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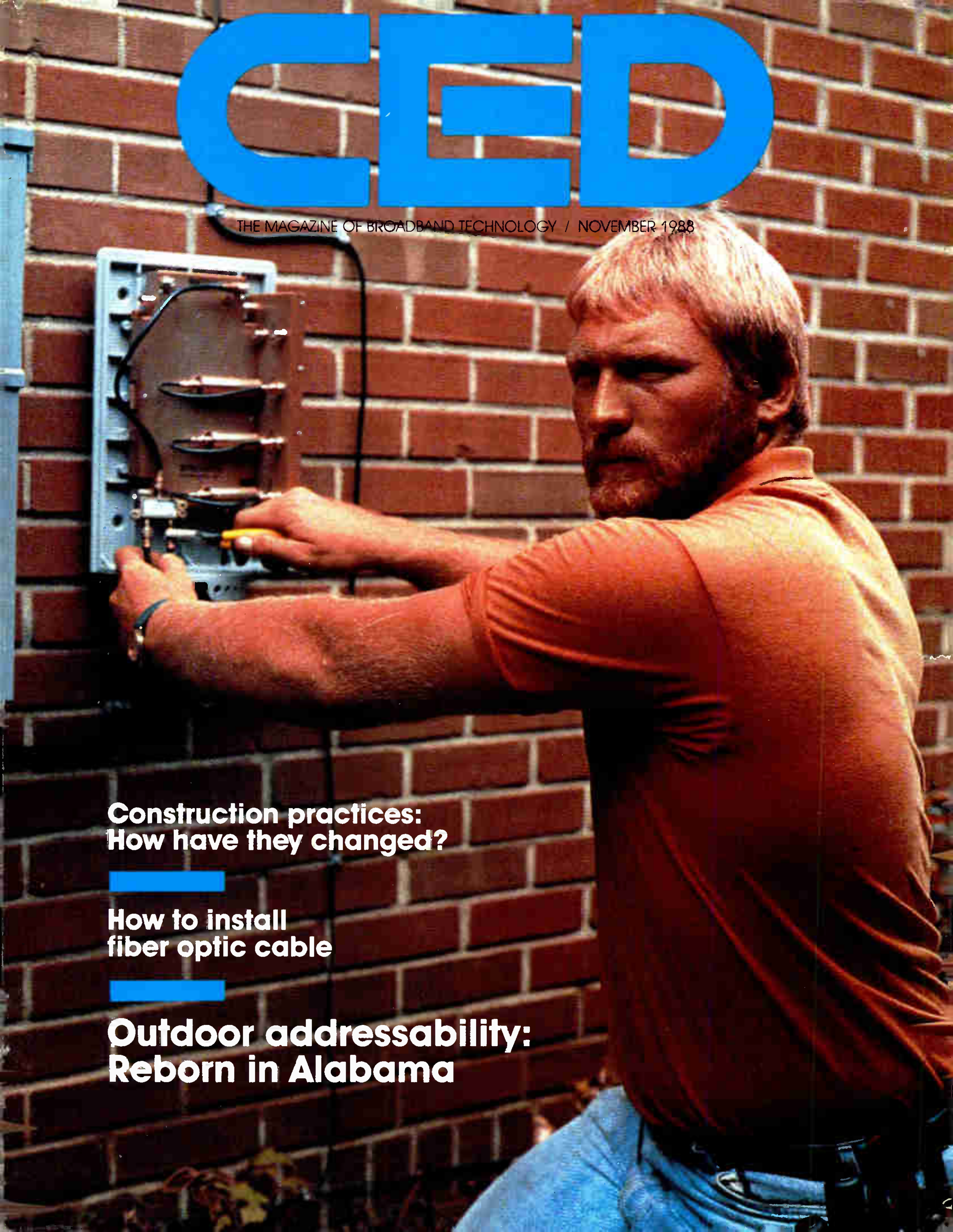
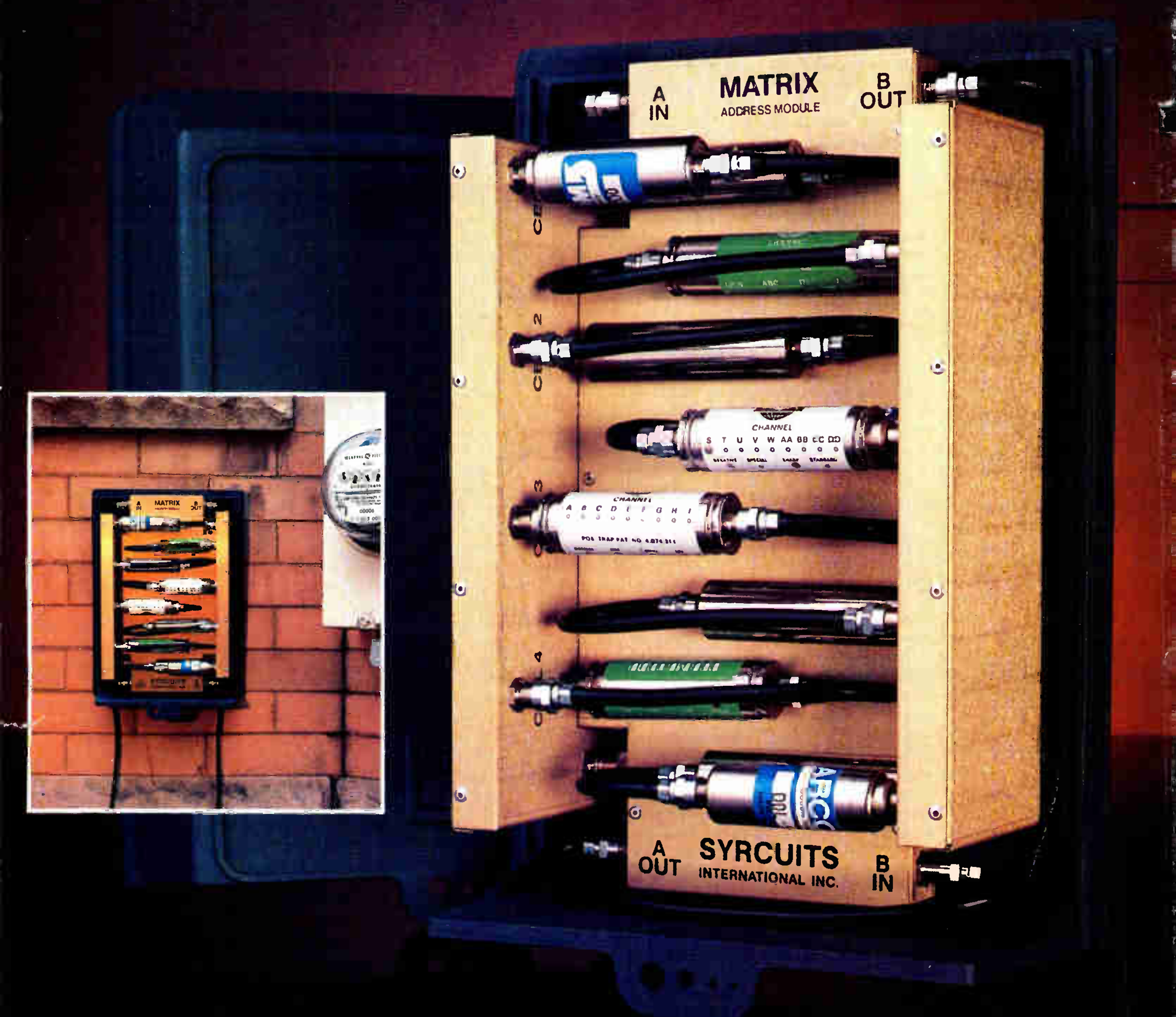


Construction practices: How have they changed?

How to install fiber optic cable

Outdoor addressability: Reborn in Alabama

THE MATRIX SYSTEM



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November 1988

CED

Volume 14, Number 11

About the Cover:
Com-Link's Installer Greg Renfroe installs one of the more than 60 Matrix off-premise addressable units in the MSO's Notasulga, Alabama system. Lynn Rotton, chief engineer (shown in photo above) has supervised the installation of the product and has good things to report.

DEPARTMENTS

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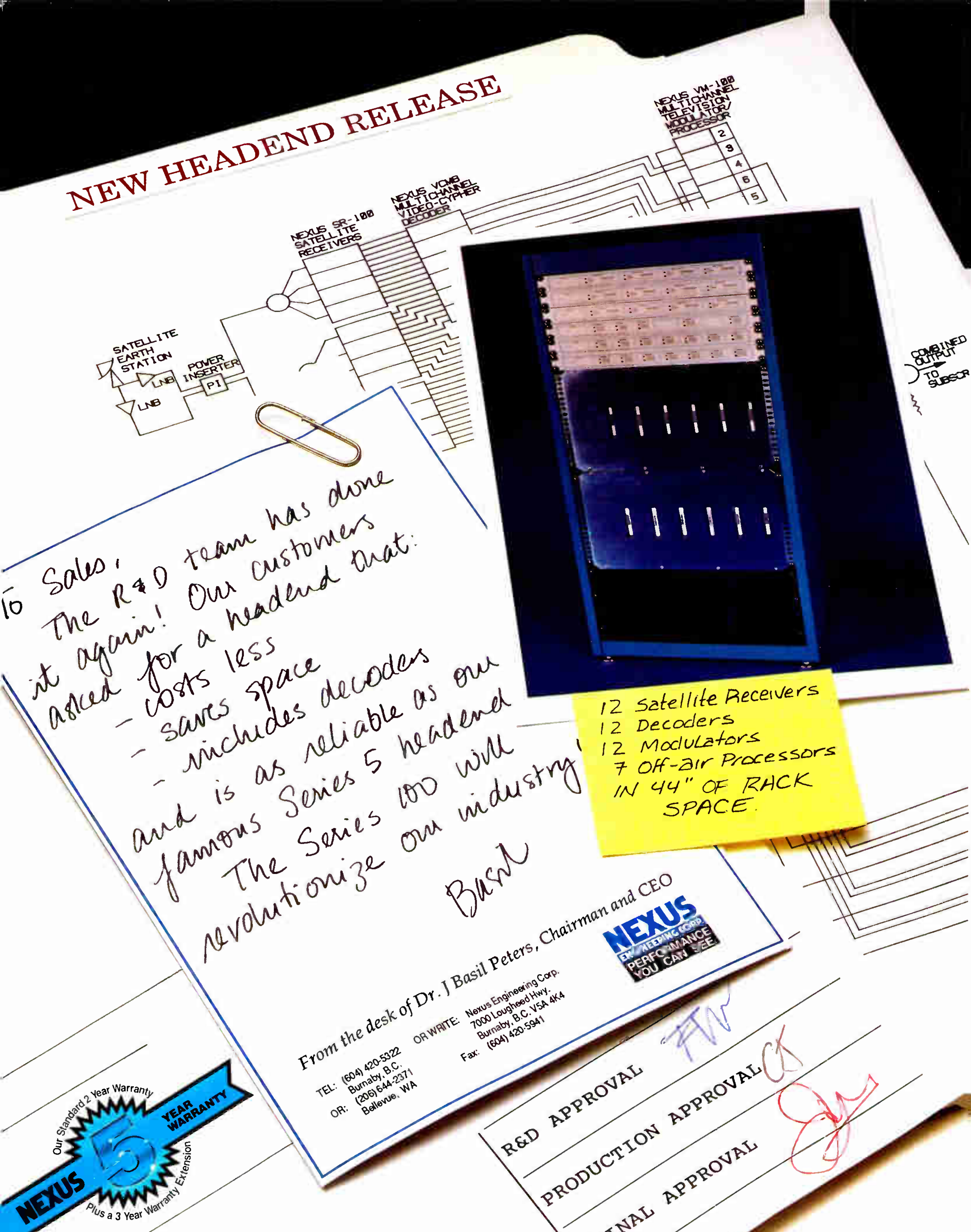

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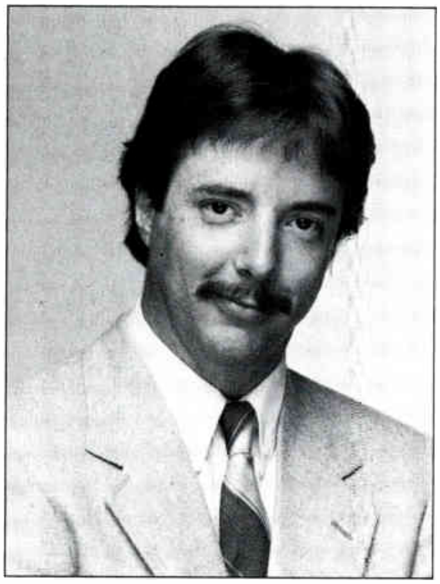
A lesson from rural America

I have to admit, I was impressed.

While winging my way back to Denver after a frenzied trip to Alabama to view the new Matrix off-premise addressable system being installed (see page 52) I started to think about how Lynn Rotton and his colleagues run their systems.

Bear in mind these systems are *small.* They typically have 12 channels (maybe as many as 21) and service hundreds of customers, not thousands.

We've heard often that systems this small tend to do things on a shoe-string budget. We've heard that once a system is built, it's often left alone (neglected) for years until it's sold to a new owner. We've heard that customer service and picture quality take a back seat to other matters.



That's not true in towns like Union Springs and Notasulga, Alabama. Examine some of the comments Rotton makes about the Matrix system. He says the system was installed because he wanted to provide good, quick service to his customers and save some money, too. He wants to better market his pay services to subscribers and potential subscribers. That's encouraging. Maybe some of the larger MSOs can borrow Com-Link's playbook and show up ready to play in the only game that counts: subscriber satisfaction.

But it didn't stop there. While out in the field with Rotton, we stopped at the system's headend (located in a 10-foot by 12-foot portable building under the city's water tower) because Rotton was concerned about some distortions in the system. He couldn't figure out what the problem was, but you can bet he's still thinking about it—and one day he'll fix it.

There is still hope for the CATV industry and it's embodied in people like Rotton and his superiors. For them it's not just profits that matter, but how you go about pleasing the customer. Maybe that's because they're in the hospitable South. Or maybe it's because they know their customers personally. Now, if only that attitude could be a part of every cable system....

Actually, there's an important lesson here. You see, the Com-Link cable systems are owned by the Union Springs Telephone Company. (Don't run to the phone to call the FCC—they have a waiver). Was this dedication to customer service an outgrowth of telephone company training, or is it just a key part of the employees' personalities? The answer to that question isn't important; but the ramifications of Rotton's attitude is. Think about that for a while.

Roger J. Brown

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Dan Pike

CATV must now shun complacency

Usually, when boys grow up on a ranch in West Texas, their lives are filled with chores, horse riding, spending summers at the fishing hole, etc. But when Dan Pike was growing up, he had a few other things to contend with.

Like stringing telephone cable from his family's ranch into the nearest town. And wiring and maintaining their own electrical system because commercial service just wasn't available.

All that experience paid off handsomely for Pike, the 36-year-old vice president of engineering for Prime Cable, the industry's 29th largest MSO, headquartered in Austin, Texas.

In fact, Pike admits he's "compressed a lot of experience" into the relatively short time he's been out of college. "I've been very fortunate," he says.

Not all luck

But clearly it's not just good fortune that has taken him to the top of his profession and garnered the respect of many of his peers. Hard work, motivation and staying abreast of the issues have been integral parts of the puzzle.

While attending Oklahoma State University (he holds BS and MS degrees from that Big Eight school), Pike spent time working in the oil patch as a power lineman and electrician and also worked as a two-way radio technician and towerman. He's even done TV and consumer electronic bench repair.

Upon graduation, Pike explored his opportunities, settling upon CATV because it posed so many challenges that had to be overcome. "I liked the cable industry because it had a wide variety of challenges," said Pike in his trademark slow Texas drawl. "I liked the breadth of all that."

In 1973, Pike joined LVO Cable (which later became United Cable Television) as a corporate project engineer and was based in the company's Tulsa headquarters. Most of his efforts were directed toward proof-of-performance work, support of the major urban construction projects the company was involved in at the time, and equipment evaluation.

Moved back to Texas

When United moved its offices to Denver in 1977, Pike jumped to Communications Properties Inc. and moved to Austin. While at CPI (which later became part of the Times-Mirror group), he held positions as staff and division engineer. He directed the operation of CPI's evaluation lab, lent franchising support and held operating responsibility for as many as 15 plants.

While Pike was busy in the lab, the principle owners of CPI were busy in 1979 forming a new cable company, called Prime Cable. By early 1982, Prime had become large enough it needed an engineering voice on its staff. Pike was chosen for the job.

Pike's main motivation seems to come from a desire for simple, basic quality. He isn't daunted by HDTV or fiber optics and has not jumped on the "cable may be doomed" bandwagon. He's duly impressed by the accomplishments CATV has made in the past and now warns against complacency.

"If you take a slice of the past 10 years, since the time earth stations became ubiquitous in cable systems, there has been a tremendous list of achievements accomplished during that time," says Pike. Satellite-delivered programming has exploded, urban markets have been almost entirely cabled, computer-controlled terminals were introduced and accepted, interactive services became real business ventures and programming has become cable-exclusive in some cases.

The big threat

"We must now guard against complacency," says Pike. "We go to where we are by being quick to recognize opportunity and put the changes in effect to take advantage of that opportunity."

Opportunities for the future, as Pike sees it, include HDTV and fiber. "High definition and other advanced television schemes are simply moves into more and better programming. It should be in our short-term planning horizons now. And fiber is just one more way to improve our plants to bring about more bandwidth and extra channels—and make our service better."

One way to guard against complacency is eduation. Being aware of what competitors are working on, what consumers are willing to pay for and how your system works and what it can offer is very important, says Pike. "We're in better shape now in this area than the industry has ever been in" because of education efforts undertaken by the SCTE and others, Pike says.

Improve service

What are the big barriers to increasing penetration? According to Pike, they include consumer friendliness, upgrading plants cost-effectively to allow for additional programming, minimizing service interruptions and providing better perceived service.

"There's always the barrier of interruption of service or the *perception* of service—whether service calls are done in a timely manner and in a way that solves the problem," says Pike. "Those are goals we can achieve only one step at a time. We can only get close to perfection, never achieve it, in these areas."

Perfection is a challenge, so you can bet Pike will pursue it. The father of two spends his free time with his family, reading or engaging in snow- and water-skiing activities (ask him about the five-man pyramid on water skis). "I just enjoy whatever looks to be challenging or strikes my curiosity." Maybe that sums up who Dan Pike is better than anything else. ■

—Roger Brown

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Zenith's blockbuster

The announcement and description in September of the Zenith "Spectrum Compatible HDTV System" has stood the Advanced TV (ATV) debate on its head.

This is the first time in the 20-year history of HDTV that changes in the characteristics of the transmission system, as well as the video baseband system, have been seriously investigated. Yet, except for a VCR playing to a video monitor, no video signal, however excellent it may be, can be displayed in the home without first being modulated on a radio frequency or optical carrier. The transmission system first adopted for television by the Radio Manufacturer's Association (RMA) Standards Committee in 1938 is still in use today, serving two-thirds of a billion TV sets throughout the world. In 50 years, the only changes in the original transmission system were to add a color subcarrier and tighten the tolerances in the chrominance portion of the channel. Some countries adopted 7 MHz or 8 MHz channel bandwidths instead of the original 6 MHz, and some use the PAL or SECAM variations on NTSC. Nevertheless, all terrestrial television broadcasting in the world today is still based on the vestigial sideband amplitude modulation transmission system first recommended in 1938.

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

Antique technology

Television and radio broadcasting are virtually the only communications services left that have not been required to split channels and adopt more sophisticated modulation schemes for more efficient utilization of the limited electromagnetic spectrum. Nearly half of the most valuable portion of the spectrum below 1 GHz has been allocated for television, most of it exclusively.

Yet, 35 years after the present television allocation plan was reaffirmed by FCC, this enormously valuable spectrum is very inefficiently occupied. Geographically, only about 60 percent of the television allotments are actually occupied, 87 percent VHF and 45 percent UHF. Beyond that, however, the actual information content of the 6 MHz NTSC television channel is far below its theoretical capacity. Spectral efficiency was substantially increased with the addition of color, and would be improved still further with any of the 6 MHz Advanced TV proposals.

However, the ancient 1938 modulation and transmission vehicle now imposes severe and unnecessary limitations on both the quantity and fidelity with which video information can be transmitted to the public. The time has come to stop trying to fit high-performance machinery into a Model T chassis.

Examine compatibility

It is also time to re-examine the compatibility issue. Obviously, the economics of TV broadcasting requires the continued availability for many years to come of NTSC transmission for 162 million TV sets presently in use. It is equally obvious that HDTV sets will not be saleable unless HDTV programming is made available, whether over-the-air, by video tape or by cable TV. It is not as obvious as many have believed that HDTV transmissions must be receivable by existing NTSC television sets. In its Tentative Decision on September 1, 1988, the FCC stated (emphasis added):

"...with 6 MHz of supplemental spectrum, *NTSC service may be maintained by simulcasting an NTSC signal and an incompatible 6 MHz ATV Signal*" (paragraph 124).

