channels per fiber. The number of optical transmitters required at the central headend is dependent on the number of channels per fiber and the distances to the hub locations.

The equipment currently being marketed by Catel is capable of 40 unscrambled television channels (or 20 scrambled channels) per fiber. The number of hubs that can be served by one fiber optic transmitter can vary from one to as many as eight, depending on the geographic distribution and distances to the hubs. Three hubs per optical transmitter seem to be a practical limit. For the purpose of this example, we will assume that one optical transmitter can accommodate 35 channels, that two optical transmitters are required for the 60 channels, that three hubs can be served per optical transmitter and that an optical transmitter costs $4,000.

The cost of the fiber optic cable is somewhat variable, based on the number of fibers and the cable construction. We will use a cost of 45 cents per foot for two-fiber cable in the 35-channel system, and 55 cents per foot in the 60-channel case. (It is customary to include one extra fiber in the cable.) The installation of the cable can vary from 60 cents per foot for simple overlash to more than 90 cents per foot for more complex installations. We will use 75 cents per foot for the this example.

The number of miles of fiber per hub can vary greatly due to the desired hub locations, right-of-way restrictions, and the like. To be consistent with the above microwave analysis, we will assume an average distance to the hub of seven miles when comparing to the low power case, and 12.5 miles when comparing to the high power case.

The cost of a complete fiber optic multihub system is summarized in Table 2. The performance of the fiber optic system is considerably better than that of the microwave system. As an example, the signal/noise ratio of

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*Continued on page 56*

# Multihub distribution systems...

## ...for cable television application.

Much as the satellite revolutionized the distribution of television programs, so is fiber optics revolutionizing the distribution of signals within the cable television system. Fiber optics has been used for several years in supertrunking applications to interconnect headends, to transport signals from remote pick-up points to headends, etc.

Fiber optics is now cost-effective for the first level of signal distribution (to multihubs) and will soon provide a cost-effective alternative that can replace all active devices used in the traditional distribution system. The fiber optic system provides a signal quality that is far superior to any alternative, and may prove to be the only technology capable of providing the performance characteristics necessary for the distribution of high definition television signals.

A number of factors have influenced the growing interest in multihub architecture. Among these are:

- The need to deliver higher quality signals deeper into large systems;
- the economic advantages of consolidating headends;
- the requirement to upgrade the channel capacity and/or signal quality of a cable system; and,
- the need to lengthen the cable runs of a system beyond the practical limit of amplifier cascades.

The hub may be thought of as an extension of the headend, since the hub will deliver "headend quality" signals to the tree-and-branch distribution system. The central headend, plus the hubs, form a distributed headend architecture that provides greater flexibility in the overall design of a cable system and a substantive improvement in the signal quality delivered to the subscriber. As distributed headend architecture evolves, the delineation between the headend of a cable system and its tree-and-branch distribution subsystem will be less clearly defined.

Two technologies exist to implement multihub systems: microwave radio and fiber optics. Microwave radio has been used extensively in this application with somewhat mixed success, depending on the distances, the terrain and the weather conditions. Fiber optics has been used to a lesser degree for multihub systems in the past, primarily due to the cost of the fiber optics and the terminal electronics. However, the costs associated with all parts of a fiber optic system have undergone dramatic reductions. In almost any multihub design today, a fiber optic implementation will prove to be more economical than a microwave system and will have significantly better performance unaffected by weather conditions.

A generalized parametric cost comparison between a microwave system and a fiber optic system is difficult, since they have few elements in common. As an example, the expense of a tower, land and/or "hill-top rental" required for a microwave is not required for a fiber optic system; on the other hand, the expense of obtaining and installing the fiber optic transmission medium between the central headend and each hub has no equivalent expense in a microwave system. A dramatic cost reduction in the hub electronics for a fiber optic system has recently been announced by one supplier (Catel Telecommunications Inc.).

In the past, a hub cost between $5,000 and $7,000 per channel for all of the electronics needed to provide the signals in a format compatible with the tree-and-branch distribution system. Today, a fiber optic hub can be purchased at $1,000 per channel with a much better performance specification than a microwave receiver. Thus, the cost of a fiber optic hub is approximately the same as an equivalent microwave receiver.

*By Charles L. Cerino,*
*Comcast Cable Communications Inc.*

TABLE 1

### AML microwave system costs

| | Low Power | | High Power | |
|---|---|---|---|---|
| | 35-channel | 60-channel | 35-channel | 60-channel |
| Transmitter | $299,000 | $500,000 | $491,000 | $873,000 |
| Trans site | 43,000 | 43,000 | 43,000 | 43,000 |
| Receiver | 11,900 | 15,555 | 11,900 | 15,555 |
| Receive site | 43,000 | 43,000 | 43,000 | 43,000 |
| Cost/1 path | $396,900 | $601,555 | $588,900 | $974,555 |
| Cost/2 paths | 451,800 | 660,110 | 643,800 | 1,033,110 |
| Cost/3 paths | 506,700 | 718,665 | 698,700 | 1,091,665 |
| Cost/4 paths | 561,600 | 777,220 | 753,600 | 1,150,220 |
| Cost/5 paths | 616,600 | 835,775 | 808,500 | 1,208,775 |
| Cost/6 paths | 671,400 | 894,330 | 863,400 | 1,267,330 |
| Estimated maintenance, 1 path/15 years | 156,800 | 231,800 | 771,800 | 1,266,800 |
| Estimated maintenance, 6 paths/15 years | 190,000 | 265,600 | 805,600 | 1,300,600 |
| **Total cost 6 paths/15 years** | **$861,400** | **$1,159,930** | **$1,669,000** | **$2,567,930** |

The costs reflected in the above chart do not take into account the additional cost of power and air conditioning. The tower used for the estimate was a 150-foot self-support tower. All dishes were eight feet in diameter.

**The cost of the fiber optic cable is somewhat variable, based on the number of fibers and the cable construction.**

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**The products necessary to take fiber deep into the distribution system will be available within the next year.**

the fiber system is 60 dB at the AM output of the hub, as opposed to the 53 dB typical of a microwave receiver—and fade due to atmospheric conditions is no longer a factor.

Some concern has been voiced about "backhoe fades" or other catastrophic failures of fiber optics. Most fiber optic installations in the cable industry are pole-mounted, and are no more subject to disruption than the traditional cable distribution system. Since fiber optics is inherently a two-way transmission medium, it is possible to configure hubs in a loop-protected architecture. Depending on the geographical layout of the fiber system, a loop-protected architecture can be installed with only a small increase in the number of miles required. Loop protection switching can be accomplished at a small increase in the overall cost.

It becomes clear that to penetrate fiber optics deeper into the distribution system, two things must occur: the cost of the hub electronics must be reduced; and a two-level distribution system (probably using optical repeaters) needs to be developed, since it would be cost prohibitive to install fiber to a large number of hubs from a central headend location.

Both of these items are being addressed by companies currently supplying fiber optic systems to the cable television industry. It is expected that a full complement of the products necessary to take fiber deep into the distribution system will be available within the next year.

An advantage of fiber optics that should never be overlooked is its inherent bandwidth. The bandwidth of single-mode fiber is measured in hundreds of gigahertz per mile. Thus, for the lengths used in cable television systems, the bandwidths of the fiber optic transmission medium are measured in tens of gigahertz and wavelength multiplexing can be used to further increase the usable bandwidth. The usable bandwidth of a fiber optic system is limited primarily by the electronics associated with the laser transmitter and the detector. This is primarily a performance vs. cost trade-off (i.e. not limited by any inherent device limitation). Significant cost reduction of these components has occurred in the last two years and further reductions are anticipated.

The single-mode fiber optics should provide bandwidth beyond any conceivable expansion of channel requirements, performance specifications and other considerations. Whereas the exact specifications for high definition television have not been established, it is clear that whatever technique becomes standard will require higher baseband signal resolution, better signal-to-noise and better differential phase

**Fiber optics has come of age in the CATV industry, as demonstrated by the supertrunking systems that have been installed.**

and gain specifications than current systems. All of these parameters imply higher bandwidth in the transmission medium. Single-mode fiber optics installed today will clearly provide this bandwidth, and may well be the only transmission medium available to the CATV industry that can accommodate HDTV specifications.

Fiber optics has come of age in the CATV industry, as demonstrated by the 50-plus fiber optic supertrunking systems that have already been installed. It is now economically feasible to build multihub systems using fiber optics that are superior to AML in both cost and performance. This technology is currently moving very fast and will soon be capable of penetrating much deeper into the distribution system, ultimately providing cost-effective "fiber to the home" transmission systems. The fiber optics architecture permits an evolutionary approach to system design, from the hubs, through the second distribution level, to fiber to the home, where each step builds on the fiber optic transmission facilities installed in the previous step. Systems built using fiber optics can be expanded, upgraded, and so forth, without having to rebuild the transmission medium. ■

TABLE 2

**Fiber optics system cost**

| **Average path:** | **7 Miles** | | **12.5 Miles** | |
|---|---|---|---|---|
| Number of channels | 35 | 60 | 35 | 60 |
| Modulators | $ 70,000 | $120,000 | $ 70,000 | $120,000 |
| Hub | 35,000 | 60,000 | 35,000 | 60,000 |
| Fiber + installation | | | | |
| Cost per mile | 6,500 | 7,000 | 6,500 | 7,000 |
| 1 hub | 154,500 | 237,000 | 190,250 | 275,500 |
| 2 hubs | 235,000 | 346,000 | 306,500 | 369,000 |
| 3 hubs | 315,500 | 455,000 | 422,750 | 570,500 |
| 4 hubs | 400,000 | 572,000 | 543,000 | 726,000 |
| 5 hubs | 480,500 | 681,000 | 659,250 | 873,500 |
| 6 hubs | 561,000 | 790,000 | 775,500 | 1,021,000 |
| Estimated maintenance | | | | |
| 6 paths/15 years | 98,500 | 147,500 | 123,250 | 172,250 |
| **Total cost 6 paths/15 yrs.** | **659,500** | **937,500** | **898,750** | **1,193,250** |

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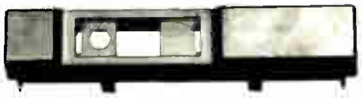

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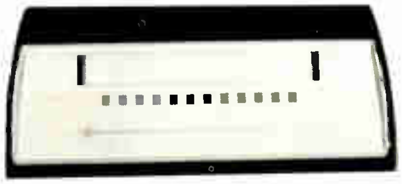

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# LAN focus heavy at CommNet

Communication Networks '88 is a major trade show aimed at federal government communication products users and has gotten to be a "must" show for many broadband suppliers, including General Instrument, TRW, Chipcom, Halley Systems, C-Cor, AM Communications, ISC Datacom, Zenith, Scientific-Atlanta and Netcon.

**Zenith**, which can always be counted on to come up with something new, is planning a March roll-out of its new low-cost PC network that Bob Dranter and Semir Serazi claim can be installed by a user in about half an hour. The new system will use RS-232 cabling and initially will support IBM PCs and compatibles. It is intended to be an inexpensive disk-sharing product aimed at the mass market and will feature transparent file exchange between 3.5-inch and 5.25-inch storage media. To keep costs down, the new network will operate without a file server.

**Halley Systems** (formerly Zeta Laboratories) plans to introduce its new ConnectLAN product line sometime soon. The company specializes in interconnecting LANs with wide area networks and does so with a line of modems, bridges, routers and network management software that operates over a broadband backbone. The first set of bridges to be delivered will work with 802.3 (Ethernet) networks.

**Scientific-Atlanta** put the spotlight on its new 1.8-meter VSAT system.

**Chipcom Corp.** introduced a new Ethermodem III/18 family of modular Ethernet-on-broadband transceivers. It also showed a new and lower-cost one-port version of its Ethermodem III/12. The new III/18 product allows frequency and bandwidth changes from 18 MHz to 12 MHz by swapping out modules. By switching chassis models, the transceivers can be upgraded from one to two ports or eight ports, or from two ports to eight ports.

**General Instrument** announced that **RFI Communications** has been chosen as the prime contractor for the Lockheed Missiles and Space Co. Communications Network Utility job. The dual-cable 450 MHz backbone network will initially connect 19 buildings. RFI decided to use Jerrold's X-2000 mainstations throughout. Lockheed's network will use the new Advanced Status Monitoring system which already has been installed at Walter Reed Army Medical Center in Washington, D.C.

Boston-based **McCourt Cable** company has created a new high-tech telecommunications division, called

**DataBeam presented the protocol document for its CT1000H system to the Defense Communications Agency.**

**McCourt Advanced Network Systems.** MANS will design, build and maintain integrated communications networks.

Stephen Twomey, director, said specific uses for MANS would include "extensions of Ethernet or other (LAN) systems, client premises to interexchange carrier points of presence, computer mainframe to computer mainframe, remote terminal applications and PABX main to satellite applications for distributed PABX systems."

**DataBeam** of Lexington, Ky., presented the protocol document for its CT1000H system to the Defense Communications Agency.

The protocol is the result of three years of product development at a cost of more than $2 million. It was designed to provide reliability, flexibility and expandability and is currently being used by the Department of Defense at its Strategic Defense Initiative sites on the Defense Commercial Telecommunications Network.

**NEC America Inc.**, via its Radio & Transmission Group, introduced two new VSAT (Very Small Aperture Terminal) products: the NEXTAR CL TSAT, claimed to be the first VSAT to operate at the T-1 transmission rate of 1.544 Mbps; and the Enhanced NEXTAR Clear Channel Indoor Unit, presented as the first VSAT transmission system to permit selectable data rates ranging from 9.6 Kbps to 2.048 Mbps.

The CL TSAT utilizes the QPSK modulation format and is also capable of operating at 2.048 Mbps, the European equivalent of T-1. The Clear Channel Indoor Unit provides selectable modulation formats.

**Fibermux** of Chatsworth, Calif., chose the CommNet show to announce that it has developed customized versions of its fiber-optic modems and multiplexers for use in encryption environments.

"KG" (a somewhat misleading pair of letters standing for "crypto gear") provides security in sending sensitive data to and from classified work sites. Government contracts often require contractors to install KG equipment to encrypt and decrypt data.