"...we believe it desirable to require that ATV signals either be compatible with NTSC receivers, *or that ATV broadcasters simulcast an NTSC signal with their ATV signal, at least for an initial transition period.*" (paragraph 125).

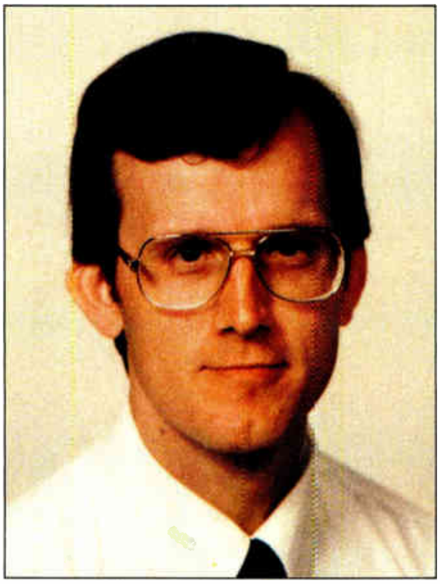
Exploding myths

Until the Zenith proposal, the conventional wisdom, buttressed by the studies of the FCC Office of Engineering and Technology, was that the available spectrum is simply unable to accommodate an extra 6 MHz channel for each TV broadcaster wishing to participate in ATV transmission, assuming the old transmission system. However, Zenith proposes a new transmission system using double sideband, quadrature amplitude modulation (QUAM) with suppressed carrier, operating at 17 dB reduced power (1/50 normal), yet yielding improved signal-to-noise ratios. Partly by substantially reducing power, and partly by directly relating the HDTV and NTSC scanning parameters, Zenith claims: "Nearly 100 percent accommodation (actually 99.7 percent) to provide each VHF and UHF terrestrial broadcaster with a 6 MHz channel for HDTV transmission—in addition to the existing NTSC channel." If Zenith's claims are confirmed in subsequent field tests, with no uncorrectable side effects, direct compatibility need no longer be considered inevitable for terrestrial broadcasting.

Maybe we can now trade in the old Model T chassis for a more suitable vehicle to carry the new, wide screen aspect ratio TV signals that are capable of nearly twice the resolution, with scanning lines obscured even at close viewing range, and without disturbing artifacts.

To expedite the transition from simulcast to exclusively ATV transmission, Zenith notes that its proposed HDTV signal is "easily transcodable to NTSC since the scan rates are deliberately related." Thus, NTSC transmission could be discontinued after a few years of simulcasting, leaving the few remaining NTSC viewers to choose between acquiring an ATV receiver or a transcoder to convert the ATV sig-

Continued on page 86



Companding, deviation and stereo separation

In order to maintain reasonable levels of stereo separation through a CATV modulator carrying BTSC stereo signals, it is critical that the main aural carrier deviation be set precisely. But why? Why is stereo separation affected by the modulator's deviation adjustment?

When the BTSC stereo system was first proposed and tested, audio signal-to-noise ratio was recognized to be a major problem. This was recognized very early in the program, and the committee set out to find a method of improving the situation. Ultimately, a *companding* scheme proposed by dbx was chosen as the system standard for noise reduction.

What is companding?

Companding (an acronym formed from the words compress and expand), is a method of noise reduction in which the audio is compressed prior to transmission such that quiet audio passages are boosted in level and loud audio passages are left unchanged. The result is a compression in the dynamic range of the audio prior to transmission.

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

Through the transmission path, if low-level noise contaminates the signal, it will be substantially reduced in the receiver through the inverse process to compression, called expansion. In the expander, those low-level audio signals that were originally boosted by the compressor are reduced in amplitude back to their original levels while simultaneously reducing any noise that was added to the signal in the transmission path.

Maintaining compatibility

In order to maintain backward compatibility with existing monaural TV sets, however, the monaural (L+R) portion of the transmitted audio could not be companded; only the difference, or L-R information could have such a noise reduction technique applied. This was of course a system compromise, and the full noise reduction capabilities of the dbx system were therefore never realized; but it did provide a workable solution. The fact that the stereo difference component (L-R) is companded while the sum or monaural channel (L+R) is not, is the reason why stereo separation suffers when the modulator's audio deviation is set incorrectly. Note that FM radio doesn't suffer from the same malady with separation vs. deviation, even though its frequency multiplexing scheme is almost identical to that of BTSC stereo, because FM radio's L-R channel is not companded!

A little help

Figure 1 will help in understanding the phenomenon[1]. As shown in the diagram, our hypothetical system starts out (a) with an input signal level of 50 "units of amplitude" in the left channel and nothing in the right channel—perfect stereo separation. The signal is then matrixed (b) into L+R and L-R information. Simple math reveals that this process creates 50 units in the L+R channel and 50 units in the L-R channel. The L-R signal is then compressed using the simple companding rule shown in the diagram (Note that this is *not* the companding rule used in the dbx algorithm, but is a simplified scheme for instructional purposes).

Since the L-R signal is 50 units in amplitude, it is boosted (c) to 75 units in the compressor. If we simply connected a matching expander at this point, these 75 units would be reduced back to 50, then we could simply de-matrix to get our original signal back as it was originally provided, with perfect stereo separation. Let's suppose that instead we inject an imperfect modulator in the path such that its deviation is set 20 percent below nominal. In effect, this reduces the transmitted signal amplitudes (d) to 40 units in the L+R channel and 60 units in the L-R channel. Unless the sensitivity of the FM demodulator in the television is set 20 percent too high, to make up for the modulator's deficiency, these are the signal levels that will arrive at the input to the expander.

L-R signal reduced

According to our simple companding rule, the 60 unit L-R signal will be reduced in amplitude (expanded) to 20 units (e), while the L+R signal, since it does not pass through the expander, remains at 40 units of amplitude. In the dematrix circuitry (f), the L+R and L-R signals are first added (40+20) to produce the 2L signal and then subtracted (40-20) to produce the 2R signal. Each of these is then simply divided by 2 to produce the output signal (g).

No longer perfect

But look at what has happened. The output signal is no longer a perfect replica of the input signal! Not only is the left channel output amplitude lower than it should be (30 units vs. 50), there are 10 units of left channel information coming out of our right speaker when there shouldn't be anything there at all! Stereo separation has suffered tremendously! Therefore, in order for the companding scheme to work, there must be *unity gain* in the transmission path between the compressor and the expander, otherwise, separation will suffer. Unity gain will not occur unless the modulator's deviation pot is set correctly. ■

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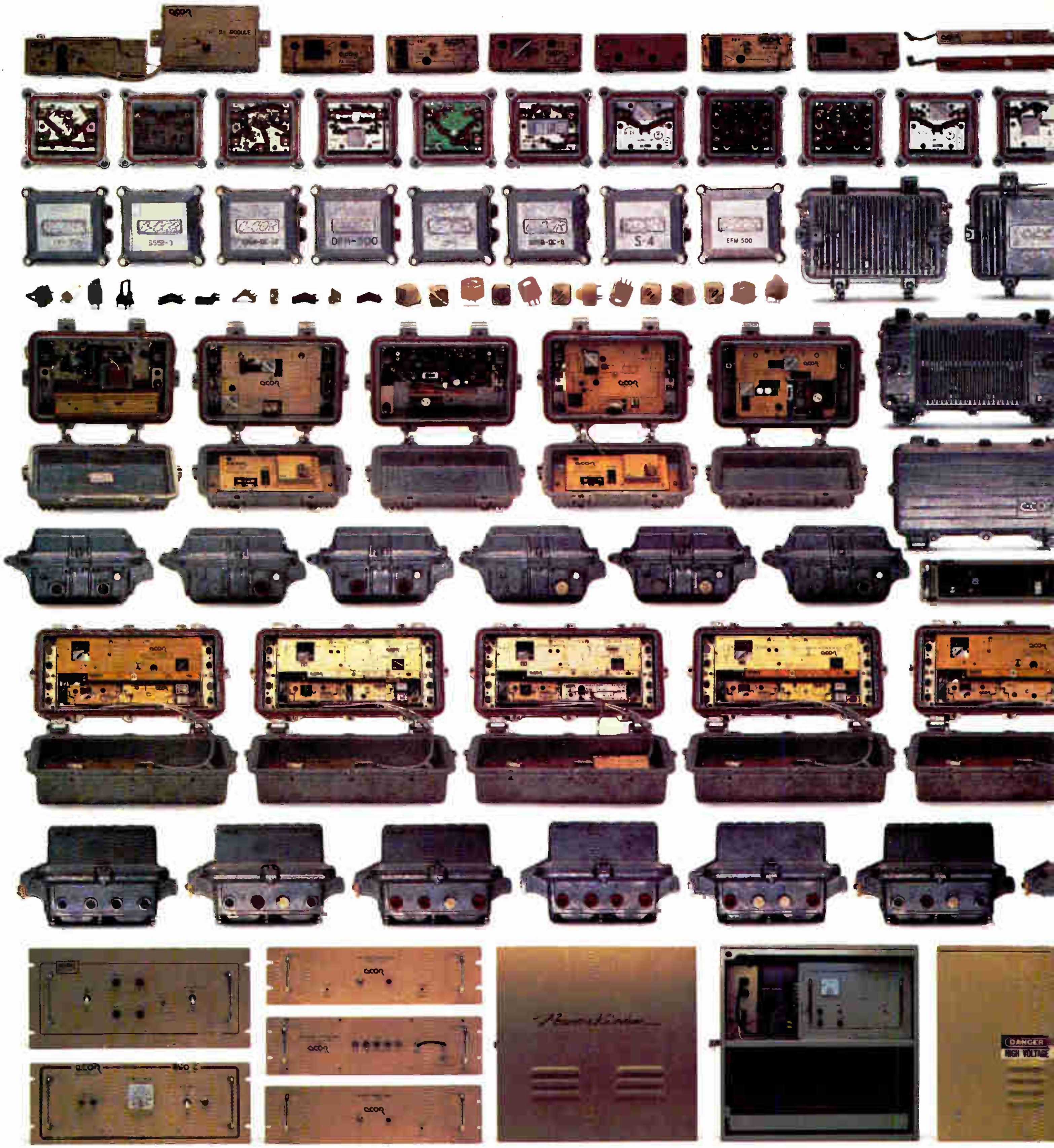

Articles turn fiber into science fiction

Fiber optics is breaking out all over. It's almost impossible to read a trade magazine (such as this one), a newspaper, a research report, private communication or popular press article that doesn't at some point wax poetic about the possibilities of the great revolution in information services to be provided by fiber optic transmission, and the cable industry is no different.

We began using fiber for trunking applications several years ago and it's safe to say that now fiber optics is merely one of several possible tools to be applied as the circumstances and economics of a particular situation dictate. It is in competition with coaxial supertrunks, FM transmission and/or AML transmission. Each has its place and each has the circumstances in which it works best, but nobody lately has debated the issue of fiber optics in the trunking environment.

What about the last mile?

What everyone seems to be interested in is fiber optics to the home, specifically, delivery of broadband services into the home. Recently, a major New York magazine, which shall remain nameless, had an article about telephone companies and cable TV companies. The tone of the article was given by its title, which suggested that cable television was about to be completely replaced by telephone companies because telephone companies were going to put in fiber. It's clear that the authors of those articles have not paid careful attention to the real world, preferring instead to listen the fantasy and science fiction that occasionally escapes when non-technical people latch on to the idea of a new technology.

Fiber isn't 'magic'

To quote from James Chiddix of ATC, fiber optics is not "magical stuff, (this is what the author of the aforementioned article called it) but it is real useful stuff." The key issue in this entire debate is pretty much the one that I started with—the delivery of broadband services to the home. Look around your neighborhood and ask yourselves who's delivering broadband services to the home. Surprise! It's us! We've been doing it for many years.

If I look at the different people who wish to use fiber optics I like to assess their relative capabilities of getting fiber to the point where they can use it. If we look at the telephone companies, who have thought long and hard about ways to use fiber, we see they're not quite sure what services they can do on fiber (except for video transmission, of course), they're unsure what people will pay for those services (although I've seen forecasts) and they're not clear on how much it will cost because all of the technology pieces have not been invented.

If we look at the cable industry's use of fiber optics we'll see that they know exactly what we want to do (deliver video to the home), they know almost precisely how much people will pay for these services (they've been selling television services to customers for 35 or more years) and we only use the products in the fiber optic realm after they've been invented. This way we can look at the price and say, "Ah, yes, for that price I can make a better system."

This leads to a problem

The problem occurs, of course, when we see the way to use a technology like fiber but the pieces aren't all invented. The other guys have large research laboratories to work on issues such as this, but remember, they're not quite sure what services they want to put on this media. All they seem to be able to come up with is vague broadband services type answers and such wildly improbable things as "video on demand," which no one is quite sure makes real-world sense. When we see the need and nothing has been invented we set about inventing it.

Look at the work of the people at ATC, the involvement of a company like Anixter with AT&T to bring about new products in this area, the work that's going on in Raychem in fiber optics. I should also mention activities at both Jerrold and Scientific-Atlanta, two premier suppliers of products to our industry, and no doubt other CATV suppliers.

All of these companies and individuals have begun work on very specific pieces of fiber technology. They have begun that work because cable engineers have seen a place and an instance in which they can use fiber optics and can describe to our vendors what we need to have developed.

A clear road

I think it's obvious that it's always easier to make progress when you know what you want to do with the tool that you're trying to invent. It's a lot harder to make progress when you want to invent a tool but you're not exactly sure what you can do with it. The progress which we can now make does not specifically call for fiber optics in every nook and cranny of our business. What it does call for is using fiber, and indeed, using any technology in those pieces of our plant where they make operational and economical sense.

So, we're at a time when our traditional technology, coaxial cable, and a new tool, fiber optics, will evolve and develop along parallel lines, with each providing improvements in operating efficiencies and economies for doing the job that we get paid to do, which is deliver broadband services into our customers' homes. At some point, these technologies will either merge or veer apart, but I believe they'll both have their place for a long time to come. In the foreseeable future I believe that the best use for fiber optics is to enhance and improve our ability to operate our coaxial cable system and that the articles and essays written by people who believe science fiction and fantasy will make amusing reading in the years to come. ■

By Wendell Bailey, Vice President Science and Technology, NCTA

Let the games begin...

ANIXTER FIBER OPTIC

LASER LINK T.M.

AM CABLE TV SYSTEM

Laser Link AM CATV System

The Anixter Fiber Optic Laser Link AM CATV System creates a fiber network architecture which meets the system needs of today while preparing the network for tomorrow. The system can transport AM-VSB (Vestigial Side Band) channels over one single mode optical fiber. This architecture, while providing improved performance, also allows for easy network upgrades to provide alternative and enhanced services such as PPV, IPPV, digital access, and HDTV.

Features/Benefits

- Accommodates up to 60 channels per fiber
- Fully compatible with existing CATV technology
- Provides improvement in signal quality, reliability, and performance
- Reduces amplifier cascades and hubsite locations
- Utilizes AM baseband modulation
- Accommodates all available scrambling techniques
- Cost effective compared to AML or other fiber optic systems
- Allows extension of existing CATV system
- Easy to install and maintain
- Allows for easy network upgrade to provide alternative and enhanced services

The system has been designed for various trunking applications. It provides point-to-point transmission of an AM-VSB spectrum from a headend location to outside plant locations. The entire spectrum is transmitted over one single mode optical fiber.

Transmission distance will vary depending on individual applications. System performance for 42 channels and a 5dB loss budget and performance curves which can be used as guidelines for network planning are shown in figures 1 and 2.

C/N	51	dB
PSO	60	dBc
CTB	65	dBc
XMOD	60	dBc
LOSS	5	dB

FIGURE 1

The system is comprised of two major elements: the Laser Link Transmitter, which is installed at the headend, and the Laser Link Receiver, which is available in either a headend or outside plant version.

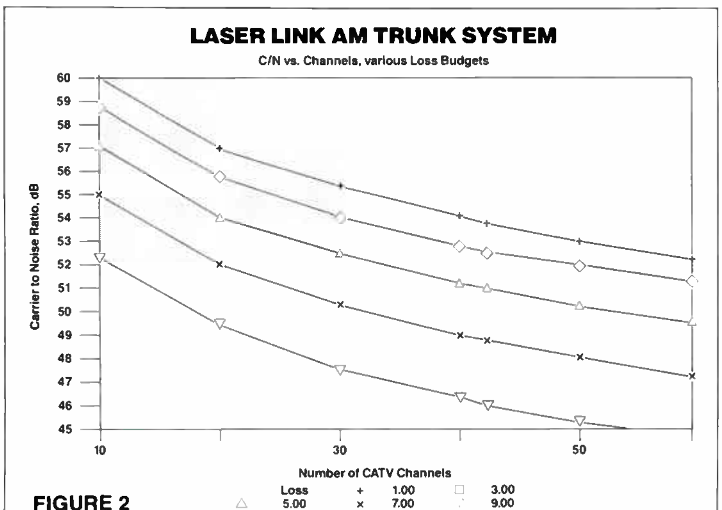

FIGURE 2

Laser Link Transmitter LLT-1300A (Headend)

The Laser Link Transmitter (LLT) incorporates a laser diode light source which has been specially developed to have high optical power output at 1310 nm wavelength in the infrared spectrum and to be highly linear so that second and third order harmonics and intermodulation products are very low.

Optical isolation techniques are used in the system to ensure quiet laser operation and high carrier to noise ratio.

Features/Benefits

- Adjustable modulation level
- Remote status monitoring
- Automatic Gain Control (AGC)
- AGC and laser status indicator lights

The LLT faceplate is conveniently equipped with the necessary adjustments and indicators to ensure proper operating status of the unit. An access protected ON/OFF power switch and an "F" connector test point are standard. Modulation level, which is preset at the factory at 5dB, can be manually adjusted from 0 to 10dB in 1dB increments.

A dual color indicator which monitors the status of the AGC is provided so the system can accept a wide range of input signal (10 dBmV ± 5dB) level and still maintain a standard operating output. The indicator will be red when the AGC is out of range (i.e., input signal is too strong or too weak) and green when the input levels are within the proper range. When the temperature is too high or when the laser bias current is out of range, the laser status indicator will turn red. When the indicator is green, the laser unit is running properly.

A 15-foot single mode pigtail is provided to terminate the laser output. The pigtail is terminated with an AT&T ST connector. The user has the option of terminating this ST connector in an ST bulkhead provided on the back of the unit, or running the fiber out a port provided in the back of the unit and then terminating the connection on a lightguide cross-connect shelf (LGX or equivalent interface to outside plant fiber).

Unit status can be continuously monitored at remote locations. A terminal strip is provided on the back of the unit for connection to the user alarm equipment. A relay closure indicates laser operation.

Specifications

Input Signal Level	10 ± 5 dBmV
Input Impedance	75 ohms unbalanced
Return Loss	16 dB
Modulation Bandwidth	30-550 MHz
Wavelength	1310 nm
Power Requirements	110 VAC, 60 Hz
Power Consumption	50 watts
Physical	19″ rack mounted
Dimensions	19″ x 3″ x 14″
Operating Temperature	+40° to 120°F
Relative Humidity	20 to 55% (non-condensing)

Laser Link Receiver LLR-1000R (Headend)

The Laser Link Receiver (LLR) is available in two versions: headend and outside plant.

The headend version (LLR-1000R) is 19″ rack mountable and comes completely equipped with the necessary electronics to terminate the fiber optic trunk in the headend environment. This unit cannot be used for distribution applications.

Features/Benefits

- Compatible with existing headend equipment
- Provides typical trunk AMP output level
- Optical power test point provided
- "F" connector test point provided for monitoring received signal power
- Equipped with AGC
- 15-foot single mode pigtail provided for option termination of fiber optical cable

Powering and cable termination arrangements for this unit are the same as for the LLT. A terminal strip is provided on the back of each unit. This should be connected to the user alarm equipment. A relay closure indicates if optic received power is below or above acceptable limits.

Specifications

Output Signal Level	30 ± 1 dBmV
Output Impedance	75 ohms unbalanced
Power Requirements	110 VAC, 60 Hz
Power Consumption	20 watts
Physical	19″ rack mounted
Dimensions	19″ x 3″ x 14″
Operating Temperature	+40° to 120°F
Relative Humidity	20 to 55% (non condensing)

Laser Link Receiver LLR-1000S (Outside Plant)

The outside plant LLR is housed in a standard CATV trunk amplifier housing and comes completely equipped with the necessary electronics. Distribution electronics can be ordered separately.

Features/Benefits

- Compatible with existing CATV technology
- Provides typical trunk AMP output level
- Provides received optical power test point
- Single mode jumper cable provided for pre-field testing of the unit
- Equipped with AGC
- Adjustable output level

A fiber input port allows the user to terminate fiber optic cable inside the housing. A Rotary Mechanical Splice (RMS), which terminates a PIN diode, is provided inside the case. It is suggested that the customer terminate his fiber here with a tuned RMS.