So what's the prognosis for broadband LANs used as facility backbones? Possibly mixed, according to Gartner Group Program Director for Local Area Communications Service Bill Redman. Gartner is a consulting outfit that works with Fortune 500 type companies on communications system choices. Lots of those companies are delaying their backbone network decisions at the moment, Redman said. The exception is the Department of Defense and the Aerospace industry.

"I don't see much broadband being selected for new jobs now. I think it has about five years left before FDDI (Fiber Distributed Data Interface) becomes the medium of choice," Redman said.

*—Gary Kim and Greg Packer*

# Ad insertion systems

Local advertising has become an important revenue source for many cable systems, with annual sales in the millions no longer uncommon. Forward-thinking operators with aggressive sales forces are selling most of their available air time and, in many markets, cable advertising is becoming a very viable alternative to local broadcast advertising.

This acceptance of cable by local advertisers has also resulted in a substantial increase in the rates charged, with 30-second spots selling for as much as several thousand dollars during the ESPN NFL telecasts. Should this upward trend continue, as indicators reveal it will, industrywide sales will reach a staggering level in five to 10 years.

#### The problem

From a manufacturer's standpoint, this rapid growth has presented numerous problems. Equipment developed to automatically insert the first spots less than a decade ago had a product life of about two years. Second generation equipment, although totally new and vastly improved, faired only slightly better. Many cable systems, after only a few short years, are already using their third generation of commercial insertion equipment.

Channelmatic is now shipping its fourth generation product which is a very complex microcomputer with high-level software that not only inserts the spots, but handles all of the sales trafficking and even the accounting and billing functions. (See Figure 1.)

Among other things, this system has the capability of random accessing any one of a 100 spots from each of four VCRs. The VCRs can then be sequenced back to fill avails of up to 2 minutes in duration. If desired, any or all of the VCRs can be assigned to a second channel by operator program.

This rapid growth cycle has been expensive for the manufacturers and the cable operators. It also has created a problem: in the vast majority of cases, the persons assigned the responsiblity of purchasing this type of equipment do not have the necessary technical expertise to properly evaluate these newer, more complex systems.

*By Bill Killion, Channelmatic, Inc.*

> Complex systems dictate that cable engineers become involved in the buying decision.

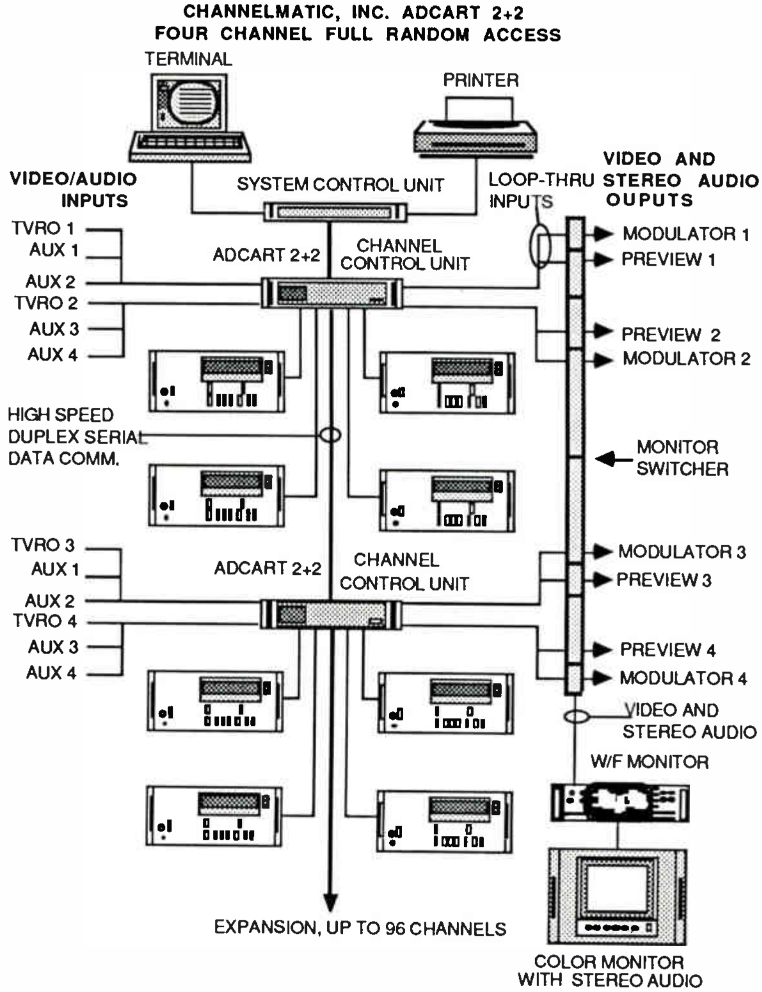
In the early years of local ad insertion, many fly-by-night suppliers appeared and, almost as fast, disappeared, leaving a trail of boat anchors long enough to sink Manhattan . . . at the expense, again, of both the quality manufacturers and the cable operator.

Time has not substantially changed this costly, growth-inhibiting situation. At Channelmatic, it is estimated that high-level engineers are only involved in the buying decision in about 30 percent of the submitted proposals. And, in many cases, even these engineers do not understand the complexities of the more sophisticated ad insertion systems.

This is not intended to downgrade the decision-maker, which is usually the person with overall ad sales responsibility or, in some cases, the program director or system manager. These people often know their business well,

FIGURE 1

**Typical 4-channel ad insertion system**



**If cable operators are to be competitive with the broadcaster, cable engineers must become involved.**

with many of them having long-term advertising experience in the broadcast fields. Most do not have technical backgrounds. In the broadcast industry, however, the chief engineer is *always* involved in hardware buying decisions.

The technical problems a broadcaster has with commercial insertion are much less complex than those of a medium or large cable system. Keep in mind that the local broadcaster is simply concerned with a single channel. To implement one channel of automatic ad insertion, including traffic and billing, is a piece of cake, particularly when the buyer doesn't mind spending $1 million or so to do it.

If cable operators are to be competitive with the broadcaster, cable engineers must become involved.

## Equipment considerations

**Basic system.** A basic automatic ad insertion system consists simply of a device which decodes cueing information from a satellite service, prerolls a VCR and then performs the necessary audio and video switching to insert the taped commercial into the network. Even the first commercial insertion system did this function in a clean, broadcast fashion.

This basic system remains a good choice for cable operators who are selling to a limited number of advertisers on reasonably long-term contracts and on a run-of-schedule basis. These systems are called spot sequential and are generally found in only the smaller cable systems.

Larger systems often have requirements that far exceed the capabilities of this kind of device. These requirements have culminated from the problems incurred in handling the heavy advertising schedules we've had to deal with in just the last year or so. All of them grossly effect the overall complexity and cost of a system.

**Systems complexity.** The internal circuitry of just the channel control unit of a current four-VCR, two-channel ad insertion system shows the complexity of such a unit. This device alone has seven large circuit boards and 168 integrated circuits, many of which are large scale. It also utilizes programmed logic arrays which tend to greatly reduce integrated circuit (IC) count. The microcomputer in this unit is a 16-bit device which controls 224K bytes of RAM, 256K bytes of EPROM and 8K bytes of non-volatile memory. (See Figure 2.)