Specifications

RF Output Level	30 dBmV ± 1
Output Impedance	75 ohms unbalanced
Power Requirements	60 VAC, 60 Hz
Power Consumption	20 watts
Physical	Strand mount
Dimensions	18¾″ x 5¼″ x 8⅞″
Operating Temperature	−40° to 140°F
Relative Humidity	5 to 100% (non condensing)
RFI Isolation	130 dB (5 MHz – 1 GHz)
Air Tight	15 psi

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What do cities want?

The history of cable legislation in recent years has been one of agreements and accommodations between cable and competing interests. The Copyright Act of 1976, for example, reflects a compromise between Hollywood and the cable industry that resulted in a compulsory license for the retransmission of broadcast signals.

The equilibria established by such compromises are never permanent, however, and tomorrow's legislative agenda often consists of efforts to revise yesterday's resolutions. Thus, Hollywood and the cable industry are back at the negotiating table looking for a legislative balance for the marketplace of the 1990s.

The 1984 Cable Act was, however, much more comprehensive in scope than either the compulsory license agreement or the must-carry compromise, and can provide the basis for a stable relationship between cable and the cities for years to come. Still, city regulators who gathered at the recent annual conference of the National Association of Telecommunications Officers and Advisors (NATOA) made clear that they were not wholly satisfied with the world according to the Cable Act.

By Michael Schooler, Deputy General Counsel, NCTA

Complaints over implementation

Two of their complaints are directed at the manner in which the FCC has implemented the Cable Act. Under the Act, cities are prohibited from regulating cable rates, except that basic rates may be regulated where the cable system is not subject to "effective competition." In 1985, the FCC ruled that effective competition existed if the Grade B contours of three broadast signals touched *any portion* of the cable community.

The cities viewed this as going beyond what Congress intended and appealed the decision. The court of appeals upheld the three-signal standard, but questioned the FCC's conclusion that a signal should be counted if its Grade B contour merely touched the community. As a result, the FCC has modified its rule to allow regulation unless the *entire* cable community can receive three Grade B (or significantly viewed) signals.

In another key decision, the FCC established limits on the technical requirements that franchising authorities could impose on cable operators. That decision was also appealed by the cities, but the Supreme Court this year held that the Cable Act authorized the FCC to preempt state and local requirements that are more stringent than the FCC's standards.

Having lost the battle over federal preemption, the cities remain free to attempt to persuade the FCC that its maximum standards are inadequate. The existing standards apply only to Class I signals (retransmission of broadcast stations), and the FCC has recently initiated a rulemaking proceeding to adopt standards for Class II (satellite services), Class III (local origination) and Class IV (two-way) signals.

First Amendment concerns

Another cause for concern among cities is that while the Cable Act gives cities the right to limit the number of cable franchisees, some courts have held that the First Amendment does not permit such restrictions. Most cities would prefer to grant a single franchise and to require, for example, that their franchisees serve the entire franchise area, provide access channels and pay franchise fees.

But many cities feel that the threat of First Amendment liability—and, especially the prospect of substantial monetary damages to a denied franchise applicant—could give them no choice but to grant unrestricted franchises to cream-skimming overbuilders. To alleviate this situation and maintain this framework mandated by the Cable Act, NCTA and the National League of Cities are discussing the possibility of legislation that would immunize cities from damages for certain First Amendment violations.

While the city regulators tend to blame the courts and the FCC for taking away some of what they thought they'd hoped for in the Cable Act, many are also upset at cable operators over poor customer service. And they are concerned over acquisitions of cable systems at prices that, they believe, can only lead to higher rates for subscribers. For these reasons, we may see more enforcement of customer service requirements.

Telcos to the rescue

The telephone industry portrays itself as the answer to the cities' problems. The telcos are telling the cities that they could provide coaxial competition in the short term and integrated voice-data-video systems in the future, if only the cities would grant them franchises and/or support their efforts to get rid of existing cross-ownership restrictions.

City regulators are not leaping at the bait. Many understand that telcos have the means and incentive to enter the television business in a way that thwarts, rather than promotes, competition. They also understand that telephone company providers of video programming would likely be regulated, if at all, at the state and federal levels, and that the cities' regulatory role under the Cable Act would probably disappear.

Nevertheless, to the extent that the city regulators view FCC and court decisions as undermining the legislative compromise embodied by the Cable Act and are frustrated by what they perceive as unacceptably poor customer service, they are willing at least to explore alternatives. They would clearly prefer, however, to maintain a stable regulatory relationship with the cable industry, which is why they are pursuing immunity legislation and FCC relief on technical deregulation, and why they are paying more attention to the customer service and transfer-of-control provision in their franchises. ■

Personnel shortage hitting contractors hard

In the early 1980s, when CATV construction was booming, operators had it made. There were so many contractors out there that MSOs could dictate price, speed, incentives and other clauses to contracts in order to get systems up and running as fast as possible.

Now, it's the late '80s and constuction is booming again. Though this round of construction (fueled mainly by rebuilds or upgrades of existing plant or extensions into newly developed areas) will never rival the halcyon days of yesteryear in terms of miles built, constructors, equipment suppliers, manufacturers and distributors are all reporting long backlogs of equipment, record revenues and brisk business.

Not the same

But this time, something's different. MSOs often cannot meet construction schedules because of a shortage of manpower. Finding qualified personnel is more difficult than finding systems to rebuild, according to every contractor interviewed for this story. What's happened? Where did all the labor go? And, perhaps more importantly, where will the qualified labor pool come from when fiber optic cable begins to be implemented in a big way?

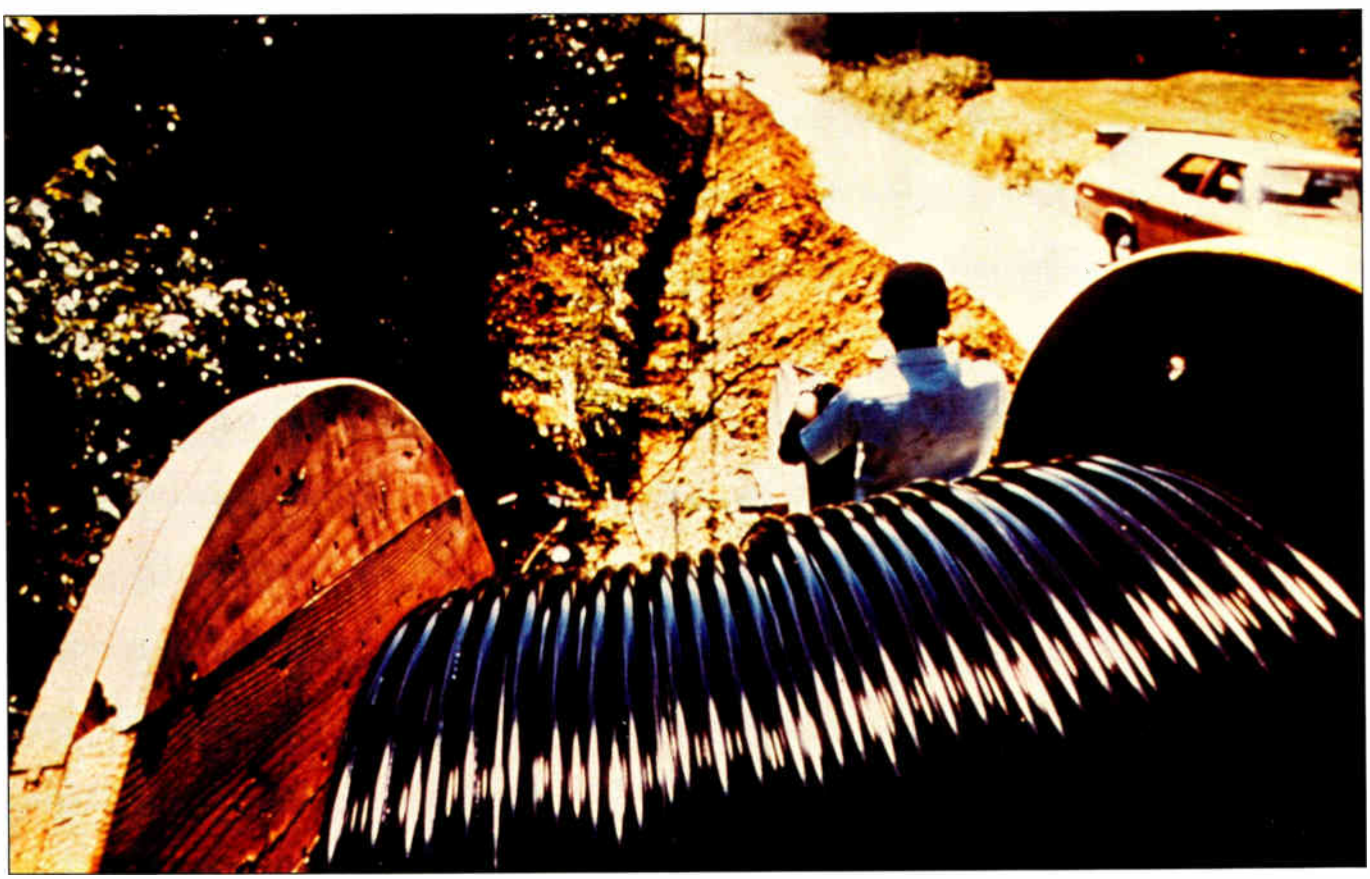
Concern over quality

With the industry maturing, many contractors have noticed that MSOs are more concerned with the quality of the job over anything else, including price. Gone are the days when any fly-by-night company could waltz in, promise to build a system for little more than a song and assemble it in no time, says Harry Wahl, vice president of turnkey sales at Cable Services Co.

"People don't want it slapped together," he says. "In a short time frame, the industry has gone from 220 MHz to 550 MHz, so now there's a quality concern. People want it done right. Speed isn't as important as it was five or 10 years ago."

Mike Refalo, president of Elan Engineering, has also noticed the importance of quality to MSOs. "People are more aware that quality is worth paying for because it reduces long-term maintenance costs," he says. "There's more thought going into plant builds—people used to just put up the plant anywhere, now there's more cost analysis and modeling going on. It's not like the old days where it was fight for the franchise and build everything."

That's also true to some extent in the installation world, says Jamie MacGeorge, vice president of the installation services divison of RTK Corp. "Quality seems to be more of a priority



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

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

Plymouth, MA................25 Miles
Knoxville, PA ....5 Miles
Nanticoke, PA ....15 Miles
Onancock, VA ....15 Miles
Mays Landing, NJ ....50 Miles
Keene Valley, NY ....20 Miles
White Marsh, PA ....20 Miles
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Eastown, PA ....50 Miles
New Britain Twp., PA....30 Miles
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Tredyffrin, Twp., PA....150 Miles
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Northampton Twp., PA
....150 Miles
Whitpain Twp., PA ....50 Miles
Springfield, PA................30 Miles
Skippack Twp., PA ....45 Miles
New Baltimore, MI.........25 Miles
East China Twp., MI.......25 Miles
Newtown Sq., PA ....50 Miles
Harrison Twp., MI ....100 Miles
Ira Twp., MI ....20 Miles
Worchester, Twp., PA ....50 Miles
Marine City, MI ....30 Miles
New Haven, MI ....10 Miles
Sharon, PA ....12 Miles
E. Whiteland, PA ....25 Miles
Romeo, Washington,
Bruce, MI......................100 Miles
Poland, NY ....25 Miles
Selfridge A.F.B., MI ....10 Miles
Trenton, Remson, NY ....25 Miles
Henderson, NC.............100 Miles

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Reader Service Number 9

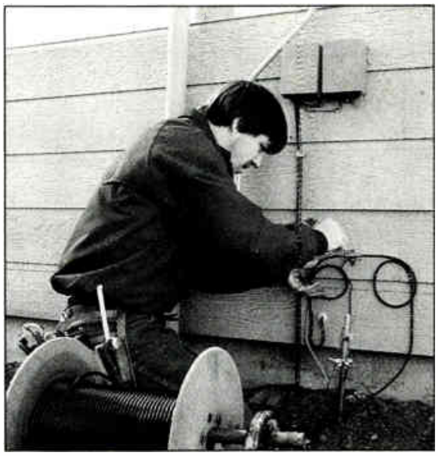
with some companies, but not all of them," he says.

For example, while Bob Luff was at United Artists Cablesystems, the company realized it was worth paying the additional costs of a good install because the job was done so much better and the materials used were also better. And now that Luff is at Jones, MacGeorge says Jones has taken that attitude, too.

MacGeorge says other developments—such as TCI's acceptance of the relatively expensive Raychem connector and Sammon's almost-universal use of quad-shielded coax—are direct evidence that quality has become much more important than in years past.

Practices have changed

"Practices have changed 120 percent," agrees Harold Bigham, a 22-year cable industry veteran and president of Bigham Cable Construction. "We used to just put it up, no one cared how it looked as long as it worked," he says. Sue Taylor, president of Taylor Telecommunications, also agrees that things have changed. "Practices are much more efficient now, there's so much more high technology. The old school is out and the new school is in."



Quality installs are important.

Over his 22 years of experience, contractors have perfected their methods and tools have been devised for every conceivable need, says Bigham. In the late '60s, certain tools taken for granted today—like bending boards—weren't universally available, he says. "We were just starting to perfect some tools back then."

Ed Schenck, president of Schenck Construction and a veteran of 24 years, feels that price still is still the paramount issue with many operators. "I think the quality required by operators may be less than in the past," he says. "I find more emphasis on price than quality. Maybe I'm in a different world than some other contractors but we're constantly having to compete with 'overnight contractors.' "

The big change Roger Kennedy has seen since 1972, when he first entered the industry is in the tool area. "We didn't have the necessary tools to do a good job by today's standards," says Kennedy, president of Kennedy Cable Construction. "Now we have better tools and procedures." That's important these days because so much new construction is underground. In fact, underground work is becoming so prevalent that it's fully one-half of Kennedy's work load, he says.

Personnel shortage

With the need for a quality job comes a demand for qualified personnel to do the job right the first time. And that's where a lot of contractors are being hung up, because there just isn't the number of laborers available as before.

This is due to several reasons, according to contractors. Experienced CATV construction crews have grown

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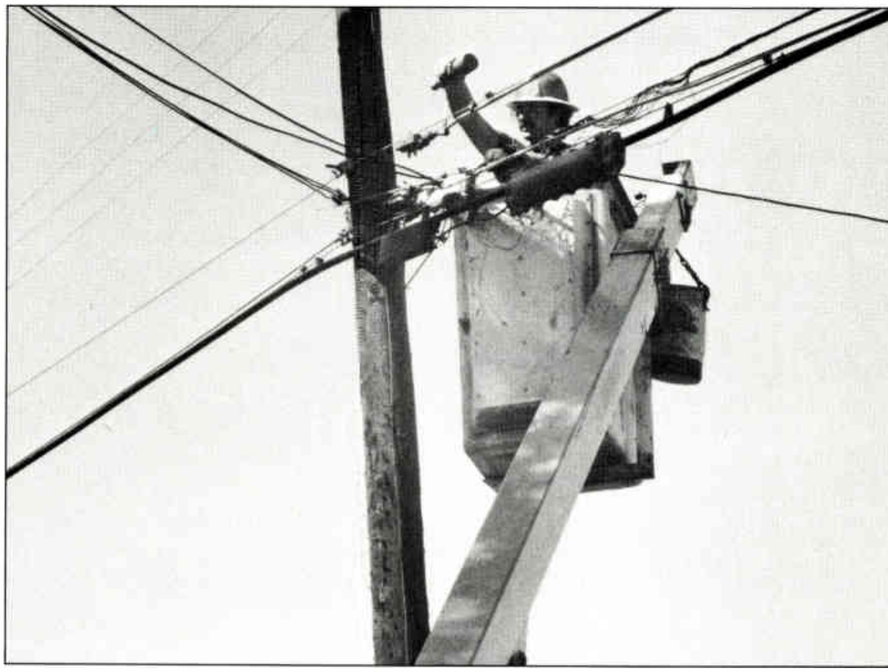
older, settled down and found jobs in different industries that don't require so much travel. Wage increases have not kept up with other industries. Benefit packages are not universally offered. The type of skills in demand today are more technically oriented and demanding. All that has left contractors suffering from labor shortages.

"We're having an awful time keeping linemen," says Taylor. In one Ohio job Taylor had, she kept losing personnel to the big Cleveland build, where better wages and longer contracts were offered. Bigham says he often has to go through five or six candidates to find one qualified person for the job. And Refalo's company now offers holidays, vacations, medical and disability insurance whereas five years ago he didn't have it. "We want to hire more long-term employees," Refalo says. "We want to keep our trained personnel."

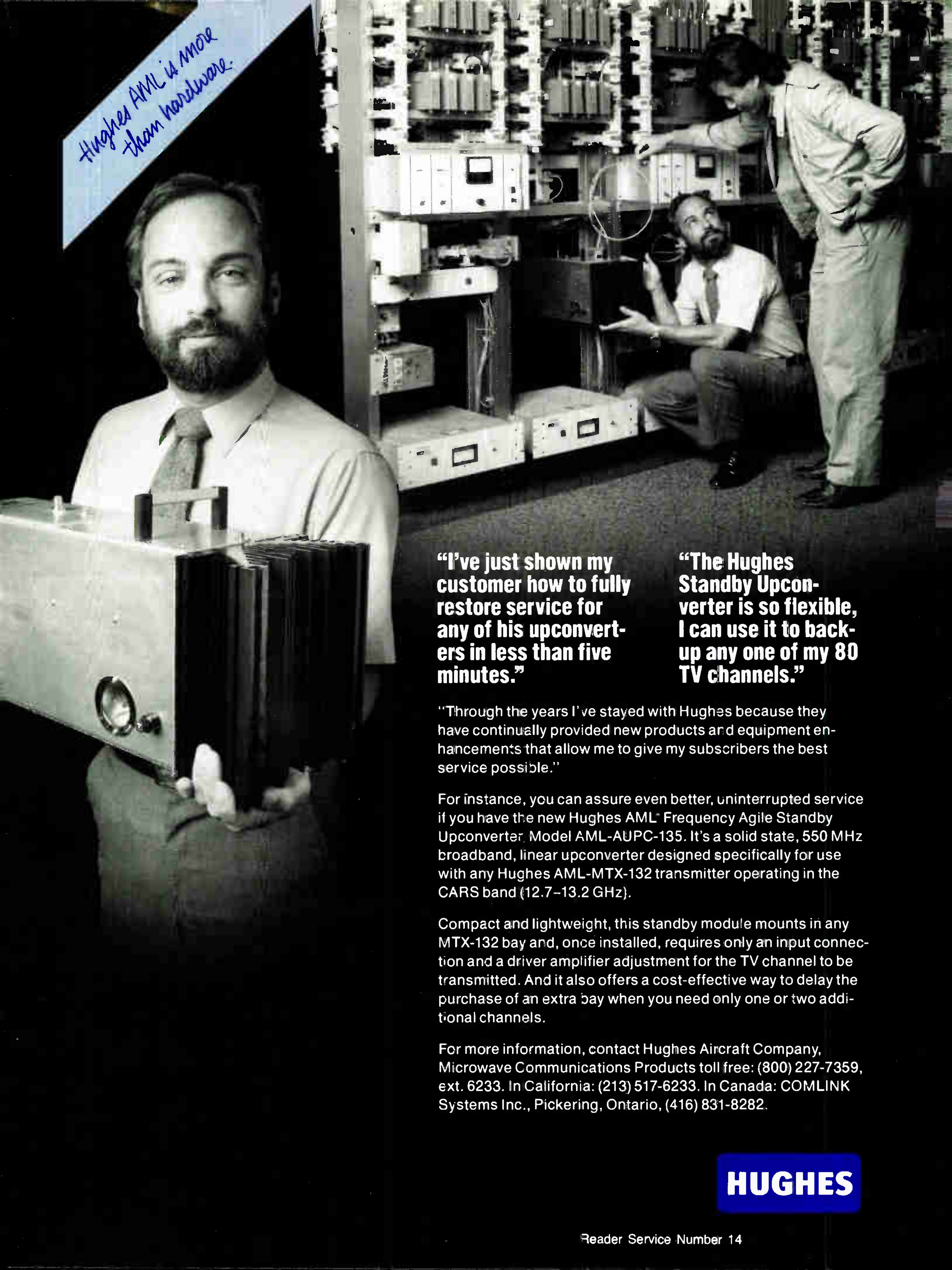
Treating people as long-term employees pays off in the long run, says Wahl, who says he isn't as troubled by the shortage as many others are. "We try to treat our people well," he says. "That way they stick with us." Chris Murray, vice president of Murray International, says it's difficult to find traditional linemen, "but I think they're out there," he says.



With proper tools, construction is easier than before.

Some solutions

Robert Long, president of Burnup and Sims Cablecom said the job requirements have changed, so there are fewer people with the skills necessary for today's construction activity. Consequently, Burnup and Sims, his parent company, operates a mobile school that trains people for the work that's in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demand. Right now that school is in the Atlanta area, training a number of people who were recently laid off by a large aerospace firm to install CATV, telephone and fiber optic cables and electronics.

"It's about as tough (to find and keep employees) as I've ever seen it," says Schenck. There's more turnover because wages haven't kept up with the cost of living, some of his long-term employees are starting to settle down, and the travel is wearing on others. "I see almost a backward curve on benefits—some contractors don't even offer benefits," he says.

What can be done to keep employees? In addition to treating them well, MSOs could do more long-term planning for system rebuilds, says Long. "That would help keep people at the rebuild site if they know they're there to build and maintain it. They know they'd be there for a certain length of time and would give them more security. We've moved people around a lot. Usually, if those guys can find another comparable job, they'll take it."

Keys to success

Along with quality work, operators often rely on a contractor's track record and the services he offers when selecting a company to build a project, says Wahl. "Price is still an issue, but service is the biggest issue," he says. And because Cable Services offers turnkey service, operators know the company won't pack up and leave until the system works properly and won't be saddled with left over coax, electronics or other "spare parts."

Refalo's Elan Engineering also offers turnkey service. "One-stop shops tend to disrupt things less, especially if they're brought in to extend an existing system," he says. He also agrees that price is important, but being the low bidder can work against you too. "If you're the lowest bidder, maybe you're not giving them the service they want," he says.

No longer vogue

Even though he's done turnkey work in the past and still does some now, turnkey is not always what operators want, says Schenck. "Turnkey isn't as much in vogue now because many of the projects are smaller now and they (MSOs) can control them better than before," he says.

Reputation and personal knowledge of the MSOs can also open doors for

you, says Bigham. "It's hard to get into the MSOs who don't know you because they often work with specific contractors" who they know and trust. Bigham adds that a good reputation for getting the job done correctly can often make up for a higher cost.

What about fiber optics?

When fiber optic technology begins to be deployed in a big way starting next year, these same contractors will experience even more changes over a short period of time. Although many say that actual installation of the cable itself is similar (or even simpler) than the traditional coaxial type, some of the rules will change and splicers will be very important to the overall success of the job.

Every contractor questioned for this article acknowledges that fiber is the wave of the future; some even have extensive fiber installation experience under their belts. Those who don't are doing everything they can to learn about the medium.

"We'll have to get into fiber to survive," says Taylor. In fact, the company is expecting to install fiber in a Mississippi system in the near future. To handle the work, Taylor will be hiring experienced fiber installation people and are eduating themselves daily. "Everything's changing," Taylor says.

Fact-finding mission

Cable Services' Wahl is in a similar situation. "We're on a fact-finding mission," he says. Key company personnel are attending seminars, reading tutorial material and taking trips to various equipment and cable manufacturers. "We anticipate no problems" with the advent of fiber, says Wahl. "Right now it (fiber) is practical and doable for supertrunking" but the big issue is how quickly it will be used for subtrunks and feeders. "Just about every customer we talk to is asking about fiber...it's a very hot topic," Wahl adds.

But keeping up with product announcements and making sense of who offers the best system isn't easy, either. "We're waiting for the dust to settle" in the AM race, Wahl says. "We're doing it slowly."

Saw changes long ago

Kennedy's construction company has been doing some fiber for about three years now, he says. "We saw the industry changing. We feel we have good, broad experience in fiber." Kennedy has installed fiber for Southern Bell, Microtel and a fiber LAN project for Martin Marietta.

Although LAN projects and telephone companies have used fiber extensively, many CATV companies still harbor a "wait-and-see" attitude, according to Refalo. "They see fiber as new and expensive. Most see it as a good technology but they're hesitant" because they know they need to train their personnel.

Training personnel for fiber installation and maintenance will be a big issue that may pose additional personnel problems for construction companies. They'll have to recruit experienced technicians from companies experienced in fiber installation or they'll have to rely on in-house training seminars to bring their existing people

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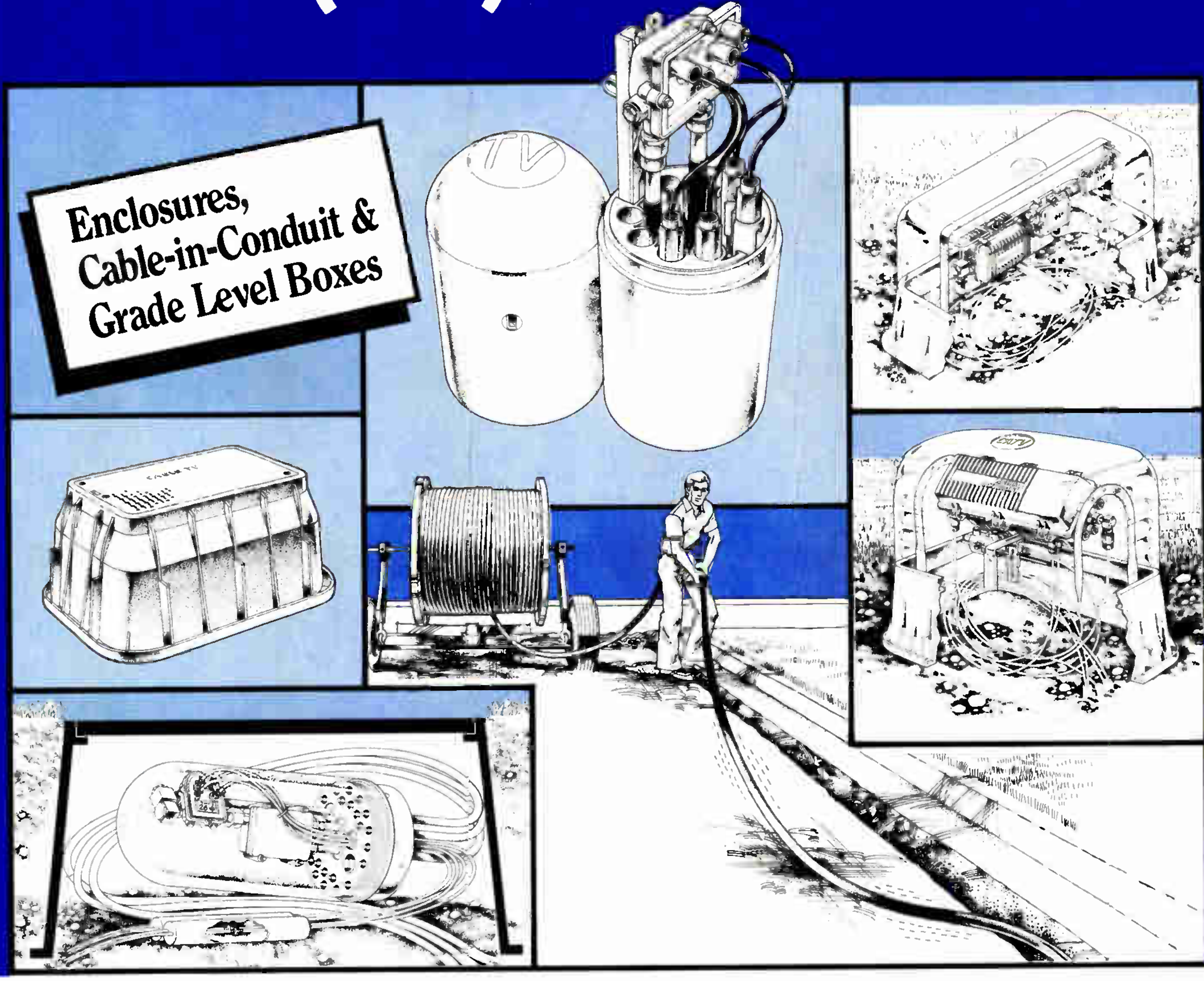

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up to date. Either scenario is likely to cost them—and also their customers—more money.

"The supply of qualified personnel may have to be cultivated," admits Long. "We hope to be able to do that with our mobile school."

"There's going to be a big shortage" of installers, predicts Refalo. In anticipation of that situation, Elan has been training its people and also has hired some splicers from various telco projects they've done.

Unlike some others, Murray isn't pressing the personnel panic button yet. His firm has extensive fiber experience with the Dublin, Ireland cable system and several telco projects in the U.K. Murray trains its people and recruits from other companies to make sure he has a large enough pool to draw from.

Can the industry survive a shortage of splicers?

Future looks bright

Despite the shortage of personnel that seemingly will carry into the next few years, the immediate future for CATV construction companies looks bright. With some contracts now being let for the next three to four years, some are saying this "bubble" of activity could last well into the early 1990s.

Burnup and Sims' Long says it's hard to predict how long the boom will last, but says it'll be around for "the next couple of years at least. It depends on how quickly some of those jobs are completed. If everyone meets their projections, it may end (about 1990). But people usually fall short of their projections," he says. And with a shortage of personnel, that situation doesn't look to change rapidly. ■

—Roger Brown

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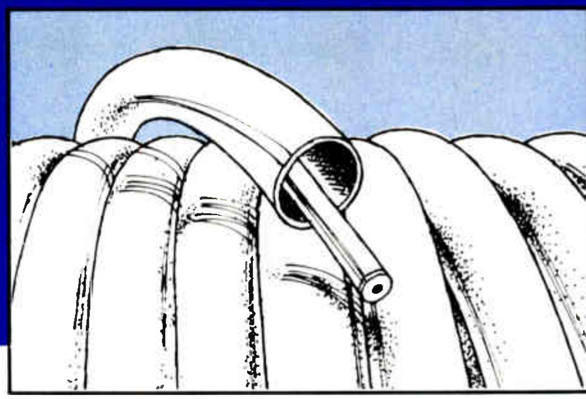

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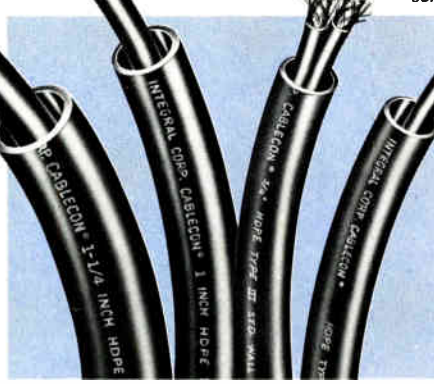
13mm with RG service wire.



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Reader Service Number 21

Fiber optic installation

As we all know, fiber optic technology is beginning to find appropriate applications in CATV. As this technology comes out of the laboratories and into use over the next decade, the local system technical people will learn to deal with it on a daily basis. One aspect of this technology is the installation and maintenance of the fiber cable plant itself. Here we discuss the fundamental physical characteristics of glass fiber and the resultant cable designs, installation practices and maintenance practices that will yield success.

Cable designs

Casual observations of most fiber optic cables will discover that they differ in construction from traditional coaxial and twisted-pair metal cables. The nature of glass has presented the cable manufacturer several challenges. First is the size of the fiber, which is several orders of magnitude smaller than typical metallic conductors. Mechanically, glass exhibits very high tensile strength but very low elongation which means particular attention must be paid to bending of the fiber to prevent breakage, whereas copper and aluminum have relatively good bending characteristics. However, perhaps the most challenging characteristic is fiber's performance sensitivity to mechanical strain. Under even very small sustained strain loads, the transmission characteristics will be altered and the life of the fiber may be shortened.

The first requirement of good cable design is to furnish finished product which has the intended life and performance under the installed conditions. Communications fiber optic cables have followed the design life objectives of our traditional coaxial and twisted-pair products. Thus, materials and environmental protections applied should under most conditions exceed 20 to 30 years, excepting physical damage. Careful attention must be applied to construction techniques and to unusual environmental conditions so as not to compromise the design life.

By Larry W. Nelson, Executive Vice President, General Instrument Comm/Scope Division

Figure 1

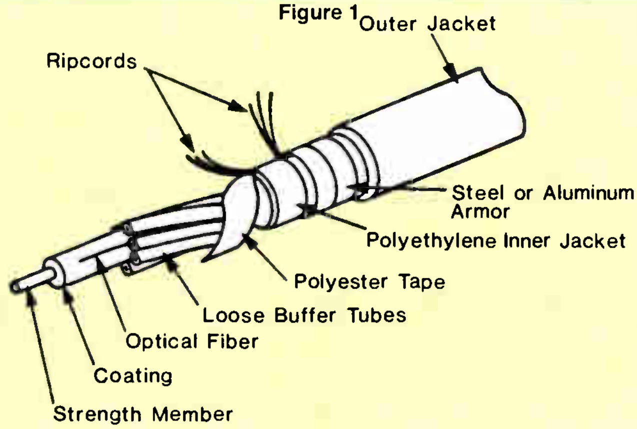


Figure 2

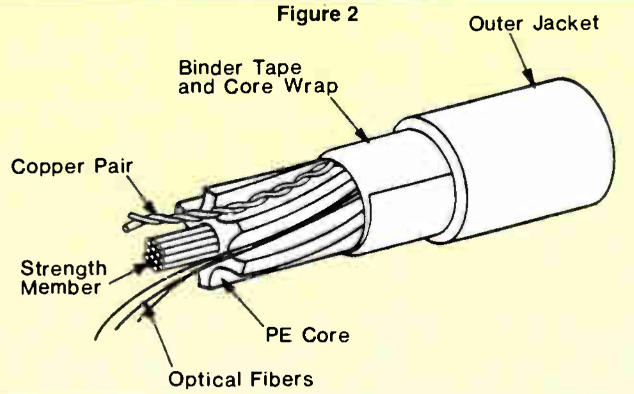
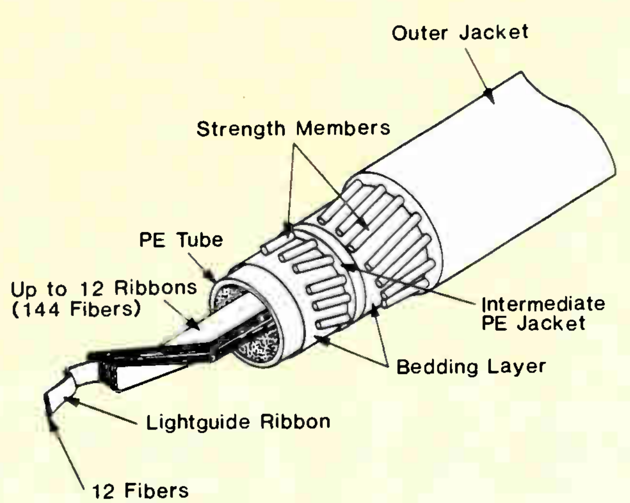


Figure 3



Cable designers have been successful in developing cables which can be installed by conventional means with very few exceptions or changes. In fact, the areas of concern in construction practice for fiber cables mirror those of our traditional CATV coaxial lines. Materials and geometric design elements are chosen to combat severe bending, tensile elongation and impact loads. All construction techniques can be utilized including aerial lashed, aerial messengered, plowing trenching and duct.

As with metallic cables, the most destructive environmental element is water in its several forms. Fiber cables intended for outdoor use, whether aerial or underground, must be protected from water ingress. For this reason, you will find flooding materials and bonding between cable elements commonly used in all cables. Glass is attacked by water in a process called hydrogenation. This results in microcracks which will propagate over time, ultimately resulting in fiber failure.

Three basic designs

Three basic cable designs have evolved, all of which are

successful in obtaining the objectives set out. These are known as loose tube, slotted core and ribbon cables.

Loose tube

Several implementations of basic loose tube design are available. One generally representative sample is shown in Figure 1.

All of these designs utilizes the concept of buffering and incorporate a strength member. Buffering simply means that the cable design attempts to mechanically isolate the fiber from all adverse conditions including impact, crushing, bending, tensile and thermal stress.

Figure 2 shows one of several variations in slotted core (open channel) construction.

Strength members are available as either steel or a dielectric such as Kevlar or FRP. Both materials produce cables which meet all the mechanical, physical and optical requirements set forth. In cable designs which place the strength member in the center surrounded by fibers, the use of a dielectric is advantageous to prevent the possibility of an electrical potential between the strength member and outer steel armor or aerial strand.

Also, use of all dielectric designs for duct and buried plants may be particularly advantageous in higher lightning areas of the country. The marginal increased cost of dielectric materials are worthy of consideration particularly with higher fiber count cables which carry proportionately higher revenue traffic.

A very high density fiber design available from AT&T is the ribbon cable, shown in Figure 3. In many respects, this design is similar in concept to a loose tube construction.

Aerial installations

All of the general techniques and methods of aerial installations which have been successfully used with coaxial cables can be applied to fiber optic cables.

In order to have a successful install, the fiber must be protected from stress. If a fiber is subjected to a stress equal to 30 percent or more of its breaking strength, there will be a reduction in the life of the fiber. Such excessive stress produces microcracks in the glass which over time will propagate, resulting in failure.

Cables have been designed and are specified for maximum tensile load strength such that the fibers are sufficiently protected. It is vital that the cable specifications are adhered to. Most cables carry a specification of at least 600 pounds maximum pulling strength. Observing this limit strictly during pulling will prevent fiber damage. It is recommended that a tensionmeter, fusable link or other device be used during the pulling process so as to guarantee that the maximum pull strength specification is not exceeded.

All cable designs incorporate one or more strength members. Their purpose is to absorb the tensile load applied during installation and during the life of the cable. Attaching the pulling devices to the cable properly is essential to transferring the load to the strength member rather than to the fiber. Kellums® grips, pulling eyes, etc. should be effectively attached to the central strength member.

One characteristic of fiber cable is its light weight. In most cases the cable is lighter than coax. Even so, rollers and other support devices must be used along the spans to support the cable during a backpull. The size, number and spacing should be equivalent to good coaxial cable installation. Failure to use sufficient support may result in excessive drag or exceeding the minimum bend radius.

Cable designs have been chosen to give minimum bend radius essentially equivalent to other types of cables. This is usually specified at about 10 times the cable diameter. Thus, the standard practice with regard to corner blocks should be followed. Obviously, every additional corner encountered during the pull will increase the pulling tension.

The splice case will contribute substantially to the overall life of the installation. First of all, it must be environmentally qualified for the installation. Water entry into the case will create a significant problem. The internal structure of the case must be designed with the bending characteristics of the fiber, the type splice to be used, the type cable and convenience of the splicer in mind.

The case must be designed to contain excess fiber lengths up to several meters. This allows the fiber ends to be brought out to the splicer for easy, effective work. The excess length also allows the fiber to be coiled back into the case with large enough radii to avoid damage to the fibers or excess attenuation. Specific coil frames are usually provided to hold the fibers.

The case should also contain some

Common myths of agility

by John Coiro

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

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

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

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

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

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

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

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

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Figure 4

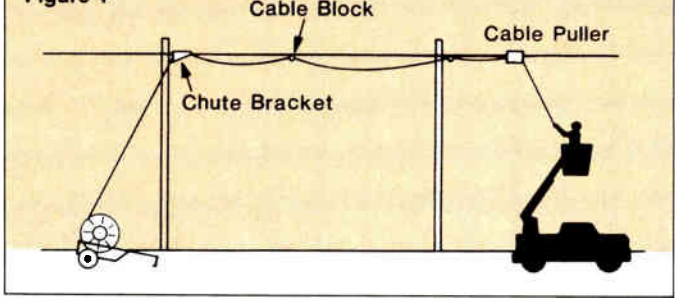
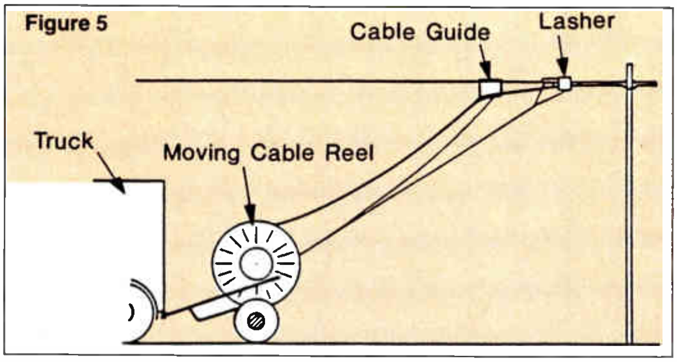


Figure 5



mechanical means of holding the splice after the job is finished. The splice cannot be allowed to hang free. All of these requirements are usually fabricated into what is generally called a fiber organizer inside the splice case.

All splicing techniques are relatively sensitive, requiring some equipment and a convenient work space for the splicer. As a result, common practice is to do the splicing at ground level, as shown in Figure 7.

After splicing is complete, the splice case and excess cable is lashed up to the strand as shown in Figure 8. Care should be taken to place the case and cable away from the pole to prevent damage by other pole occupants.