The channel control unit is only part of the system. A system control unit, which controls information from each channel control unit and multiplexes it to various other devices, including a master printer, is also required. This unit has four large circuit boards and a total of 87 integrated circuits, most of them complex functions, and uses the same high-speed microcomputer used in the channel control unit.

A computer terminal is also used with the ad insertion system. This terminal provides a total of 75 screens for normal operation of the system. A massive amount of high-level software is also required with the system.

A third device, the tape encoder unit, is also required. It controls an editor to facilitate preparing the master tapes. It also uses the same microcomputer and has four large circuit boards and has a total of 64 complex integrated circuits. It is terminal-driven and provides 35 screens for simplification of the tape preparation process.

To further complicate things, the traffic and billing portion of the system normally utilizes an IBM AT compatible turbo drive computer, with a 40

**It should be remembered that any signal degradation caused by the insertion system will not just affect the ads inserted.**

Mb hard disc drive, a 1.2 Mb floppy disc drive and a 640K RAM and color graphics board. This unit processes at 16 MHz and also has an internal 60 Mb tape backup for mirror-image program and data backup. A total of 200 screens, all color, are required in the traffic and billing functions.

**Current requirements.** A cable system dedicated to an aggressive advertising sales program in a reasonable market should address the following:

- Full four-VCR per channel random access capability.
- Expansion capabilities of hardware and software.
- Auxiliary audio/video inputs for external sources such as character generators.
- Preview-before-air switching capability with operator-controlled preview buss.
- Automatic bypass to network in event of power failure or VCR signal loss and much more.

### Specifications

If a cable system is to be successful in head-to-head competition for advertising dollars with the local broadcaster, it must be concerned with the quality of audio and video generated. To date, little or no concern has been shown by prospective buyers as to the ability of equipment to pass signals without major degradation. In fact, most ad insertion equipment manufacturers don't even bother to include performance specifications in their literature and proposals.

It should also be remembered that any signal degradation caused by the insertion system will not just affect the ads inserted; the network signal is processed by the same system components and will suffer the same degradation. The audio and video specifications of major concern are described briefly in the following paragraphs.

**General guidelines.** Because of the vast differences in size and complexity of television systems, it is difficult to establish minimum specifications on individual items of equipment with the total assurance that cumulative buildup throughout the overall system loop will not cause problems. Most distortions and other degrading factors can be additive. For example, if a given device generates noise and it is cascaded with another noisy device, often the noise level of the output device will approximate the sum of the two. Therefore, we must consider all items of equipment in the overall system signal path to determine the applicability of the specifications of a device to be added to the path.

The cascading problem is the primary reason that specifications on broadcast audio and video equipment often seem to be unusually tight.

When considering overall system specifications, always remember that your audio/video signal path actually

**Of particular importance are the differential phase and gain specifications, since they can seriously affect the overall color in the picture.**

begins, in the case of a satellite network, at the initial signal generation point of the service. Degradation will occur starting at that point and will continue to occur up to the antenna terminals of the subscriber's set.

It is also useful to note that the most offending devices are those used to generate, process, transmit and receive audio/video signals. When compared to most signal switching and amplification equipment, audio/video recorders, uplink transmitters, satellite receivers, processing amplifiers, automatic gain control amplifiers, time-base correctors and modulators all cause substantially more baseband degradation, particularly in the area of non-linear distortion.

**Audio disturbances.** Generally, if equipment of reasonable quality is purchased and good wiring and grounding techniques are utilized, audio degradation is not much of a problem. The lower frequencies involved and the simplicity of the signal result in much less processing, therefore less degradation. When evaluating an ad insertion system, the following audio specifications should be reviewed and they should be within the limits presented.

**Audio inputs:**

- TVRO: 600 ohm balanced stereo
- VCR: 75K unbalanced stereo
- DTMF: 75K unbalanced
- Aux: 150 ohm unbalanced stereo
- Level: ±8 dBm nominal, +18 dBm maximum

**Audio outputs:**

- Program: 600 ohm balanced stereo
- Preview: 600 ohm balanced stereo
- Level: +18 dBm maximum
- Freq. response: ±0.05 dB, 20 Hz to 30 kHz
- Gain: With -6 dBm input, can provide +18 dBm output, continuously adjustable ±12 dB
- THD: less than 0.05 percent, 20 Hz to 30 kHz
- Hum and Noise: -70 dB referred to +8 dBm output
- Crosstalk: worst-case interfering signal 70 dB down.

**Video disturbances.** Video degradation is far more common than audio degradation, primarily because of the shortage of good video circuit design engineers. Proper video design is not easy and also requires highly specialized laboratory equipment not found in many smaller engineering labs. Of particular importance are the differential phase and gain specifications, since they can seriously affect the overall color in the picture.

Differential gain results from an erroneous change in amplitude of the 3.58 MHz color information as the overall signal amplitude increases or decreases. Since the amplitude of the 3.58 MHz color signal determines the amount of saturation in the color picture, deviation can cause either dull or highly saturated colors, depending upon whether the amplitude is decreased or increased.

Differential phase results from a change in phase of the 3.58 MHz color information as the overall signal amplitude increases or decreases. The phase of the 3.58 MHz color signal is used to determine the hue of the color picture. Any erroneous deviations in phase will therefore cause incorrect colors to be generated in the picture. This is particularly true of yellow, which has a tendency to turn olive or orange, depending upon the direction of shift, with just minor changes in the phase of the color signal.

When evaluating an ad insertion system the following video specifications should be reviewed and they should be within the limits presented.

**Video inputs:**

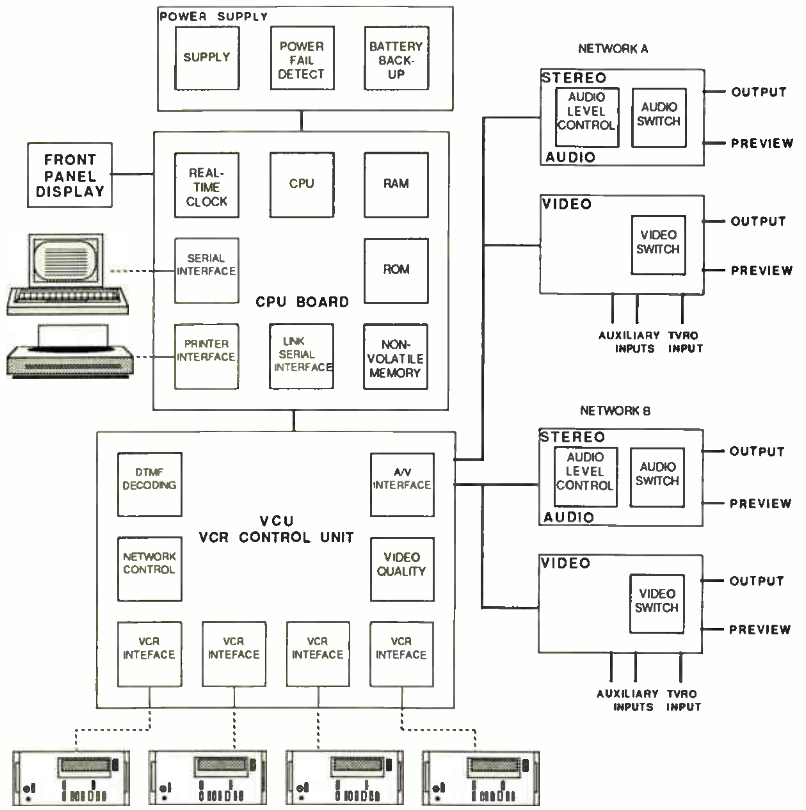
- All: 1 VP-P, 75 ohms ±1 percent terminated