Fiber cables have a need to be as longitudinally dimensionally stable as can be reasonably accommodated. Thus, unlike coaxial cable sag and tension practices, a tight span is preferrable to a loose span. The objective of the cable design and installation is to minimize the chance of stressing the fiber. A very loosely sagged strand will exhibit more differential length movement due to temperature, ice, wind and snow which, in turn, increases the chance of applying stress to the fiber. In practice, sag conditions will usually be restricted by other cables installed on the poles. Whenever possible, place the fiber cable in the uppermost available space on the pole.

Overlashing of a fiber cable to existing cables is acceptable—with a single precaution. The strand must be of sufficient size and installed correctly so that the finished installation of fiber cable and other cables will meet the sag and tension needs of all the cables.

Standard practice in CATV coaxial cable construction requires expansion loops periodically to accommodate the difference in thermal coefficients of expansion of steel and aluminum. In fact, specific care must be given to the geometric configuration of the loop to prevent premature failure of the cable. The materials used and the configuration of fiber cables present a different situation and, in fact, the requirements may differ between cable types and even between implementations of the

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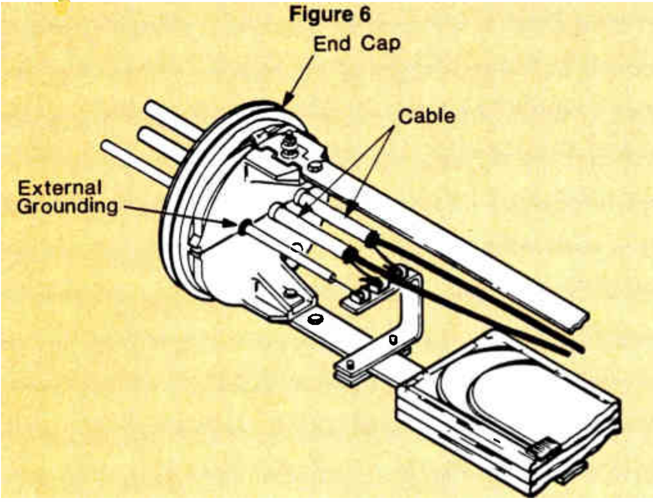


Figure 6

same cable type.

For example, loose tube cables can be designed such that expansion loops are not required. This is achieved by carefully constructing the cable in such a way as to accommodate the expansion and contraction of the strand. It is best to consult your cable supplier for a specific recommendation. Conservative practice may be to install a minimum number of loops. Because of the flexibility of fiber cables, and their lack of susceptibility to stress concentrations, the natural shape of an expansion loop is quite adequate.

Fiber cables are suitable for direct burial using either the trenching method or plowing. All of the precautions considered in aerial installations apply here, with a few additions. For plowing operations, special attention is needed for the plow design and for the entry of the plow into the ground. In both cases, precautions must be taken so that severe bend stress is not put on the cable. For added strength, bend protection and environmental protection, an armored cable design is recommended for underground.

Duct installations

These are quite common with fiber cables and should present no problems. Some precautions should be observed to prevent overtensioning of the cable. The duct should be cleared before pulling the cable. An inner duct may have to be pulled in to assure sufficient clearance. Never attempt to fill a duct over 60 percent of its cross sectional area. Excessive filling will create excessive tension. Use of lubricants is recommended to reduce tension.

Installation keys

The success of a fiber cable installation is planning and careful attention to stress. The cable runs should be well planned for clearances, avoidance of obstructions, location of splice points and the ability to place long lengths of cable. All conditions which will create difficulties should be eliminated or

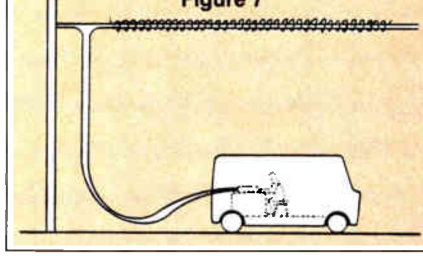
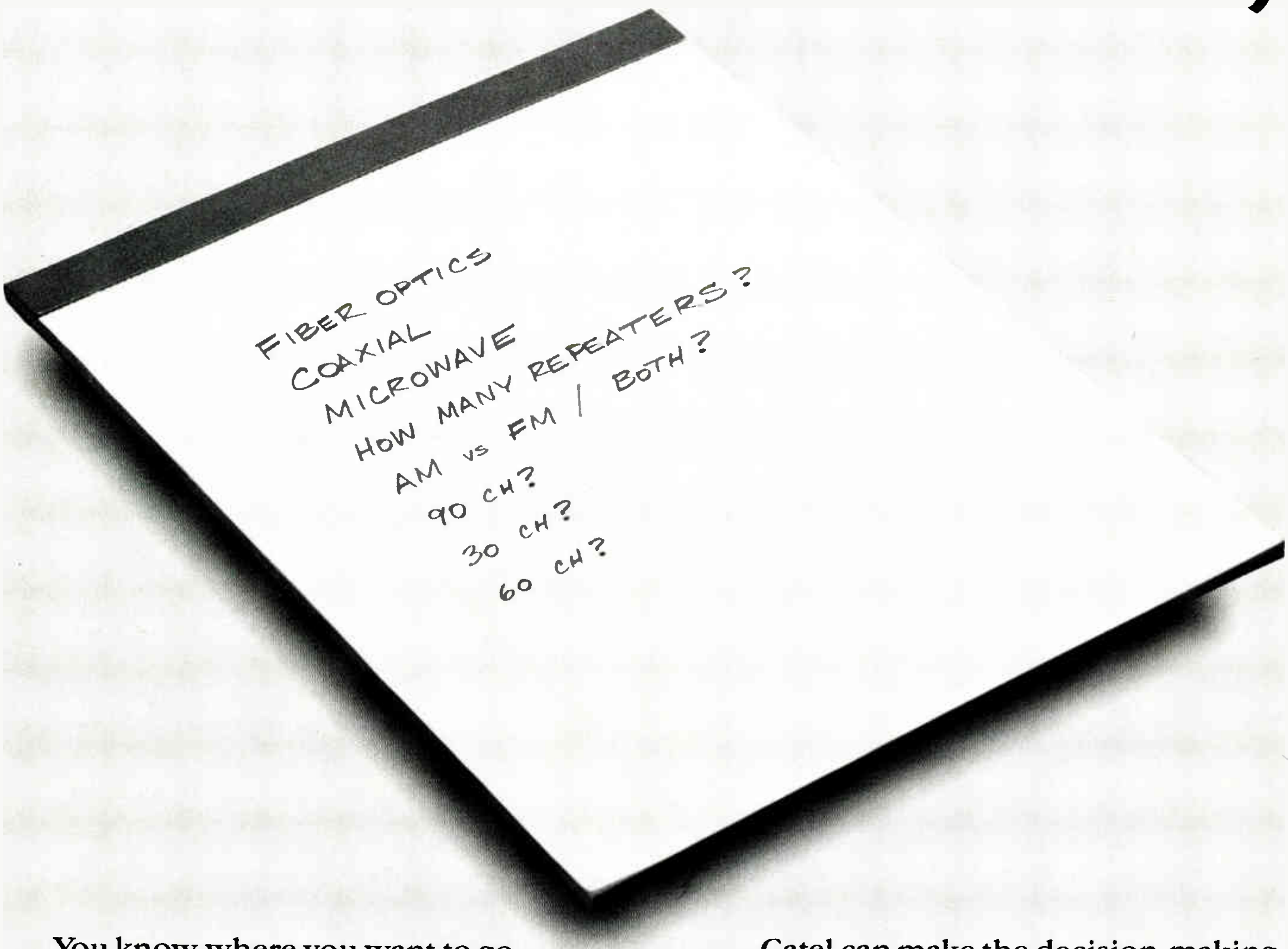


Figure 7

KNOWING WHERE YOU WANT TO GO,



You know where you want to go.

You want to stay competitive. And in the cable television industry, that means using the best, most cost-efficient technology. Maybe a new build is in order. Perhaps a system upgrade. Either way, you face a perplexing situation.

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At Catel, we realize that finding the answer isn't easy. There's a lot of talk and a great deal of confusion regarding CATV technologies—fiber optics, microwave, and coaxial.

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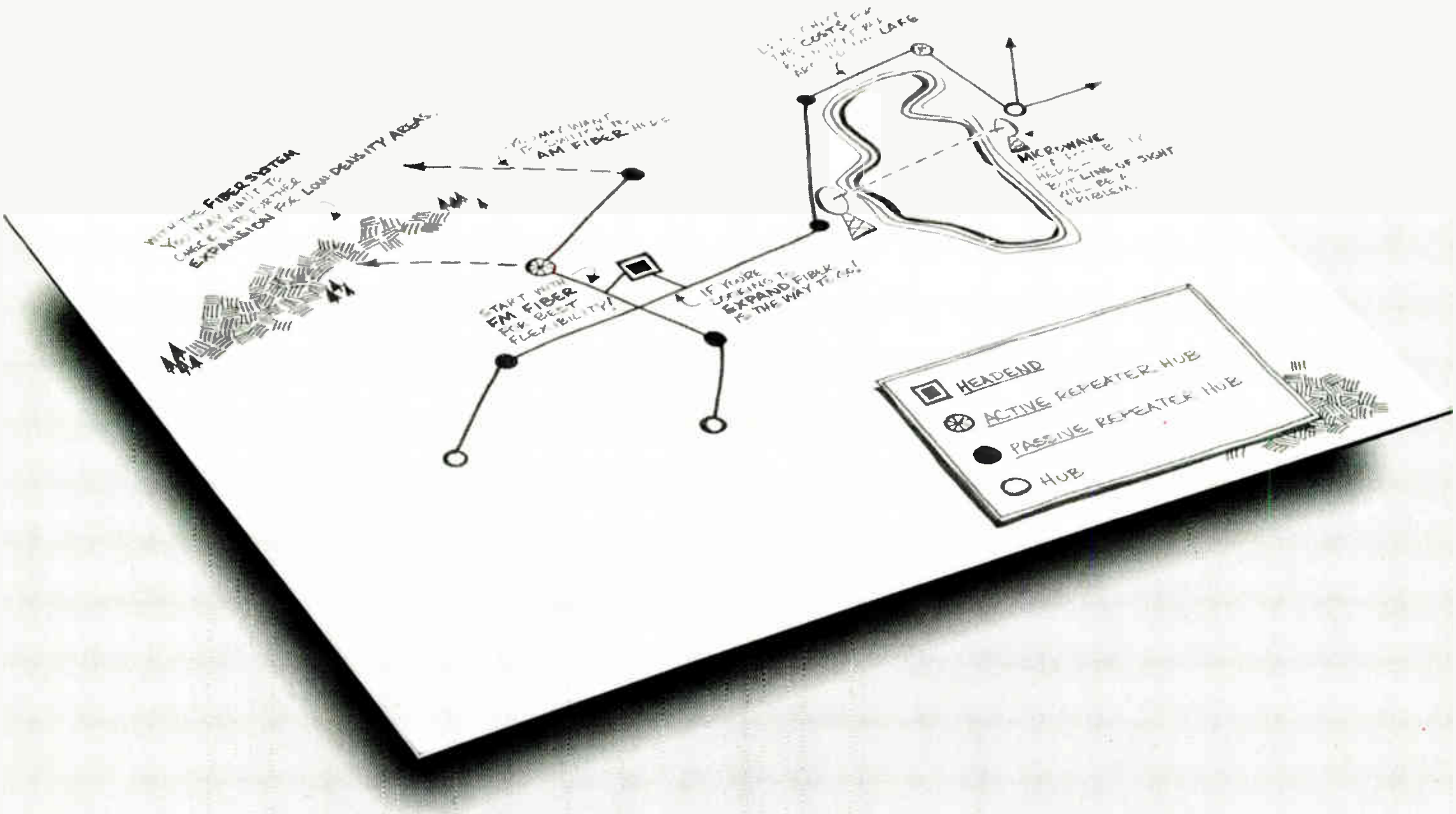
Oftentimes, the best route may consist of more than one technology. Eventually you'll realize that Catel's fiber optic technology has several distinct advantages over the others—superior quality, future expandability, and maximum channel capacity, to name a few.

ISN'T THE SAME AS KNOWING HOW TO GET THERE



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For more than 20 years Catel has provided the cable television industry with innovative solutions. The introduction of our full family of fiber optics products marks the beginning of an exciting evolution for the industry—an evolution which will bring about complete fiber-to-the-home CATV systems.

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accounted for in the planning stage.

One of the advantages of fiber optics is to utilize long lengths of cables and in fact, splicing should be minimized. For particularly long runs, whether aerial or duct, there is potential for generating excessive stress or in the case of aerial construction, having to go above other facilities perpendicular to the run.

A technique which can help in these situations is to start the cable placement in the middle of the run and work in both directions reducing the run by half. To accomplish this, it will be necessary to take the last half of the cable length off the reel in order to access the bottom end. The cable can be laid on the ground in a "figure-eight" configuration. By using the figure-eight, the cable will pull out into the last half of the cable run without kinking. This avoids the natural twist which would be induced if a simple coil were used.

To clear obstacles along the route of an aerial placement, one can use the figure-eight technique. After figure-eighting the cable on the ground, the cable end is pulled over the obstacle and the cable can then be rewound on to the cable reel by hand.

Figure 8

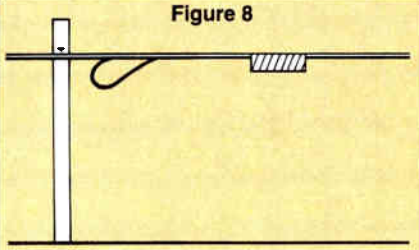
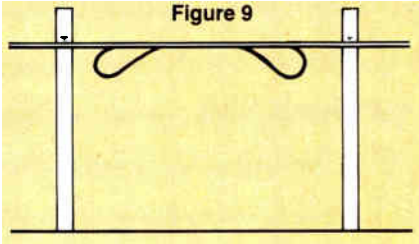


Figure 9



Repairing a fiber cable which has been damaged will be a necessary part of the system maintenance. Unlike the initial installation which will usually have been done by specially equipped contractors, restorations may be done locally due to time and to cost.

The first step is to have extra cable on hand. Usually some extra length is added to the initial order to have on hand for repair purposes. Since fiber cables at this time are generally made to order, obtaining a repair length from the factory may require several weeks. If necessary, long jumper cables can be used as a temporary repair. If a length of the original cable is not available but a length of a different cable containing sufficient fibers is available, then it can certainly be used. Under emergency conditions, even splicing together fibers from a different manufacturer is acceptable temporarily (for multimode fibers they must be equal core sizes).

For the permanent repair, two splice kits and a length of appropriate cable will be needed. The type of splices chosen and the splice cases chosen should be consistent with the objectives originally set out for the entire cable run. Some factors to be considered are splice loss, cost, reliability and local expertise.

How much cable should be removed to be assured that all damaged fiber is eliminated? One concern is that all fiber which has been overstressed and would as a result have a reduced life be removed. It is probably impossible to know with any certainty the answer due to the variability of installations and type of damage incurred. One rule of thumb which is commonly proposed

is to cut back 10 meters each side of the damage. A second factor to consider is the introduction of modal noise due to locating two splices close together. The importance of this factor is dependent on the particular manufacturers' fiber used. Avoidance of this situation requires separating the splice by 20 meters. From a practical point of view, a repair section should be about 20 meters long.

Another approach is to install an accumulated excess of cable at points along the cable run. These points could be chosen for their proximity to likely damage locations such as an area which is expected to see significant construction and development in the near future. The accumulation of excess cable can be done as in Figure 9, always keeping in mind minimum bend radius and tension.

This excess cable can then be pulled out and relashed so that the restoration can be done with a single splice.

Fiber specifications

Single mode fibers being provided for telecommunications today have parameters which in most cases are standards.

Attenuation
0.40 to 0.70 dB/km @ 1300 nm
0.30 to 0.70 dB/km @ 1500 nm
Fiber mode diameter (μm) 9.0
Fiber outer diameter (μm) 125 ± 3
Coated fiber diameter (μm) 250 ± 15

Other physical characteristic differences between fibers are generally artifacts of the manufacturing process employed. While these do produce some operational differences, they are of secondary importance and with accepted cable design, installation practice and splicing practice, should not significantly impact the system.

Cable specifications

The objectives of designing a cable fall broadly into the categories of protecting the fibers and providing ease of use by the user. Protection specifications are relatively standardized because they are quantitative and the requirements are well understood due to the long history of building and installing metallic cables. On the other hand, ease of use, convenience, adaptability, etc. are more qualitative attributes and vary depending on the needs of the specific installation.

Typical physical specifications for single mode telecommunications cables include:

Operating temperature range:
−50°C to + 70°C

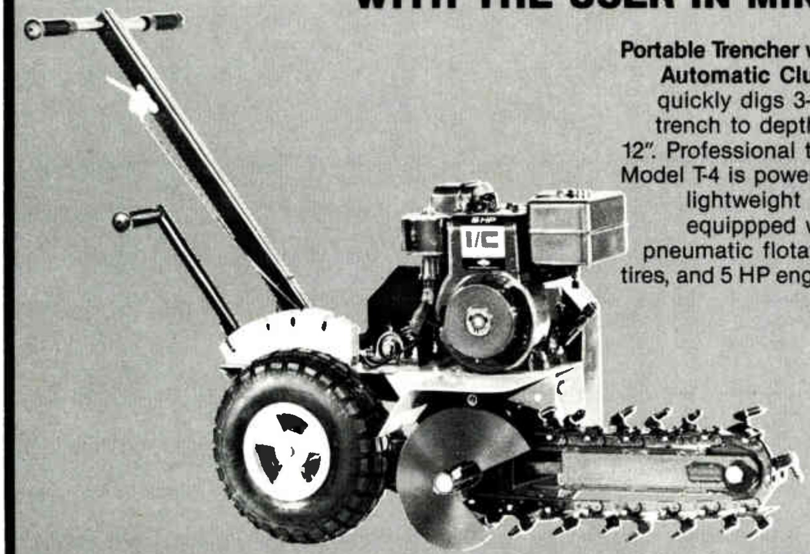
Crush resistance
Armored 460 lbf/in.
Non-armored 400 lbf/in.

Impact resistance
Armored 20 times @ 3.7 lbf/ft.
Non-armored 20 times @ 2.2 lbf/ft.

Minimum bend radius
depends on fiber count
10 times cable outer diameter

Maximum pulling tension 600 lbf

The specific geometric configuration and materials used in the cable may bear on the convenience to the user. Single tube, multitube, open channel or ribbon cable designs each have their own strengths and weaknesses from a user perspective. The choices may depend on individual preferences, installation, etc. ■



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DESCRIPTION: Manufactures earth augers and trenchers.

Lemco Tool Corp. . . . (717) 494-0620
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Cogan Station, PA 17728
PERSONNEL: Glenn Miller, President
DESCRIPTION: Designer and manufacturer of mechanical tools, equipment and material for the construction and maintenance of cable TV Systems. Lemco manufactures the TS-288 Turfserf drop-cable trenching machine.

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Manufacturing Co.
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Waco, TX 76702-0368
PERSONNEL: Charles Turner, President; John Harrison, Sales Manager; Lee Taylor, Sales Manager.
DESCRIPTION: Manufacturers of Versalift aerial lifts, telescopic and elbow types, truck or van-mounted, with working heights up to 55 feet. Sold internationally, through distributors.

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PERSONNEL: Eldred E. Lee, General Manager; Ron Rowland, Sales/Marketing Manager.
DESCRIPTION: Manufacturer of Skyjacker and Skyvan articulating and telescoping aerial baskets, in several models, and 3 power sources: Electric/hydraulic, PTO/Fan Belt Pump, or dual power with both. Mounts on pickups, vans or cab chassis.

Off-premise addressability finds success stories

After years of trials, discussions and product introductions that either failed to operate or refused to gain acceptance, it appears that off-premise addressable technology is about to be reborn as an alternative to the in-home addressable converter.

With the field test of Matrix (a Midwest CATV/Syrcuits product) now underway and development of an addressable module for Tele-Communications Inc.'s "on-premise" box just a few months away, the technology is gaining momentum at a rate not seen since the early 1980s, when numerous manufacturers brought out a slew of products.

Those products failed to gain any market presence for a variety of reasons, including high price, reliability concerns, and their inability to control numerous tiers of service. But now it's back, albeit in a different form. Why? Because it's seen as a low-cost way of implementing addressability without putting the capital investment inside the subscriber's home.

Best of both worlds

But there's another, perhaps larger issue involved here. Controlling the video pipeline at the side of the house provides customers and operators with the best of the addressable world (instant service changes without rolling a truck) and the convenience of trap technology (which returns cable-ready television and VCR features to subscribers). That keeps customers happy, which helps keep penetration levels high.

That's why Com-Link wanted to be the first to install Matrix. The system, which was installed in late September in Com-Link's small, rural, newly-built plant in Notasulga, Alabama, is now up and running with more more than 60 units working in the field, with more due to arrive and be installed shortly. Matrix is used there to control the traps on Home Box Office and Cinemax, the two premium offerings in the 12-channel plant.

Lynn Rotton, Com-Link's chief engineer, couldn't be happier with Matrix's performance. "Customer service is the name of the game. I think that as long as the (Matrix) system performs well, I see a strong possibility that we'll be putting it in other systems we own," he says. And so far, the news is good: no failures in the first three weeks of operation and a total absence of defective equipment.

With addressability, Com-Link now can improve its premium-channel promotions by offering free weekends of HBO or Cinemax simply by issuing a global authorization. And, although there is a fairly hefty up-front cost associated with Matrix, Rotton thinks he'll save money in the long run by rolling fewer trucks.

Installer Greg Renfroe (left) and Rotton install Matrix.

Basic technology at work

The Matrix system is based on two simple technologies that the CATV industry has used for several years: addressability and traps. Addressable modules inside the plastic enclosure control the traps (putting them "in circuit" when needed, "out of circuit" when they're not). Any brand of trap can be used and up to four tiers of service can be controlled (eight with the addition of a second four-port module). The plastic enclosure is attached to the outside of the home, usually located near the electric service.

"Matrix offers a marriage between two existing technologies," says Chris Sophinos, president of Midwest CATV, which holds the right to market Matrix in the U.S. and Canada. "We feel it offers a practical solution to many of the woes each side has seen. It offers addressability and takes away all the negatives of being in the house. We think that's invaluable to the operators."

After originally contemplating an agreement with Blonder-Tongue Laboratories to market the Guardsman product, Midwest instead chose the Syrcuits product because it held more potential, says Sophinos. Midwest has been working with Syrcuits for more than a year to enhance Matrix's original design. The unit was shown to several key industry engineers for their input and was demonstrated in Denver for a group of them. Sophinos says that effort resulted in several design changes to Matrix and the enclosure.

For example, a mounting grid was added to the base of the enclosure so operators would have a base upon which to add passive devices, if needed, in the future. And better connectors were put in the device to help reduce the opportunity for RF leakage.

Strongly marketed

"We've marketed this product strongly to the engineering community," Sophinos says. "We thought that was important. It stretched the development curve and added some cost to the unit, but we valued the comments we received and they ultimately made it a better product."

Rotton likes Matrix for more than the obvious reasons. In addition to its Alabama systems, Com-Link owns seven systems in Colorado and is looking to buy as many as four more. Rotton would like someday to have Matrix in all his systems.

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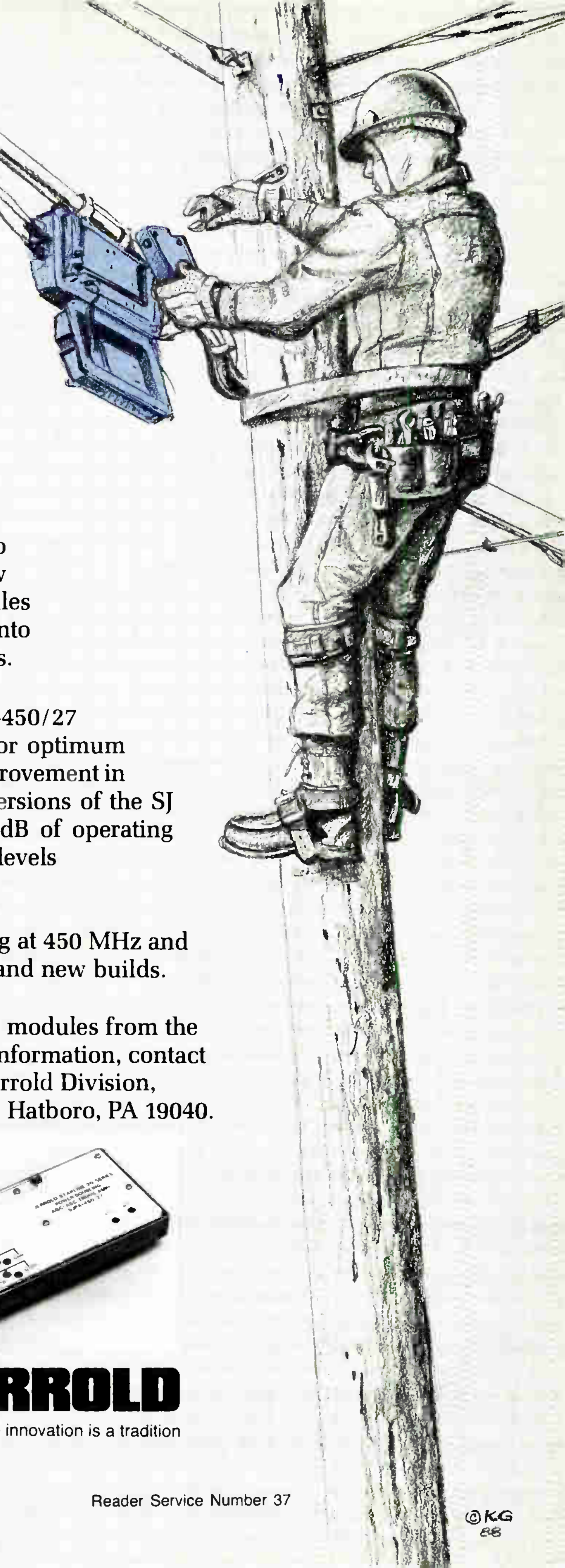

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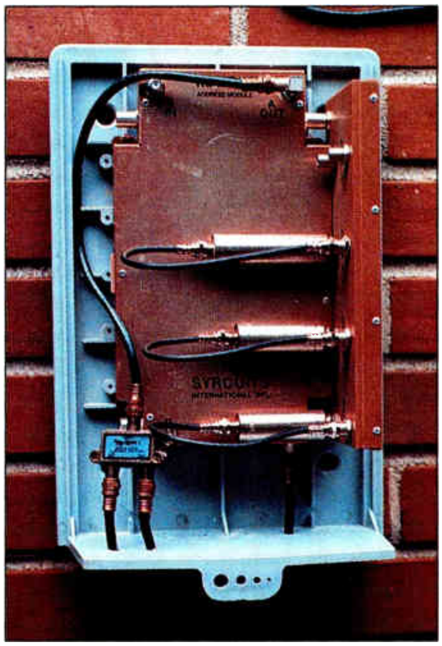
simple, according to Rotton. The first 50 boxes were placed in the field as part of complete installs (remember, this system is brand-new) while the others were installed as the need arose. The first 50 were installed by three installers, each of whom was able to place five boxes per day (including installing complete drops). Rotton figures that his installers can place each box in about 45 minutes.

What about customer reaction? "Most customers are interested in getting service as soon as possible and with this system we can often make a change within minutes after receiving a phone call. This is the type of service people will be real happy to see, I think," says Rotton.

One subscriber who likes it already is Walter Parker, the first customer to have a Matrix unit installed on his home. Parker, a member of the Notasulga town council and a man interested in electronics, says: "If it (Matrix) works like it's supposed to, it'll be very convenient to the customers."

Parker admits that most customers probably won't really care about Matrix—until it comes time to add or delete a pay service. "All my children live in cable systems that require a service call to make a change, so they can't have that change when they want it." Addressability solves that problem.



Matrix uses proven technology.

Quantify the savings

Now that the system is in place, Rotton will be gathering data on truck rolls saved and other parameters to determine how much time and money Matrix is saving him. "I'll be checking it real close," he says. Rotton's goal is to sell his superiors on the merits of the system so they'll buy more boxes. "As long as the reliability is there, I expect it to work out."

Midwest has done what it can to ensure reliability. So far, the unit has undergone testing in two different independent laboratories, says Sophinos. In one test, Matrix was subjected to temperature swings from -50 degrees to +150 degrees. Then Matrix was exposed to a salt-spray test (100 hours in high humidity—the equivalent of 7 to 10 years of outdoor coastal environment exposure). Each time the unit performed within published specifications, without failure.

Still, Sophinos says he can't always guarantee that something won't go wrong. "There's an expectation of quality that is almost beyond reasonable manufacturing specifications...because the industry has had its share of failures," he says. "We're tuned into that and trying to do what we can do to avoid it but Murphy has a way of getting involved. These tests help flush out those problems."

Although Rotton expects to save money with Matrix, he doesn't think it'll cost anyone their jobs. "We're not looking to take anyone's job away, but we hope it'll take a load off them and perhaps give them something else to do." Like

install more Matrix enclosures or perform preventive maintenance on the system.

The cost factor

The cost of the Matrix system is comparable to an addressable converter. The price per unit, which consists of the plastic enclosure, an address module, a switch module, power pack and power inserter, is a shade over $116. A second, optional address module can be added to the configuration, increasing the switching capabilities from four tiers or services to eight tiers or services. But that is a per-household cost, says Sophinos, not a per-television cost, as addressable converters are. So, a household can feed all the televisions it has from a single Matrix unit.

Equipment for the headend will cost an operator $4,950, which includes software and a controlling computer. No scrambling costs are associated with the headend because the security is in the trap technology. And because Matrix will house any brand of trap, operators can continue to use the traps they already have in the field.

Pay-per-view can also be supported, as long as a telephone return path is provided. The system can poll up to 3,600 subscribers per minute, more than adequate for many small systems, Sophinos says. Matrix can also be operated in a system using addressable converters.

A bright future?

In contrast to those systems introduced early in the decade, Matrix seemingly has a strong chance to succeed. Numerous other systems are eager to install and test the system and negotiations with a "major MSO" are expected to bear fruit soon, says Bill Dancy, Midwest's product manager.

TCI, on the other hand, has already received about 500,000 of its "off-premise" box and has them installed in systems all over the country, says Tom Elliot, TCI's director of research and development. Now, the MSO is working on developing an MDU version of the enclosure.

Elliot's on-premise concept is strikingly similar to the Matrix concept (see CED, March 1987, p.48 for details on how the TCI concept works), except that it lacks addressability. However, that situation is due to change soon. Engineers in General Instrument's Tocom division in Dallas are currently working on developing the addressable module that will be designed to fit in

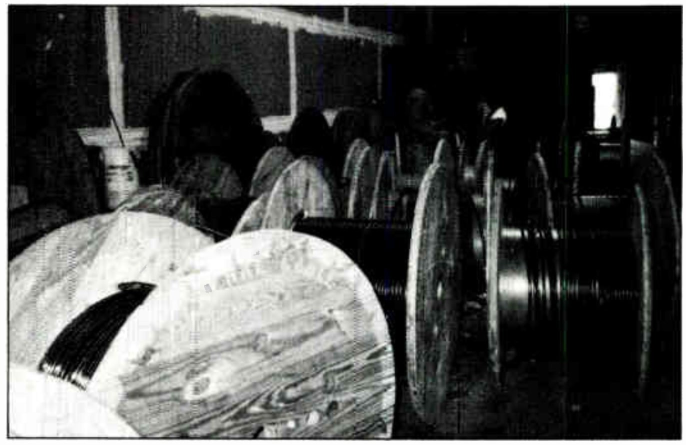
> Tocom engineers are currently working on the addressable module designed to fit in the TCI box.

Rebuilding?

Resource Recovery can save you money

The disposal of the waste cable and reels from either a newbuild or rebuild system has historically posed a significant problem to the cable companies and their construction contractors alike. There exist, at present, few companies willing to service the needs of the cable industry when it comes to disposal of and payment for these materials. Of these there is only one, Resource Recovery Systems, that has the ability to handle all aspects of this waste material...cable, electronics, and reels...simultaneously from multiple systems across the country.

We specialize in the prompt removal of these salvageable materials from the job site, thereby eliminating the problem as well as generating revenue for the cable system which otherwise would not have been realized. Unlike certain salvage contractors that would shy away from handling the wooden coax reels or require that the cable system accumulate massive piles of scrap before handling, Resource Recovery Systems provides the necessary ongoing labor and transportation from day one until completion of the build.



We are a full SERVICE company with a proven track record of performance in dealing with system operators and their construction contractors across the country. We tailor our operations to fulfill the needs of our customers, regardless of their size or location. We provide for the efficient handling and pickup of all recyclables including providing suitable containers where needed to facilitate the regular removal of all coax scrap, on or off reels.

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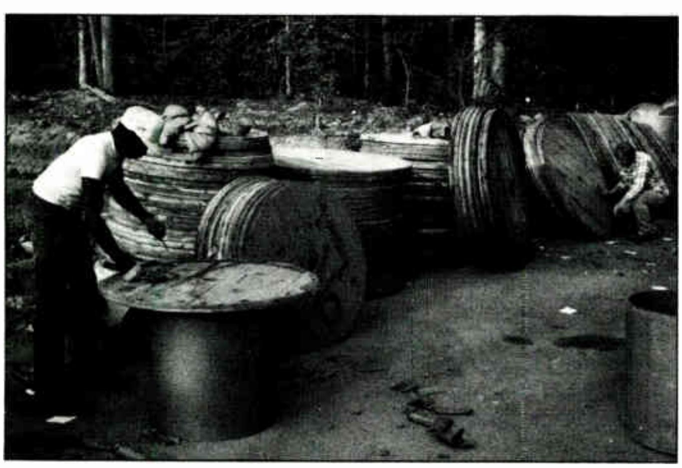

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Renfroe places the cover to seal out moisture.

the TCI box, which was developed by Scientific-Atlanta specifically for TCI.

The product will consist of an RF switch module controlled by an addressable data receiver and controller. Four switches will be configured to route incoming signals through positive or negative traps or to bypass those positive or negative traps.

The differences

If that sounds exactly like the idea behind Matrix, you're right. The only differences between the two designs are size (TCI's box is much smaller than the Matrix box) and number of connectors. Elliot has intentionally tried to reduce the number of connectors to as few as possible in order to leave leakage concerns at the door.

"We're not pretending this is novel (technology)," says Tom Martin, Tocom's director of research and development. "But we're trying to get it in as small a unit as possible."

So far, that's been the stumbling block, says Martin. It's tough to reduce that much technology to a size that will fit within the box. But Martin says he fully expects a product to be developed and field tested "within a year."

Martin also pointed out that the addressable module will be designed to drop into a Jerrold addressable system and will support impulse pay-per-view via a module (that will be designed later) that will communicate with a store-and-forward box located in the home. "It will have lots of commonality with Jerrold devices," Martin says.

Why is TCI going forward with a technology so similar to Matrix when Matrix already exists? Besides the problem over size, Elliot says the addressing capability of Matrix is too slow for a large-system environment.

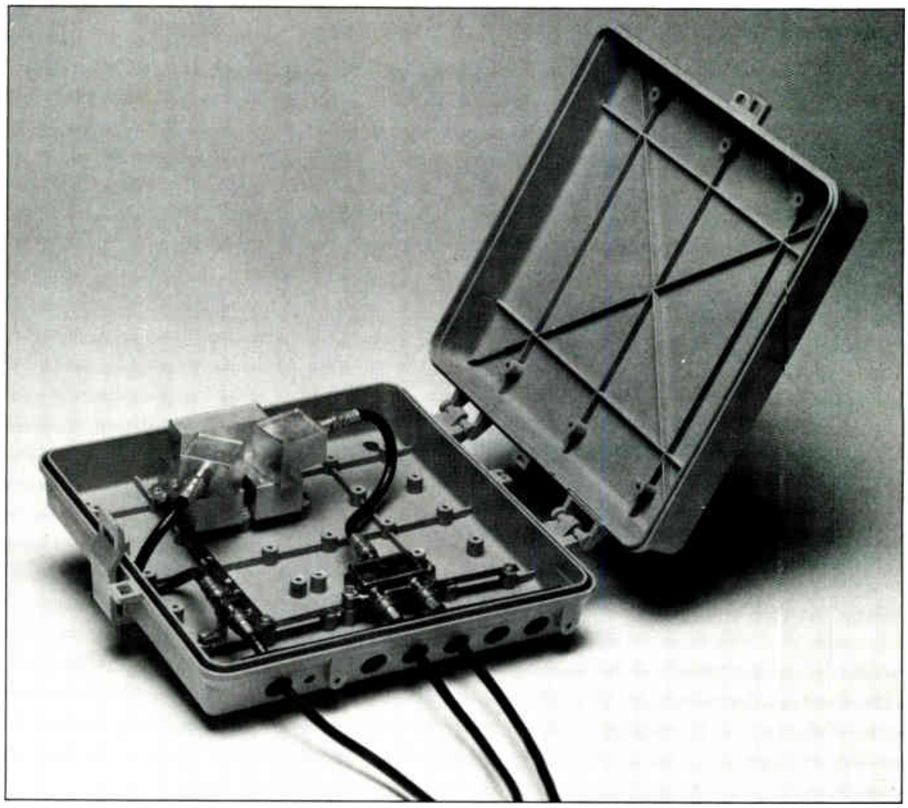
"Clearly (Matrix) is the concept we're looking for...(maybe someday) we could merge our requirements," Elliot says.

Over the hump

With apparent success stories coming from both camps, it appears that off-premise (or outdoor) addressable systems have finally gotten over the hump that held them back in the past. With so much attention being focused on customer friendly applications of technology, this could be a real winner.

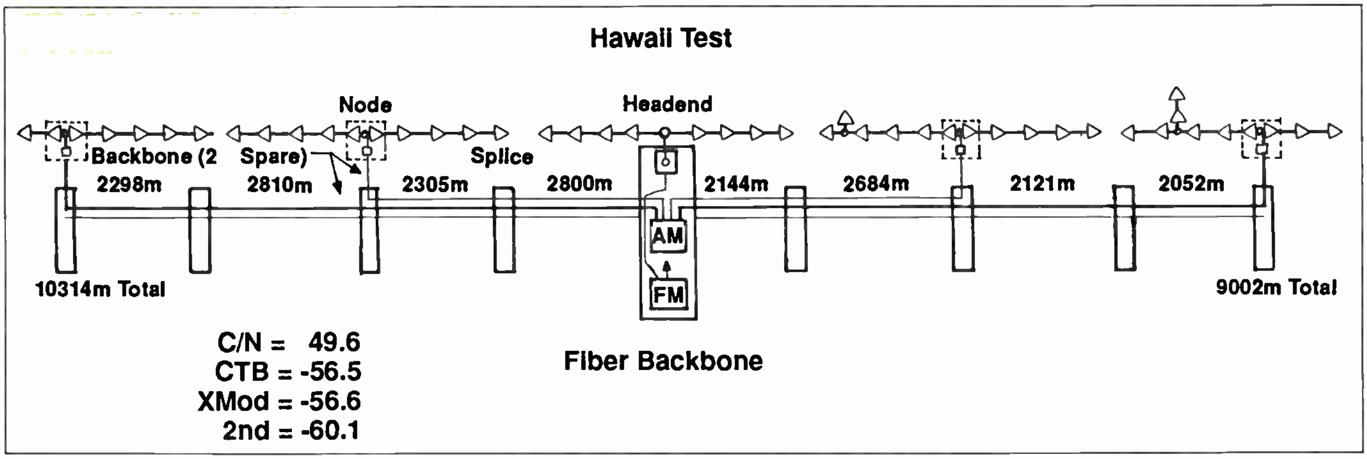
But perhaps more importantly, the technology could be seen as a low-cost method of adding addressability and all its associated benefits to small, rural systems separated by miles of open road. By installing addressability, those rural systems that dot the countryside could be efficiently tied together, or clustered, without forcing subscribers to suffer from the poor service associated with systems that have their service vehicles separated by miles of open road. And operators, too benefit through reduced costs and better customer relations. That combination may be just what the public ordered and worth its weight in gold. ■

—*Roger Brown*



A prototype of Scientific-Atlanta's Outer enclosure, used by TCI.

ATC implements AM fiber system in Hawaii



Though dominated by programmers again this year (Turner launched TNT), the Atlantic Cable Show in Atlantic City offered a few tidbits of technical information and innovation, if you were willing to do a little digging and a lot of listening. Telephone company representatives also were in abundance, all of whom were quick to deny that they wanted into the cable industry as operators.

The technical sessions again focused on the two hot issues of the day: Fiber optics and high definition television. The HDTV non-technical session consisted of presentations designed to give an overview of the issues and a discussion of what regulatory issues stand in the way of implementation while the technical session featured a discussion of how the headend and distribution systems will be affected by HDTV.

But perhaps the most important and heavily attended session was the one on fiber. Dave Pangrac, director of engineering for American Television and Communications, outlined how an

US West bearing down on CATV

US West Communications, the asset-rich ($20 billion) Regional Bell Operating Company (RBOC), has formed a Cable TV Industry Marketing Group to sell video transportation and ANI (automatic number identification) services to cable operators in its 14-state territory that covers 45 percent of the continental United States. Walter Huff, regional marketing manager, says US West has no current plans to get into the CATV business but believes its fiber-to-the-home plans will get a boost if the costs of laying that fiber can be shared. The company believes it still is about 10 years away from full local loop penetration, but guesses it will have fiber "to the curb or close to it" in five years, Huff says.

US West believes it can leverage its existing fiber network by selling super-trunk and trunking ("backbone") services to CATV operators in its territory. The benefits to operators include reduced maintenance costs, reduced capital costs to migrate to a fiber network and higher signal quality.