**Video outputs:**

- All: 1 VP-P, source-terminated in 75 ohms
- Freq. response: ±0.05 dB to 5 MHz; ±0.1 dB to 10 MHz
- Gain: unity, adjustable ±6 dB
- Diff. gain: l0.1 percent, 50-90 APL

FIGURE 2

**Internal block diagram of a channel control unit, CCU-2A**



**It is strongly recommended that plug-in connectors be provided for all rear panel cabling.**

- Diff. phase: |0.1°, 50-90 APL
- Tilt: |0.5 percent, line or field rate
- Hum and noise: -70 dB at 1 VP-P output
- Sync out: 5 VP-P, composite
- Crosstalk: |-55 dB at 3.58 MHz, worst case

**Power specifications.** Minor AC power fluctuations often cause problems with computerized equipment. A system should operate correctly with deviations of ±10 percent from the normal 115 VAC power. Sufficient memory backup in the form of a battery or, better yet, a large capacitor, should be provided to maintain operator memory in event of power failure. Individual items of equipment should have built-in AC spike suppression and AC power strips having spike suppression should be used for power distribution in each rack.

**Connector specifications.** Connectors are an important consideration, particularly with balanced stereo systems, where a large number of audio connections are required. Add these to the many control connections for terminal interface, printer interface, VCR control and video and a major wiring problem results.

This cabling problem not only requires much time and thought during installation, but can also cause major maintenance problems later. If the equipment has screw terminals for audio and possibly even control, it can be time consuming to remove the equipment for repair or replace it.

It is strongly recommended that plug-in connectors be provided for all rear panel cabling. This will make the otherwise time-consuming task of removing and replacing the equipment a simple, fast procedure.

**Processing power.** Although not readily apparent from printed specifications for literature, it is extremely important that the microcomputer and related software have the necessary power and speed to handle a fully loaded advertising schedule. Keep in mind that most hardware demonstrations are performed with a minimum schedule loaded into the system and usually only one channel is operated. All too often equipment is purchased based upon such a demonstration and, when installed, simply does not have the computing power to handle a heavy schedule on several channels.

To perform well under loaded conditions, a powerful, high-speed microprocessor should be dedicated to, at most, two or three channels. Preferably, real-time multi-tasking software should be utilized, which results in a radical increase in processing speed and power. Interfaces to peripheral hardware, such as the VCRs, should always be bi-directional to enable status to be monitored.

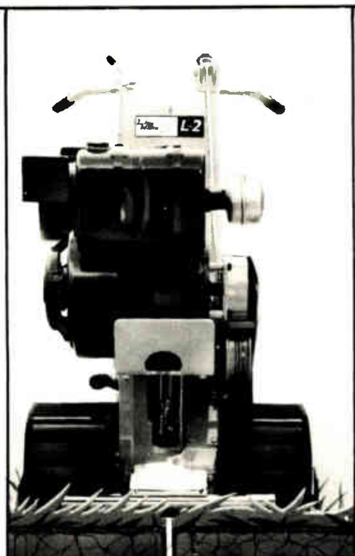
Software should also be prepared in a modular form, which almost always dictates the use of higher-level programming languages. Generally, high-level languages require a substantial increase in memory capability over machine programming language, consequently, machine language is often used to save hardware costs. However, aside from the speed and power benefits, modular software also greatly simplifies the task of updating software and adding new operating features at a later date.

### Turnkey installation

It would be a good idea to check pricing for a full turnkey installation from the supplier. With the large quantity of calling required, if the manufacturer has a well-equipped systems shop, he will probably be able to perform this work at less cost then you can internally. When evaluating the cost of a turnkey system, be realistic about your internal costs.

A properly equipped shop will have all of the electric cable strippers, connector attachment jigs and other specialized tools necessary to perform the job quickly and professionally. The turnkey should also have computer-identified cabling with full support documentation. A professionally cabled system can greatly simplify maintenance and reduce system down time. ■





# Power doubling offers better performance

As the cable industry's need for more bandwidth has grown, so has the need to develop better and more efficient electronics. In the "old" days it was simple—conventional amplifiers was all that was available. But ever since bandwidth capacities began climbing over 300 MHz, vendors started to look for ways to increase output.

But along with the higher levels came a substantial drawback. As levels were increased, the amount of distortion created by the active electronics grew. It took a new variation of an old idea to overcome the shortcoming. And it became known as "power doubling."


*Magnavox's power doubling module*

Magnavox was the first manufacturer to offer a power doubling amplifier to the cable TV industry. That technology, known generically as parallel hybrid, splits an incoming signal in half, sends both halves through two conventional push-pull stages placed in parallel, then recombines the signals at the outputs of the stages. The results are significant: signals are amplified an additional 3 dB and distortion is improved about 6 dB over conventional push-pull designs. It's a technology that's been around for a while but was forgotten until the early '80s.

It was first used in a transistor configuration about 15 years ago, says John Caezza, product manager at Magnavox. But when hybridized versions of amplifiers were brought out, the idea was left behind. "That (idea of placing two circuits in parallel) got lost a long time ago because in the hybridization process, they were able to effectively get the same improvement without going through the complicated procedure," said Caezza.

In 1983, as engineers were asking for more room without more degradation, Magnavox went to Amperex and suggested the technology be reinstituted. Amperex came through and Magnavox offered the first parallel hybrid built on a single substrate to its customers later that year.

"The trick was in what Amperex called the heat spreader," says Caezza. "That allowed them to put in the two discrete amplifier circuits on a single substrate and get the heat off the substrate and out of the module."

So when should you use power doubling? With today's demands for better performance at a cheaper price, just about all the time.

"It's used primarily in upgrades and rebuilds when you need more dynamic range," says Bert Henscheid, vice president of research and development at Texscan. "If you don't have more dynamic range (available) you have to decrease the (amplifier) spacing. So, in order to do a direct drop-in, for example to go from 300 MHz to 400 MHz or 450 MHz, without changing the amplifer locations, you need a better distortion amplifier. And power doubling (or "power addition," as Texscan calls it) fits that bill."

*Texscan's Pathmaker Line Extender with reverse*

The technology has proven to be so popular that virtually all the amplifier manufacturers (indoor and outdoor) offer a complete line of power doubling products, in all bandwidths and in all applications.

"In most cases we're after better distortion," says Henscheid. "In the trunk you want better distortion, while in the bridgers, sometimes you need to get the levels up so you don't have to change out the taps; because there's more loss at 400 MHz than 300 MHz. So in order to keep the same tap output level, you have to run the bridgers higher. Power doubling allows you to do that."

And by improving distortion levels, the economics of system design change tremendously, according to Robert Loveless, supervisor of applications engineering for Scientific-Atlanta's Broadband Communications Business Division.

"The 6 dB distortion improvement you get is enough to allow you to run bridgers and line extender outputs higher, which means economics in a feeder plant," said Loveless. "A 3 dB (increase) in level could save you as much as 30 percent of your line extenders out there. So even though the individual amplifier costs more, when you're looking at it on a per-mile investment basis, your per-mile costs come down. In the system designs we've done, it doesn't make sense to use push-pull line extenders or bridgers anymore. The parallel hybrids are cheaper all the way around the board."

Power doubling amplifiers can help bring down the overall cost of a cable system by expanding the reach of each segment of the plant. According to Keith Weil, Magnavox's manager of products and marketing, some of the biggest expenses can be consolidated because maybe that one extra hub or headend won't be needed, or that extra microwave hop won't be necessary.

Because the chips are manufactured by three companies—Amperex, Motorola and TRW—everybody's amplifiers provide roughly the same performance, within 1 or 2 dB, the manufactur-


# The Genius of Magnavox

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Magnavox CATV SYSTEMS, INC.

A NORTH AMERICAN PHILIPS COMPANY
100 Fairgrounds Dr., Manlius, NY 13104

Reader Service Number 38

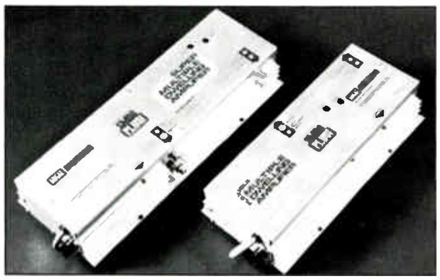
## Power doubling amplifiers can help bring down the overall cost of a cable system by expanding the reach of each segment of the plant.

ers say. "Now that things have gotten a little closer it really comes down to design considerations," says Magnavox's Caezza.

Loveless from S-A agrees. Performance is similar among all brands, he says, with subtle differences resulting from packaging, the number of test points, internal losses and tilt levels. For instance, S-A amps run with 3 dB of trunk tilt, while Magnavox actives run with 6 dB of tilt. The more tilt, the better the distortion, says Loveless. "It gets down to a game of specsmanship in the catalog," he says.

While the technology has advanced a long way already, the manufacturers haven't ceased research into ways to get even more performance out of power doubling actives. Scientific-Atlanta recently announced an advanced parallel hybrid trunk amp that delivers 8 dB distortion improvement, a 2 dB increase over other power doubling amps.

The amp was designed for systems needing more distortion improvement



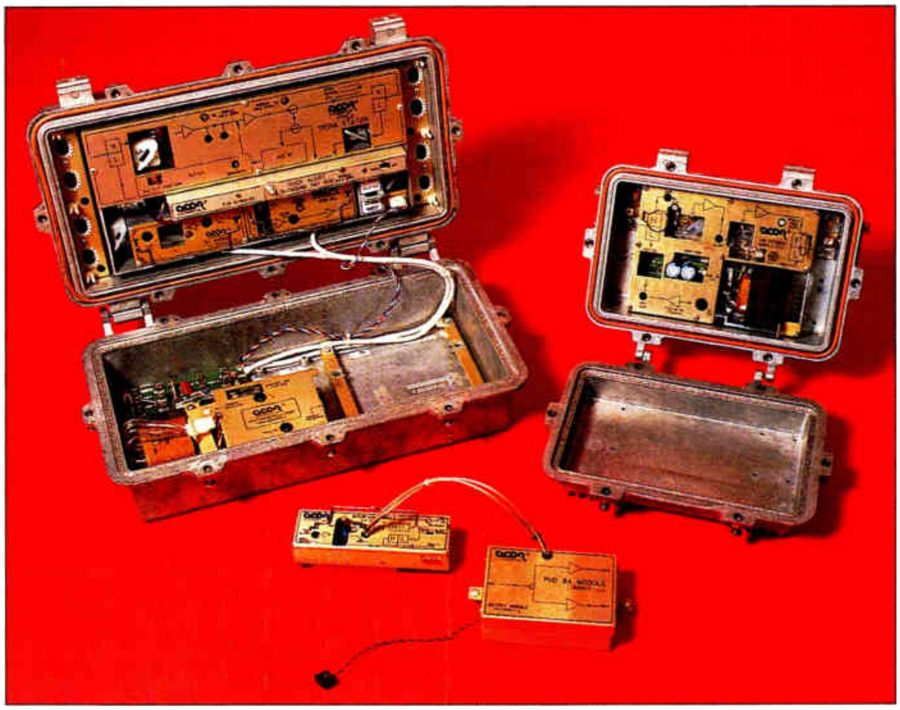
*Broadband Engineering's SMDA*

than can be provided by conventional push-pull, but not as much as feedforward. The new AT amplifier provides sufficient channel expansion while maintaining picture quality without a significant increase in power consumption. Additionally, the amps are needed only every 2,600 feet instead of every 2,200 feet. Therefore, life cycle costs are reduced from lower power consumption and less installation and maintenance costs.

Triple Crown also introduced a new 550 MHz amplifier that can be configured as a power doubling unit. The IDM Series features a module housing a dual integrated circuit that employs replaceable input and interstage slope circuits.

The input and interstage plug-ins determine the operating bandwidth of the amp and incorporate selectable attenuators and equalizers, eliminating the need for plug-in attenuators and equalizers.

*—Roger Brown*



*C-COR's PTSW series power doubling amplifiers*

*For more information about these products or any other amplifier products, contact the following companies:*

**Broadband Engineering**
1311 Commerce Lane
Jupiter, Fla. 33458-5636
(305) 747-5000

**C-COR Electronics**
60 Decibel Road
State College, Pa. 16801-7580
(800) 233-2267

**Electroline Television Equipment**
8750 8th Avenue
Montreal, Quebec, Canada H1Z 2W4
(514) 374-6335

**Jerrold division of General Instrument**
2200 Byberry Road
Hatboro, Pa. 19040
(215) 674-4800

**Lindsay Specialty Products**
50 Mary Street
Lindsay, Ontario, Canada K9V 457
(705) 324-2196

**Magnavox CATV Systems**
100 Fairgrounds Drive
Manlius, N.Y. 13104
(800) 448-5171

**Scientific-Atlanta**
One Technology Parkway
Atlanta, Ga.30348
(404) 441-4000

**Texscan Communication Products**
10841 Pellicano Drive
El Paso, Texas 79935
(915) 594-3555

**Triple Crown Electronics**
4560 Fieldgate Drive
Mississauga, Ontario, Canada L4W 3W6
(416) 629-1111

**Viewsonics**
170 Eileen Way
Syosset, N.Y.
(800) 645-7600

**As a safeguard, the program will not overwrite a design to a file it does not recognize.**

*Continued from page 37*

lected.

The next window shows the insertion losses and signal tilt occurring at the forward and reverse band edges. This window automatically recalculates all signal band edges each time a component is added, deleted, changed or when the highlight cell is shifted across the entered components in the Working Design window.

The Operational System Design Parameters window includes important reminders taken from the set-up. The Working Design Cell window is where all cable entries are placed. The next small window above tracks the total cable footage used and unresolved splits. Directly below all windows are two status lines: time of day and percentage of program RAM free. When the [/] is invoked the pop-up command line replaces the time status. The operation of Current Design Status actually allows the designer to directly interface with the program as the design develops.