Although it has little fiber in the subscriber portions of its network, the company has an extensive trunking network within its region. With net annual income of nearly a billion dollars, US West has used its $2 billion annual construction budget to lay over 50,000 miles of optical plant, mostly to link central office locations. And, after studying matters, the company has concluded that it has fiber backbone in place that closely parallels population locations CATV operators now serve. In Denver, a single central office serves about 100,000 subscribers. In outlying areas a CO might serve between 10,000 and 20,000 subscribers.

Huff says the already-existing fiber can be used by CATV operators to break up long amplifier cascades or replace AML facilities. He proposes to use existing active fibers carrying telephone traffic at the 1310 nanometer window. How? By carrying CATV traffic at the 1550 nanometer window.

Current plans call for directing most of the marketing attention at backbone signal transport—replacing AML service, linking remote headends and creating advertising interconnects, says Huff. Among the proposals being made to cable operators is a plan to tie several TCI headends in Washington state together using a main receive site in Seattle. US West would run signals north to Ferndale and south to Olympia, a distance of 160 miles. That proposal uses FM techniques delivering a minimum 57 dB S/N. Two repeaters would be used on the hop north to Ferndale and another two for the hop south to Olympia.

The company also is proposing a 103-mile system for Sammons that may use a DS-3 rate (90 Mbps) digital modulation scheme. Three repeaters would be required if the route were to use FM techniques instead. The group also expects to submit a proposal for tying together Cable TV Puget Sound facilities as that system contemplates

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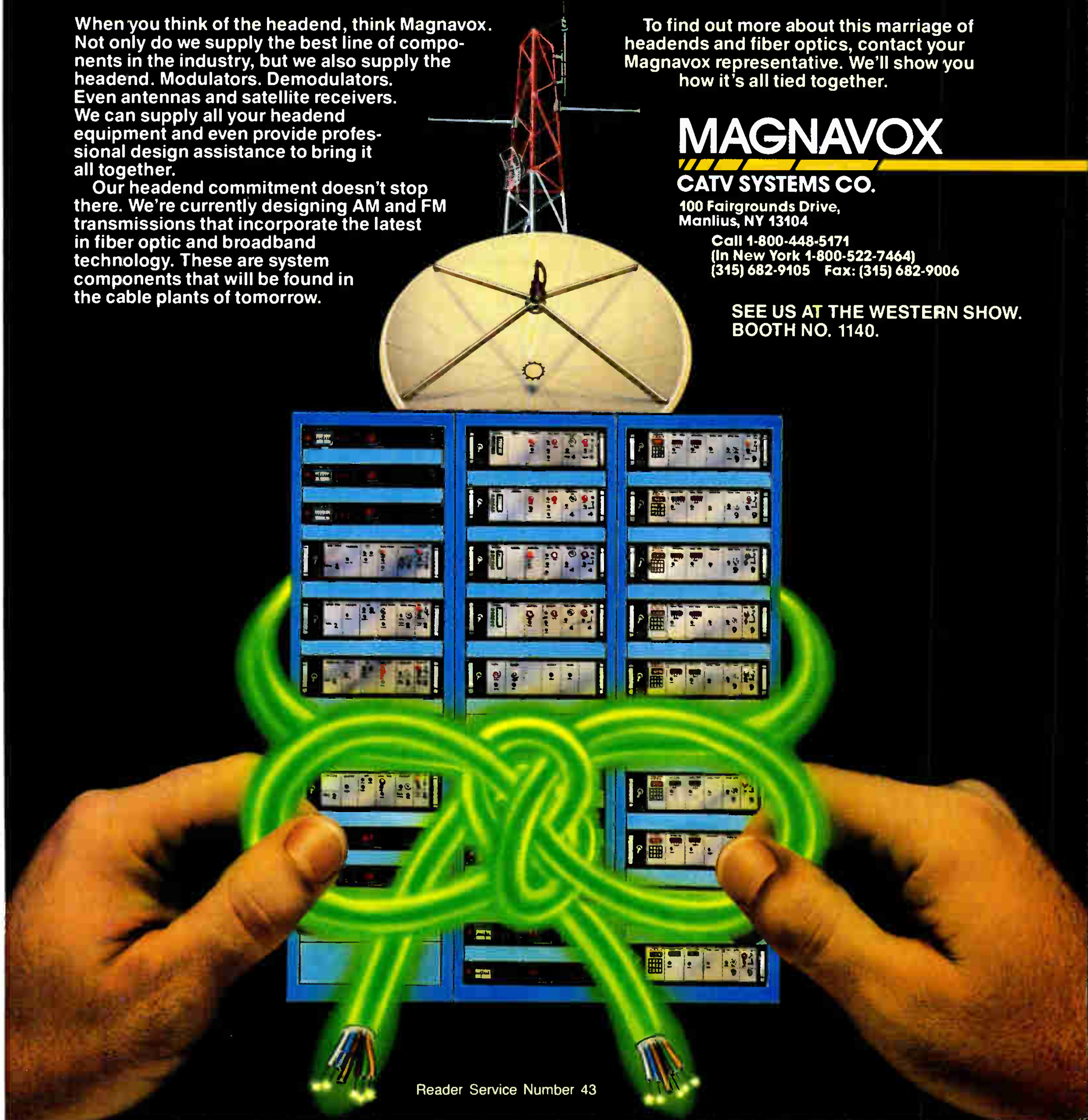

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AM transmission scheme using Panasonic electronics will be integrated into the MSO's Honolulu area.

The system, which was slated to be entirely installed by Nov. 7, will deliver 36 channels over 10 km of fiber at 51 dB C/N and distortions at least 60 dB down, says Pangrac. The fiber run is part of a rebuild of the 32-channel Panaluu system and will consist of four nodes (see diagram). This AM portion of the run is the recipient of an FM feed from Koneho that was installed a few years ago.

The development is significant in that it represents perhaps the first deployment of an AM trunking system to a large number of subscribers. It's also interesting in that Panasonic will be the vendor providing the electronics. Watch for a significant announcement and product demonstration from those folks at the Western Cable Show in Anaheim in December.

HDTV: What are the issues?

Nick Worth, vice president of engineering at TeleCable, said that HDTV systems that rely on simulcast or augmentation channels offer "a glimmer of hope" for real, proper high definition pictures because it's highly unlikely that a 6-MHz NTSC compatible format that offers true high definition will be forthcoming.

In Worth's mind, systems like the new Zenith Spectrum Compatible approach (see October CED In the News for details) that utilizes the UHF spectrum holds a lot of promise because that spectrum is "vastly underutilized."

Will systems have difficulty finding room for two-channel systems? Not if TeleCable is typical says Worth. As a result of the normal rebuild and upgrade procedures the MSO is presently going through, there will be room for as many as nine advanced television signals in 80 percent of all TeleCable systems by 1992, Worth says; and that number accounts for several new programming services that are likely to be launched within that time, he adds.

"We were surprised" at the amount of spectrum that will be available, says Worth. But he said amplifier technology has gotten so much better and because so many systems are rebuilding to 54-channel capacity, the room will be there.

Home Box Office's Paul Heimbach said it's important for CATV to have a voice in the standards-making process going on right now and urged cable operators and executives to attend meetings and have their voices heard, before it's too late.

Heimbach also said he expects multiple formats, optimized for different delivery methods, to be created and used. The multiple formats can be accommodated by "universal" or "multiport" television receivers, says Heimbach. (Multiport sets is a concept the receiver manufacturers are not keen on, however.)

The flip side of that discussion came out during the technical session on HDTV, when Ben Crutchfield, now employed by the Advanced Television Test Center, said he has hopes for a single standard that incorporates elements of all 17 or 18 proposed systems. ■

an upgrade to 53 channels. Today, that system uses 23 AML runs. Expect other proposals for systems across the US West territory, possibly including Denver, CATV's unofficial capital.

Huff also sees the possibility of linking all operations controlled by a single MSO in a given state, creating, in essence, a giant long-distance supertrunk network capable of slicing cascades to eight or 10 deep throughout the service area.

That sort of a network would almost certainly have to use digital transmission facilities, perhaps using the DS-3 service (90 Mbps).

Given an initial green light this spring, Huff already has begun reviewing fiber transmission systems made by Catel Telecommunications, Synchronous Communications and American Lightwave Systems and expects to review all existing systems by all current CATV lightwave vendors for possible applications. It doesn't expect to develop an exclusive relationship with any single vendor, however. Huff reports he initially is favorable toward Catel because of product performance and manufacturing capabilities and soon will take a look at how TransHub works in the field.

Huff's efforts will be closely watched by other RBOCs, who obviously are guarded about the possibility of developing business relationships with CATV operators. If Huff's group is successful, expect to see at least two more RBOCs follow suit.

Expect to see the group exhibiting in a large booth at the Western Cable Show in December and expect the group to add more personnel soon and to push intently for customers. ■

—Gary Kim

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Reader Service Number 45

Composite second order: fact or fantasy?

Distortion parameters have always been the limiting factor within a CATV system, but as the bandwidth has increased from 12 channels to 60 and 77 channels, the characteristics of the limiting distortions have changed. At the beginnings of CATV, cross modulation and noise limited the number of amplifiers an operator could run in a cascade. As the number of channels increased, cross modulation gave way to composite triple beat as the limiting factor, with noise still a prominent element.

A strange thing has occurred, however. As the number of channels increased further so did the importance of a distortion parameter that caused little if no concern before. This distortion parameter is called "second order" and in its discrete form still presents no problem to the CATV operator. But when this parameter is taken in its composite form, composite second order can compete with composite triple beat as the limiting factor for cascade length and feeder levels, especially in a 77-channel system.

This paper will re-investigate the causes of second order distortion. It will also provide insights into calculating which composite second order beats are present from discrete second order numbers. In addition, it will provide an analytical analysis of a trunk amplifier, bridging amplifier and line extender for composite second order and how this distortion can be a limiting factor within a cable system.

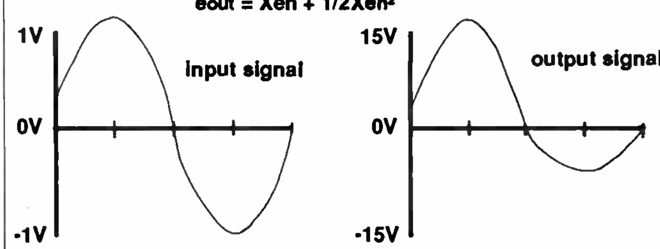
Industry has changed

The CATV industry has seen a tremendous amount of change in the last 15 to 18 years. Systems that in the early 1970s carried 12 or so channels have now progressed to a point where today, 60 or even 77 channels are reaching consumers' homes. This represents approximately five times the number of channels that once were present. Along with this growth however, additional problems have presented themselves to the industry. This paper looks into one of these problem areas. It must be understood however, that the data used to calculate the amplifier models and the distortion numbers within this paper are in their worst case situations. In reality, the effects of offset headends, modulated carriers and many other combinations can contribute improvements in the numbers presented.

Figure 1

Amplifier Transfer Characteristic

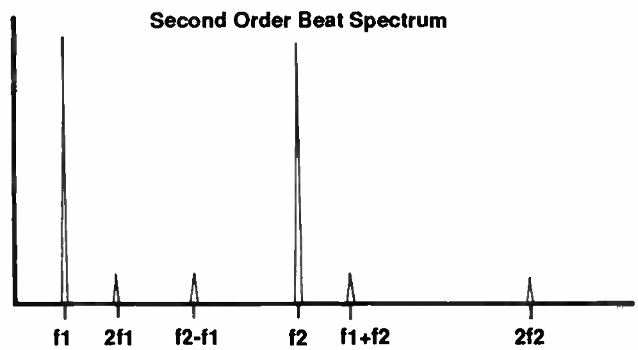
eout = Xen + 1/2Xen²



Amplifier Gain = 10 : X = 10

Figure 2

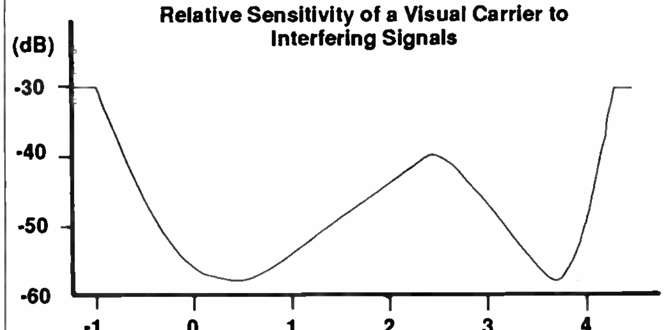
Second Order Beat Spectrum



f1 = 55.25 MHz
f2 = 241.25 MHz
2f1 = 110.50 MHz
f2-f1 = 186.00 MHz
f1+f2 = 296.50 MHz
2f2 = 482.50 MHz

Figure 3

Relative Sensitivity of a Visual Carrier to Interfering Signals



Frequency of Interfering Signal With Reference to the Visual Carrier (MHz)

Causes and effects of beats

In a CATV system, amplifiers and cable are the medium used to transport TV signals from the point of origin to the viewer's home. If things were perfect, the amplifiers would provide only signal amplification and there would be no limit to the number of amplifiers that could be cascaded. However, in the real world there is no such thing as a perfect amplifier and they provide not only the desired signal increase or gain but they also introduce several unwanted elements commonly known as distortions.

Distortions can take many forms, but in this discussion, only the distortion parameter known as second order will be addressed. Second order distortion is created when the amplifying transistors are not biased in balance. This imbalance creates the non-linear transfer characteristic in the amplifier. This

By Mark Adams, Scientific-Atlanta, Inc.

non-linear relationship results in the compression and expansion of the peaks of the sine waves of the amplifier output signal in relation to its input signal. This non-linear transfer characteristic can be expressed mathematically by:

$e_{out} = Xe_{in} + 1/2X (e_{in})^2$

and is characterized by Figure 1.

This diagram shows how the output signal is distorted with compression and expansion of the sine wave peaks when a 2.0 volt peak-to-peak input signal is inserted into an amplifier that exhibits the form of: $e_{out} = Xe_{in} + 1/2X (e_{in})^2$. This non-linear effect is known as a square law transfer characteristic.

Beats will be evident

This square law characteristic, when present in amplifiers with two input signals, will present beats within the spectrum as the phase relationship of the two input signals changes with time. These beats will be evident at 2 times f1 (1st frequency); 2 times f2 (2nd frequency); f1 + f2 (1st frequency + 2nd frequency) and f2 − f1 (2nd frequency − 1st frequency). Figure 2 shows this relationship of beats for an amplifier with f1 = 55.25 MHz (channel 2 − IRC headend) and f2 = 241.25 MHz (channel N − IRC headend).

As can be seen in Figure 2, beats fall at 2f1 = 110.50 MHz; 2f2 = 482.50 MHz; f1 + f2 = 296.50 MHz and f2 − f1 = 186.00 MHz.

The beat relationship depicted in Figure 2 holds true for whatever input signals are inserted into amplifiers that exhibit the square law transfer characteristic. Such beats can affect the picture quality of TV signals if the amplitude of the second order beat product is great enough.

What it looks like

Second order is evident to viewers as a herring-bone pattern that appears to be floating across the picture. The viewability of this phenomenon is highly subjective, and ranges of susceptibility have been as great as 9 dB.

Recommendations for the levels of discrete second order interference are -60 dBc by the NCTA and Figure 3 shows the permissible limits for interfering signals
in relation to visual carriers.

As can be seen by Figure 3, only the signals that fall at a frequency of fref +1.25 MHz (fref = reference frequency) will present possible interference problems. The level of interference to visual carriers must be greater at this point than that of fref − 1.25 MHz. If the beat products taken from

Figure 4
Number of Composite Second Order Beats in a 77 Channel System

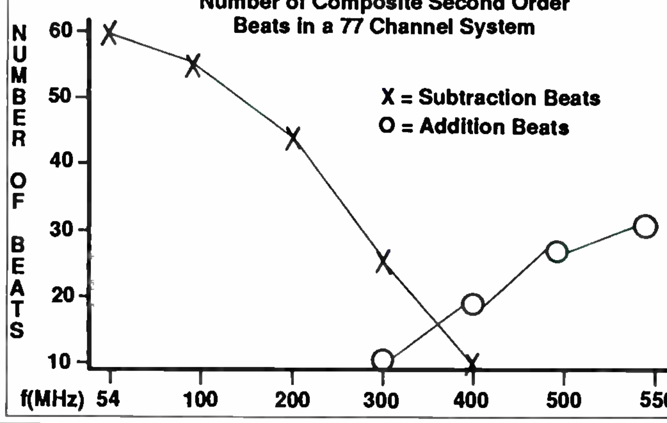


Figure 2 are applied to the graph of Figure 3, then the only beats that could possibly present problems are those at 110.50 MHz, 296.50 MHz and 482.50 MHz. For this reason beats that are generated as a subtraction (f2 - f1) are not considered problems to the CATV operator. Even beats that fall into the fref + 1.25 MHz category present no problems to systems with a small number of channels present. But now consideration will be given to the second order beats in systems that carry 77 channel loading.

Composite Second Order numbers

Composite Second Order occurs when many combinations of signals beat together. The once unimportant discrete second order beat, when summed with many other discrete second order beats falling on the same frequency (due to other channel pairs), results in a composite second order distortion which may have a level large enough to interfere with the visual carrier. This presents problems since amplifier manufacturers and CATV equipment manufacturers at present only specify what Discrete Second Order (DSO) numbers should be—not those of Composite Second Order (CSO). Composite second order numbers can be calculated however, by the equation CSO = DSO + 10 log X, where X = number of beats on fref + 1.25. The unknown now is the number of beats that make up X. In a 550 MHz system (77 channel) there are 29 beats that fall on 54.8.50 MHz, the relationship of the number of beats to frequency can be seen in Figure 4.

As can be seen, the maximum number of CSO addition beats falls at 548.5 MHz. Experiments have been performed on 10 samples each of a 550 MHz 19 dB gain push/pull hybrid; a 550 MHz 19 dB gain parallel hybrid

Table 1
550 MHz 19dB Push/Pull Amplifier

Discrete Second Order Spec =
-66dB at +50dBmV
Calculated Composite Second Order Spec =
CSO = DSO + 10 log X where X = 29
= -66 + 10 log 29
= -66 + 14.6
= -51.4

	Average Measured DSO	Average Measured CSO
Freq. 548.50MHz	67.0	51.6

Table 2
550 MHz 19dB Parallel Hybrid Amp.

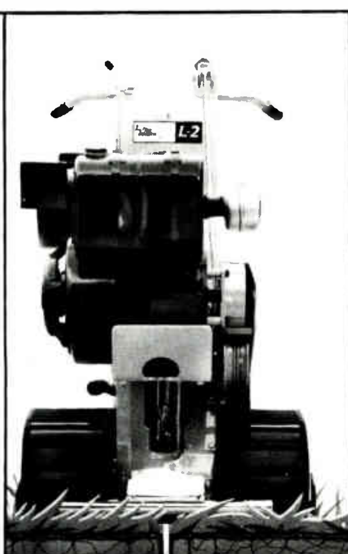
Discrete Second Order Spec =
-65dB at +50dBmV
Calculated Composite Second Order Spec =
CSO = DSO + 10 log X where X = 29
= -65 + 10 log 29
= -65 + 14.6
= -50.4

	Average Measured DSO	Average Measured CSO
Freq. 548.50MHz	70.0	58

Table 3
550 MHz 24dB Feedforward Amplifier

Discrete Second Order Spec =
-80dB at +50dBmV
Calculated Composite Second Order Spec =
CSO = DSO + 10 log X where X = 29
= -80 + 10 log 29
= -80 + 14.6
= -65.4

	Average Measured DSO	Average Measured CSO
Freq. 548.50MHz	85.0	71.0



and a 550 MHz 24 dB gain feedforward amplifier to determine how accurate the equation CSO = DSO + 10 log (X) is. The average of each group of amplifier is given in Tables 1 through 3.

As can be seen from the data, all three amplifiers exhibited better DSO performance than specified: the push/pull by +1 dB, the parallel hybrid by +5 dB. However, the relationship that needs to be looked at is that of the discrete second order beat to that of the CSO beat. In the case of the push/pull and feedforward amplifiers, the 10 log X with X = 29 holds very close to being true (difference = .6 dB in both cases). Only in the case of the parallel hybrid amplifier did this relationship break down. These amplifiers showed only a 12 dB degradation instead of the 14.6 dB that was calculated.

Explanations to this might come from the fact that just as transistors within amplifiers are not biased in balance, the two separate amplifier sections that make up a parallel hybrid amplifier may not be balanced and the square law transfer characteristic of the gain block might be out of phase. Now that the relationships of DSO to CSO has been established, an analysis can be made as to how this affects trunks, bridgers and line extenders used in a CATV system.