Assuming the designer is starting from the headend amplifier, component entry is a simple matter of pressing keys. To enter DCs, the [-] key is pressed followed by the use of the [Tab] key to move the highlight to the desired selection on the command line, then pressing the [Enter] key. For example, if the designer selects a DC-8 through, the through losses will be added to any previous component losses already entered. To get to the down-leg, the [Tab] key toggles between the through or down leg when the DC or splitter is highlighted in the cell window. One also selects splitters, equalizers or power inserters from the [-] key command.

Entering cable is a simple matter of keying in a number from the keyboard. The program knows that a cable segment is to be entered when numbers are entered. To enter 75 feet of cable, enter the numbers [7] and [5] then [Enter].

To enter taps, the [ + ] key is used. The program will then ask for the number of drop ports. Selecting a 2, 4 or 8 key entry number, the program will instantly and automatically select a tap value from the pre-selected database that meets the minimum drop specification. The drop level analysis of the tap ports is then displayed in the top window, as shown in Figure 3. To defeat the program's automatic tap selection, press [ + ] twice. This tells the program that the user wants to manually select a tap.

To enter amplifiers, the [F3] key is used. A variety of amplifier selections can be invoked from the amplifier database followed by a ID label request. The program will display and document the values for amplifier tilt compensation and padding for both directions.

To look at signal levels at the drop outlet, the [F5] key will ask the designer to set the drop cable type, the cable drop length, any insertion losses due to signal splitters used, if any, and the minimum expected output at the forward band edges. Once this is set, pressing the [F5] when the highlight cell is placed over a tap in the Working Design window, the user can observe the drop level calculations based on the drop settings. When the drop specification is set for continuous running by the user, the program will select taps based on the drop outlet specification rather than at the drop port. Now the drop signal analysis reflects the wall outlet. To look at the RF levels at the port, the user inserts the augment command or [Ctrl][A]. Alternate pressing [F5] and [Ctrl][A] toggles the drop analysis display between the wall outlet or tap port.

The user can always edit previous design entries by using the delete, insert or replace commands, [Ctrl][D], [I] or [R] respectively. For example, if 100 feet of distribution cable was entered and it should have been 200 feet, the user would highlight the 100 foot entry using the [Arrow] key, followed by invoking the Delete Command or the speed keys [Ctrl][D] and the section is then erased. Then using the insertion command or [Ctrl][I] at the same cell location, the program will ask the designer to select an insertion option. With cable selected, the program will then ask how many feet are planned. Enter the number and press [Enter]. The correct cable length is inserted and the whole distribution leg is then automatically recalculated.

The program will abort component entries that cause the signal path to fall out the operating window defined in the set-up parameters. Directional couplers can be replaced by other DC values or splitters using the replace command [Ctrl][R]. Taps can also be deleted or inserted in the same manner that cable is replaced.

Another feature of BSE is the ability to see files in any directory path. Like the DOS DIR command, the program lets the designer view file names in any path or directory location. As a safeguard, the program will not overwrite a design to a file it does not recognize. If the design file already exists, the program will ask for verification. The program will not load a file not recognized by the program as its own. Design files can be saved in any designated path, directory or drive. While program is limited to a maximum design size, large designs should be divided into several files. The user has full control over how the files are organized.

Using the file formatting, BSE design files can be directed to a printer for a bill of materials and RF level analysis documentation report. In addition, the design documentation can be directed to a disk drive as an ascii file. Figure 4 illustrates the format utility program menu. The program features a check of available disk space before writing the design and will abort the print execution if the disk lacks file space. Having the design documentation on disk, data can be imported to a word processor or spreadsheet program. (A sample design printout is shown in Chart 1.)

The program will not do AC powering. It will, however, printout DC loop loss in ohms for each section of cable used. So, keep the calculator for Ohm's Law calculations. In addition, the program design does not link to CAD software to draft a schematic design. For those designing trunk amplifiers with bridgers, splitters from the database must be selected instead of feedermakers for feeder branching. Trunk and feeder design must be linked manually. To use the newer 1.5 dB increment taps, they must be rounded off to the nearest whole number when configured in the database. The only requirement is that one must remember that the RF port levels will be off 0.5 dB, which is generally not of serious concern as most taps are ±1 dB in tolerance at best. ■

# classifieds

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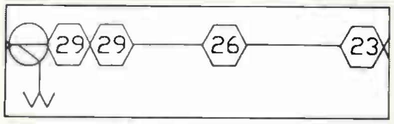


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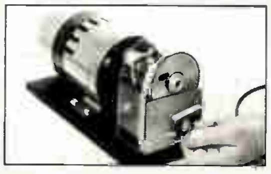

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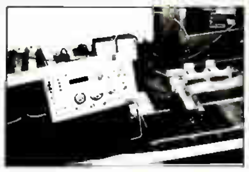

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For more information call Judy Medley at (303) 860-0111.

**A complete line of wire and cable clamps was introduced by Ziptape Identification Systems.**

than power doubling amps. The new actives are designed for use in narrow upgrades, newbuilds and/or rebuilds. Call (404) 441-4000 for information.

A new line of 10-foot four-piece mesh antennas has been introduced by **Channel Master**. The Extruded "T-Lock" Plus antennas offer a more precise surface and better Ku-band reception. Four models are available; two each for both C- and Ku-band use. For information, call Greg Hurt, (919) 934-9711. Also new from Channel Master is a low-cost line of ASE passives designed for commercial use. The Pro-Pack line includes band separators, cable, line splitters, transformers, joiner/separators, directional tap-offs, wall plates, A/B switches, attenuators, UHF loops and FM dipoles.

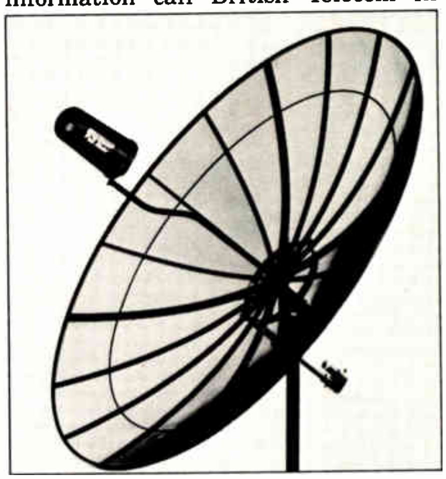
**LRC Electronics** has redesigned its three-piece connector line. The new W-series connectors still feature a no-twist center conductor seizing mechanism, but the keyway has been removed to make installation easier. Call (607) 739-3844 for information.

**Panduit Corp.** introduced two new products. A new cable tie push mount is used to secure wires and cable to wooden surfaces and a new metal adhesive cord clip is designed to secure wire, cable or tubing to flat, smooth surfaces. Call (312) 532-1800.

A complete line of wire and cable clamps was introduced by **Ziptape Identification Systems**. Called Zetclip, the devices are available with a self-adhesive base for fast mounting on any clean, flat surface. Call (602) 966-2999 for information.

A new fiber optic mechanical splice has been introduced by **Siecor Corp.** The SeeSplice provides positive visual and tactile feedback, assuring fiber mating. Two coated glass rods and a taped surface combine to allow self-centering of the fibers. Average splice loss is 0.2 dB. In other news, Siecor also introduced a new attenuation test set to configure any combination of detector and light-source modules; an aluminum cabinet-mounted interconnect center for use within equipment closets; a pigtail storage cabinet, a plastic splice tray for both loose tube and buffered cable designs that house up to 12 splices; and an enhanced wall-mountable interconnect center. For information, call (704) 327-5998.

In other fiber-related news, a new optical fiber cleaving tool was developed by **British Telecom**. The tool produces highly accurate squarely cleaved faces and has a life expectancy of about 6,000 cleaving operations. For information call British Telecom in Britain at 223 354102.



*Channel Master's four-piece mesh antenna*

**Norland Products** unveiled a laboratory splice kit designed to make temporary fiber optic connections in the lab or field. It includes 10 optical splices, three splice holders and one syringe each of adhesive and index matching fluid. Cost is $250. Call (201) 545-7828 for information.

Two new products have been developed by **John Fluke Manufacturing**. The Philips PM 3350 is a fast digital storage oscilloscope with real-time capability and the PM 2525 digital multimeter is a general purpose instrument with extra functions like capacitance and frequency counting. For information, call (206) 347-6100.

**Wavetek RF Products** has released a new version of software for the Model 1882 Sweepless Sweep. Software version 3.4 features two non-volatile fre-

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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.

## 1100 CKR—the C- and Ku-band receiver designed for use with low-cost LNC's

Our newest receiver, the 1100 CKR for C- or Ku-band reception is compatible with all major scrambling systems such as BMAC™ or VideoCipher™. It delivers consistently superior video quality through the use of Microdyne's patented optimal threshold extension demodulator.

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Reader Service Number 48

# New LAN OTDR maps fiber optic cable routing

**The TD-9960 high resolution OTDR is available with disk-drive mass data storage for easier cable system documentation and trouble-shooting**

Laser Precision's new high resolution optical time domain reflectometer for LAN applications offers a wide range of features and capabilities. The mass data storage option enables you to store the test trace of the total length of each fiber optic cable link on convenient floppy disks. Upon retrieval of a trace, you can obtain readout of dB loss and location at any point along the trace, such as at a splice or connector. You can also expand any point of interest along the trace for close analysis. This can be done on the TD-9960's CRT, or on an IBM type personal computer with the TD-958 OTDR emulation software to provide an easy method for maintaining and trouble-shooting the cable system. The full ASCII keyboard enables you to add notes, such as date, location, and code, as well as retrieve any trace on the floppy disk. This convenient method for mapping the routing of the cable system also makes it easier and faster to pinpoint any location of a cable problem.

The superior capabilities of Laser Precision's LAN OTDR are to the real benefit of the user. It has the capability to zoom in on any area along the total length of the trace, without having to rescan and reaverage the data. The TD-9960 eliminates the time consuming and irritating requirement of having to constantly rescan. During splicing, only a single marker is required to establish the splicing location on the TD-9960's CRT. This position is maintained, going from fiber to fiber, during sequential splicing. No reprogramming required. The TD-9960's real-time display with continuous dB readout makes it easy to optimize the fiber core alignment prior to splicing.

The TD-9960 features plug-in modules for 850 and 1300nM, ±0.01% base accuracy, 0.01dB resolution, 20dB backscatter range, 10cm resolution, short 3 meter dead zone which is compensated by the pigtail, 40 kilometer distance range, real-time display, dual cursers, built-in digital X-Y plotter, and available IEEE-488 or RS-232 interface, as well as the TD-959 mass data storage option.

For more information, contact LASER PRECISION CORPORATION, 1231 Hart St., Utica, NY 13502, or call (315) 797-4449, or telex: 646803

Reader Service Number 49

IN THE NEWS

## A number of satellite progamming services have either moved or plan to move to different transponders and/or satellites.

quency sweep plans and eight programmable memory locations for storage and retrieval of spectrum displays or sweep responses. Call (800) 851-1198 for information.

Two new home amplifiers are now being offered by **Pico Macom**. The Model FMA-15 amplifies the FM signals of the home stereo system while improving reception. It features 15 dB gain and a low noise figure. The IA-20 amp is used to improve TV signal reception. It features a 50 MHz to 890 MHz bandwidth, 12 dB gain and a low noise figure. Call (818) 897-0028.

In a move that will once again consolidate the leadership of **General Instrument**'s Jerrold and Tocom divisions, **Hal Krisbergh** has been appointed president of Jerrold. He will report directly to Frank Drendel, executive vice president of General Instrument and will oversee Jerrold's subscriber and distribution systems divisions as well as the Tocom and international operations along with Cable Video Store. **Anthony Aukstikalnis** was appointed VP and GM of Jerrold Subscriber Systems while Lemuel Tarshis was named VP and GM of the distribution systems division.

*Tony Aukstikalnis*

**Avantek Inc.** elected five corporate officers. Elected as corporate VPs were **Steven Allen**, VP and corporate controller; **Richard Clark**, VP of telecommunications; **Robert Malbon**, VP gallium arsenide technology development; **Peter Manno**, VP of microwave product sales; and **David Norbury**, VP of subassemblies.

**Netlink USA** has named **Sally von Bargen** vice president of marketing. She comes to Netlink from CommTek Publishing in Boise.

Three personnel changes were announced by **Times Fiber Communications**. **Craig Scalzo** was named director of sales and marketing, **Ralph Hilburn was named national territory sales manager and Rex Porter** has left the company to pursue other interests.

**Gary Carter** has been named national sales manager of **FOR-A Corp. of America**.

**Steven Rosenberg** has left **Paul Kagan Associates** to pursue other interests.

**John Newlun** has been named field application engineer for the East Coast at ADC Telecommunications. He was with the New York Telephone Co.

**Midwest CATV** has named **Forrest Frakes** and **Bill Cody** Eastern Region sales representative and Southern Region telemarketing sales rep, respectively.

A number of satellite programming services have either moved or plan to move to different transponders and/or satellites. **Cable Video Store** will move to Transponder 5 of Galaxy III, from Satcom IV. Galaxy III is located at 93.5° West longitude. **Cable Value Network** moved to Transponder 9 of Galaxy III on Feb. 1. It moved from Satcom F3R and F1R. **The Fashion Channel** moved to Transponder 1 of Satcom 3R on Feb. 1. It will simulcast over Satcom IV, Transponder 14, until May 1. And finally, **United Video** began delivering KTVT from Dallas/Fort Worth on Satcom F1R, Transponder 22, on Feb. 15. It moves from Telstar 303, Transponder 20. Stereo transmission will commence by April.

### Correction

In the December 1987 issue of *CED*, a listing was inadvertently left out of the converter repair profile. The following listing should have appeared:
Southwest General Industries
Service and Repair Division
(619) 438-1518
2245 Camino Vida Roble
Carlsbad, CA 92008
Personnel: Tim D. Mullennix, general manager; Pam White, sales manager.
Description: The only in-warranty repair center for Oak Sigma Phase I and II addressable decoders, headend equipment and Orion satellite encoders and decoders. Repair center for Oak TC addressable decoders. Standard non-addressable converters/decoders including Pioneer, Jerrold, Sylvania, Hamlin and Scientific-Atlanta.

We regret the error.

*—Roger Brown*

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