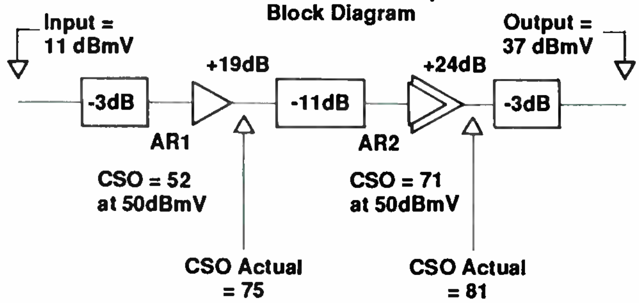
Amplifier analysis

As mentioned previously, amplifiers are used to transport TV signals from one point to another. The most common of these are called trunk amplifiers. These units are built to better distortion specifications than bridgers and line extenders due to the fact that several (most cases up to 20) may be cascaded together to transport these signals. When distribution of signals is required to neighborhoods, units known as bridging amplifiers and line extenders are used. These units, while not exhibiting as good of distortion performance, operate at higher levels than trunk amplifiers.

In order to see the effects of CSO on a CATV system, models of these amplifiers will be made using the average CSO numbers from Tables 1 through 3. In the case of the trunk amplifier a push/pull hybrid will be used together with the feedforward block. The bridg-

Case 1

Feedforward Trunk Amplifier Block Diagram



AR1 = 550MHz 19dB Push/Pull Amplifier
AR2 = 550 MHz 24dB Feedforward Amplifier

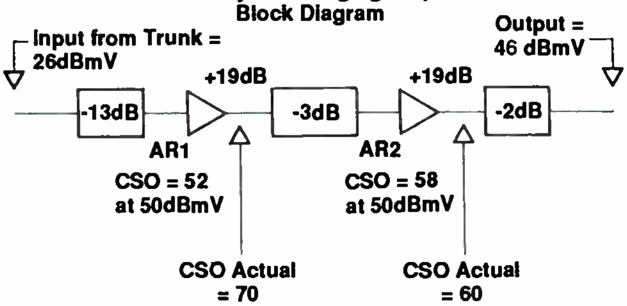
Case 1:
CSO for unit =

$$10 \log \left(10^{\frac{x}{10}} + 10^{\frac{y}{10}}\right)$$

$$= 10 \log \left(10^{\frac{-75}{10}} + 10^{\frac{-81}{10}}\right)$$

$$= -74$$

Case 2
Parallel Hybrid Bridging Amplifier
Block Diagram



AR1 = 550MHz 19dB Push/Pull Amplifier
AR2 = 550 MHz 19dB Parallel Hybrid Amplifier

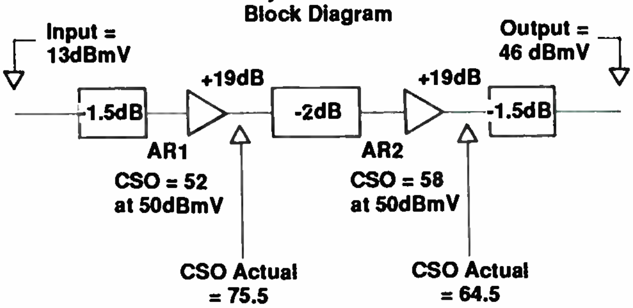
Case 2:
CSO for unit =

$$10 \log (10^{\frac{x}{10}} + 10^{\frac{y}{10}})$$

$$= 10 \log (10^{\frac{-70}{10}} + 10^{\frac{-60}{10}})$$

$$= -59.5$$

Case 3
Parallel Hybrid Line Extender
Block Diagram



AR1 = 550MHz 19dB Push/Pull Amplifier
AR2 = 550 MHz 19dB Parallel Hybrid Amplifier

Case 3:
CSO for unit =

$$10 \log (10^{\frac{x}{10}} + 10^{\frac{y}{10}})$$

$$= 10 \log (10^{\frac{-75.5}{10}} + 10^{\frac{-64.5}{10}})$$

$$= -64$$

ing amplifier and line extenders will both be parallel hybrid units, meaning that the push/pull hybrid will be used as the input with the parallel hybrid device used as the output. Levels for the units will be +11 dBmV input; 37 dBmV output for the trunk; and the outputs for the bridger and line extenders will be +46 dBmV.

A review of the preceding cases shows that in trunk amplifiers, the input hybrid is the limiting component in determining CSO, while in the bridging amplifier and line extender, the output device is the one that contributes the most to CSO.

System analysis

Now that models have been generated for trunk, bridging and line extender amplifiers, the numbers derived from these models can be used to determine the consequences of CSO on the cable plant. If a typical system of 20 trunk amplifiers, a bridging amplifier at the 20th location, followed by two line extenders is analyzed, the following CSO numbers can be calculated. From Cases 1 through 3:

Case 1 Trunk amplifier CSO = -74
Case 2 Bridging amplifier CSO = -59.5
Case 3 Line extenders CSO = -64.

Table 4

Trunk contribution = 74 + 10 log 20
where 20 = number of identical amplifiers in cascade.
Trunk contribution = -61dB CSO
Bridging Amplifier Contribution =

Trunk Amplifier CSO Number + Bridging Amp CSO Number
therefore,

$$CSO = 10 \log (10^{\frac{-61}{10}} + 10^{\frac{-59.5}{10}})$$
$$= -57dB$$

Line Extender Contribution =

Trunk & Bridging Amp CSO Number + Line Extender 1 CSO Number
therefore,

$$CSO = 10 \log (10^{\frac{-57}{10}} + 10^{\frac{-64}{10}})$$
$$= -56dB$$

This is added to a second line extender whose CSO number is also -64 therefore,

$$CSO = 10 \log (10^{\frac{-56}{10}} + 10^{\frac{-64}{10}})$$
$$= -55dB$$

This -55 dB CSO number represents the end-of-the-line performance and is 5 dB below what the NCTA recommends for DSO performance. When this -55 dB CSO is compared to the minimally acceptable interference graph of Figure 3 it can be seen that CSO is right on the threshold on acceptability.

Conclusions:

While the data presented in this paper is that of an absolute worst case situation, (IRC headend—no offsets; CW carriers, no system tilts, etc.) care and consideration must be given to CSO. No longer can operators afford the luxury of ignoring this phenomenon if 77-channel and larger systems are to be built. Additionally, both the amplifier and CATV equipment manufacturers must start specifying equipment with CSO numbers. ■

TV audio deviation: measuring and setting it

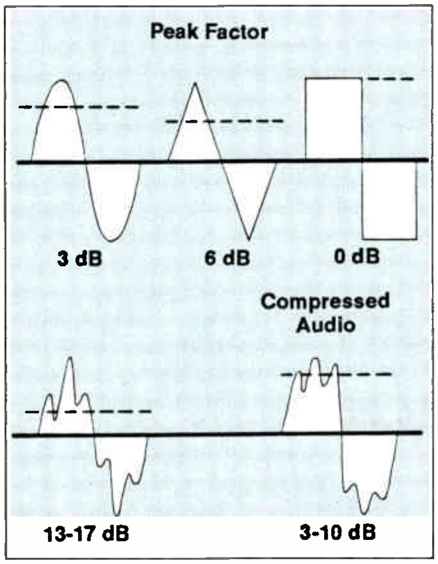
Measurement and control of TV audio volume has always been with us, but other concerns have usually taken precedence. Loudness contrast between channels is accentuated by program source switching and local ad insertion, not to mention audio volume changes with each new program on any given channel. This paper explains why two programs of equal peak deviation can have very different loudness; how to measure "loudness;" how to adjust TV audio modulators to equal loudness on each channel; and how to keep loudness constant even though the source program volume changes. First some theory, then the practical art "equalizing" audio levels.

Peak factor

The peak factor of an audio signal is herein defined as the ratio between the peak voltage and the RMS voltage in the particular waveform being observed. This is usually expressed in dB. Thus a square wave has a 0 dB peak factor, since the peak and RMS voltages are equal. A sine wave has a 3 dB peak factor since the peak voltage exceeds the RMS voltage by 1.414 and 20 log 1.414 = 3.01 dB. Natural voice or music waveforms can have peak factors ranging from 13 dB to 17 dB. "Single talkers" tend to have the highest peak factors, with certain languages and talkers ranging up to the 17 dB level. Multiple musical instruments and combined voices (such as singing) tends to reduce the peak factor to about 13 dB.

Well, if most natural audio has a 13 dB peak factor, why does the audio industry refer to a standard 10 dB peak factor? Because almost all testing is done with sine waves that have a 3 dB peak factor! Thus we are referring to the difference between the 3 dB sine wave and the 13 dB music peak factors.

All of the foregoing discussion refers to natural voice or music. In practice, these numbers will vary according to the degree of peak clipping and/or compression applied to the natural audio prior to transmission. Note that the FCC defines frequency modulation (FM) in terms of a deviation limit, which is directly proportional to the peak voltage of the modulating waveform. However, the human ear perceives loudness as a power-derived factor, which relates to the RMS value of the modulation waveform. Since the broadcaster has a natural interest in producing the loudest audio possible



without exceeding the FCC deviation limits, the industry has expended considerable effort and ingenuity to compress the peak factor ever more while still not increasing distortion excessively.

Of course, it could be said that any change in the waveform constitutes technical distortion, but what is important to the broadcaster is perceived distortion. Thus it comes to pass that some broadcasters (and recording studios) are far more aggressive in peak factor reduction than others. As a result, any two program sources that exhibit equal peak deviation can be very different in perceived loudness.

A good practical example of differing peak factor compression resulting in loudness differences can be found on your FM dial. Tune in a "classical" station, then a "rock" station. They are both modulating ±75 kHz, but the "classical" station will sound much weaker, even during a loud passage.

Practical implementation

While all of the foregoing leaves us with program of varying loudness, the sub still will complain if the volume changes more than he or she perceives as acceptable. No standard fits all subscribers in how much is acceptable. The only thing that will reduce complaints to a minimum is to reduce volume differences below the level of audible perception. One deciBel is ordinarily conceded to be a just-perceptible level change, so if we can hold average level differences between channels and between successive programs to the order of ±1 dB or so, we can hope to reduce this source of subscriber complaint to a minimum.

Off-air channels usually have their audio carefully controlled and so should not require further control at the headend. This is fortunate since most off-air signals are I.F. converted and cannot be controlled without going to baseband conversion. In fact, since these channels tend to have constant volume and can't be controlled in most systems anyway, these are usually the "reference channels" to which the volume of other channels are adjusted.

Ad insertion channels are prime candidates for program audio level control. The same ad videotape will play back at differing loudness on different VCRs and obviously tapes recorded at different times and locations also vary in volume.

All of these combinations tend to be different from the preceeding program material. All channels carrying local advertising should be equipped with audio ALC systems between the ad-insert equipment and the TV modulator (not just within the ad-insert equipment).

Program switching between different sources very often results in severe volume changes. An audio ALC system should be placed between the program switches and the TV modulator.

Local origination audio is very diffi-

By Frank F. McClatchie, FM Systems Inc.

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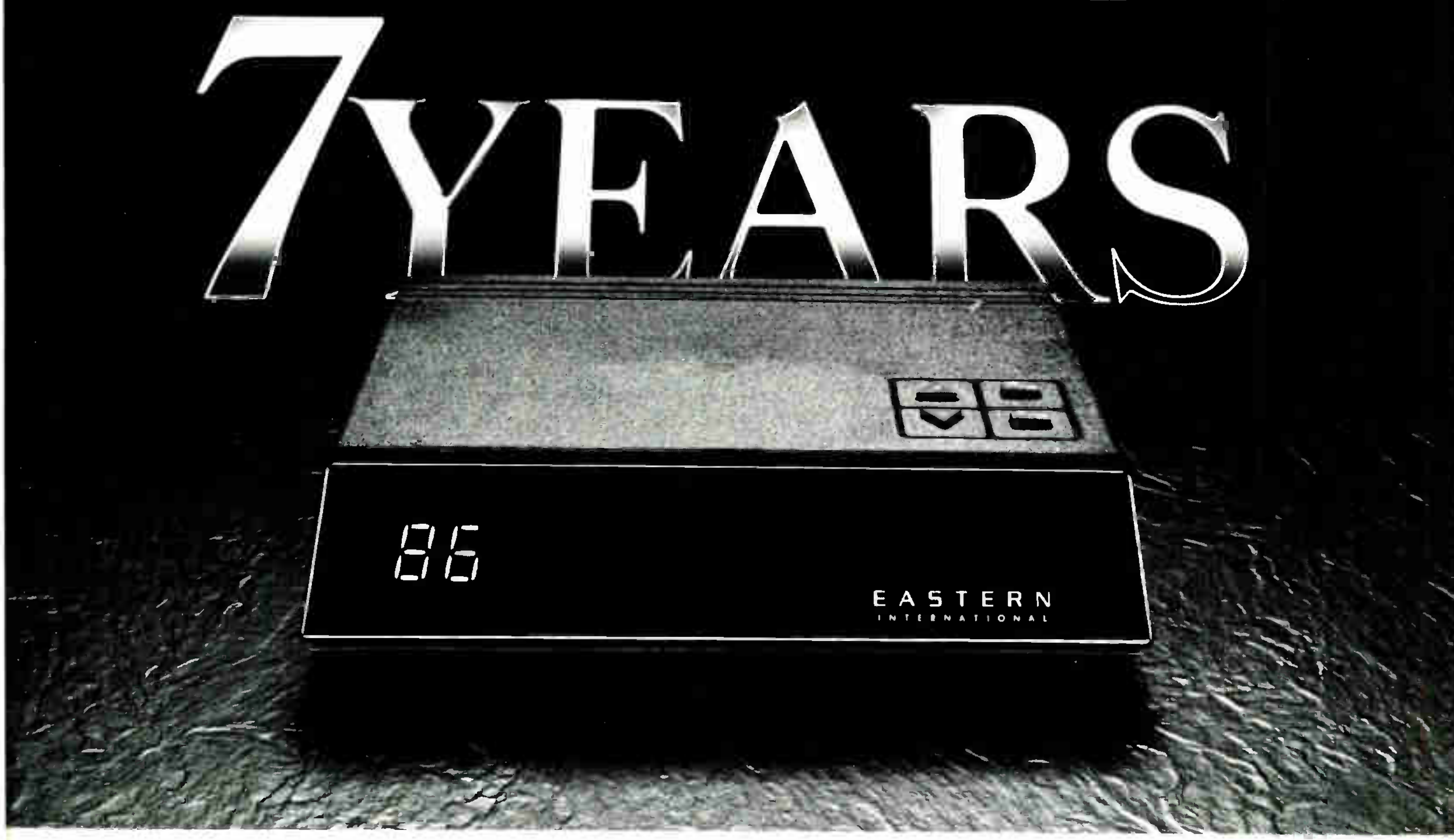

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cult to control and usually requires an operator, but he or she is busy enough with the video, so often the audio volume changes more than it should. An automatic audio ALC system would exert this control and thus keep this channel under control.

In addition to the preceeding group of channels that are on the "must control" list, you may find that some other program sources should be added to the "controlled" list.

The conundrum

Now, if we are to placate the subscriber, we must either re-process all incoming audio to the same peak factor and so have equal loudness, and equal audio deviation, or we can accept audio as we find it, but set the audio volume to be constant between channels and let the deviation fall where it may (within reasonable limits). Since the cable operator is not constrained by the FCC in the same way that a broadcaster is, the cable operator can adjust his deviation over ±25 kHz for underprocessed audio and under ±25 kHz for aggressively processed audio.

The "old-fashioned way" to set equal loudness is to let your ear decide by switching between channels. This is very time consuming and pretty frustrating because the ear has very poor loudness memory. The ear is pretty good for comparing on an A/B basis, but since the two programs are not necessarily at 100 percent modulation at the same time, much time is lost waiting for volume peaks on both in quick succession.

As we have already seen, neither peak deviation (as measured on a storage spectrum analyzer), or peak voltage measurement (as measured by "peak flashers" or peak reading voltmeters) will measure comparative loudness between audio waveforms of differing peak factors. The only measurement that comes close to the human ear perception of volume is the RMS measurement. An ordinary RMS reading voltmeter will do this, but it still requires considerable interpretive skill to read, since the operator must establish just what "peaks" to read. If it is an analog meter, this difficulty is compounded by the mechanical time constants and dynamics of the meter. If it is digital, reading the flickering numbers is literally impossible. The RMS reading meter must record and store the highest RMS reading over the testing interval to be practical, for it is the highest (or 100 percent modulation level) that should be recorded, not some lower intermediate level that may be on part of the time.

It does little good to measure the audio going into the TV audio modulator even with the digital RMS storage meter that was just postulated. To compare one channel with another, the digital RMS storage meter should be connected to the audio output of a TV tuner. Such a meter is available today[1]. It is called the ADM-1.

Keeping loudness constant

Now that we know how to equalize the volume on the channels that we can control, how can we keep them from changing during ad inserts, program source switching, and other sources of volume changes? The answer is automatic audio level control applied between the audio source (such as the satellite receiver) and the TV audio modulator. This requirement is especially acute on the new BTSC stereo modulators, some of which have an audio control system built-in. A number of audio automatic level control systems (ALC) are available today from such manufacturers as Circuit Research Labs, Leaming Industries, FM Systems Inc., Aphex Systems Inc., Orban and Scientific-Atlanta. Some are elemental in operation, while some are quite sophisticated. Just what can a sophisticated ALC do that it's more elemental brothers cannot do? Why buy the fancy model?

Audio ALC systems range from simple automatic variable gain devices to complex systems that control the gain in such a way that the listener is not aware that control is being exerted.

The simple ALC control system will maintain a constant audio output, but with certain rather obvious "control artifacts" such as:

1. "Noise pumping." This is heard as a rushing hissing noise gradually increasing and decreasing in amplitude as the program volume changes. This hiss can be really objectionable during long pauses between normal program levels.

2. "Ducking." The sudden reduction of ordinary background sound following a sudden loud sound, such as a gun shot.

3. "Program pumping." This is caused when intermittent high level low frequencies such as bass drums or other low frequency pulsing sounds modulates the volume of mid- and high-frequency sounds. This can be particularly noticeable and objectionable on certain program content.

Sophisticated ALC systems

These more complex ALC systems deal with these control artifacts with varying degrees of success. The best of them give no audible clue to their operation, except that the audio level stays substantially constant over a wide range of input levels. Characteristics to look for when searching for a very good audio ALC:

1. "Gating." A good gating system will prevent noise pumping. The gate locks the gain setting upon a sudden reduction of audio level, like a pause in speech. A good gate will not permit the gain to change until program audio returns. Since the gain is prevented from increasing during pauses, noise cannot be pumped up.

2. "Program-dependent gain control." This feature, when properly implemented, will prevent ducking. Sudden very loud noises will not change system gain, while longer term loud passages will exert gain reduction to maintain a constant output level.

3. "Dual-band control." By splitting the audio band into two parts, the low frequencies can be separately controlled from the high band, therefore intermittant high level low frequencies cannot modulate the volume of the higher audio frequencies, thus preventing program pumping.

Artful implementation of these three aspects of the automatic level control system can control audio level to very close tolerances even with input level variations of 30 dB, and do so with no perception on the part of the subscriber that any control is being exerted. In effect, a very good ALC system acts just like a tireless professional audio operator on the job.

Over the years, TV audio has almost been a "necessary evil": Necessary for obvious reasons, and evil because really good control systems were absent and there were many other more pressing problems to solve. Cable has grown and with that, subscriber expectation of professional grade video and audio. ■

Negative trapping for pay-TV security

When all channels are transmitted from the headend in watchable condition (none encoded or scrambled) negative trapping at the individual subscriber's drop is necessary if he is not paying for premium reception. An appropriate trap or filter is installed in an unaccessible location, usually at the line tap-off, to block the premium channel to unpaid subscribers. The term "negative" is an economic one: we're investing in equipment for which there is no revenue return from that particular subscriber. (Next month we'll discuss "positive" trapping, for which income is proportional to equipment investment).

Types of negative filters

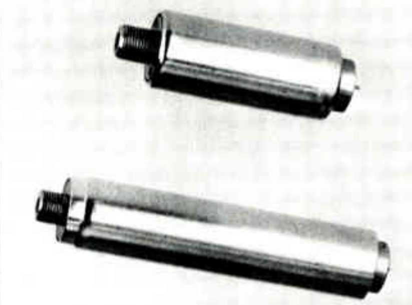
When the CATV system offers only one premium channel, the natural filter choice is the video carrier trap, more commonly called the negative trap. It suppresses the premium carrier video channel 60 dB or more with some impact on lower, adjacent sound. When there is more than one premium channel offered and the customer has a "cherry picking" choice of premium channels, the economic choice is often a "screw together" of the appropriate negative traps. If only a few premium channels are being offered, they are the lowest cost filters available and are readily locked together in desired combinations either by the user or the trap manufacturer.

Tiering filters

Whenever the number of premium channels exceeds about four, the long "stick" of negative traps becomes cumbersome and other types of filters, often called tiering filters, come into use.

These suppress a number of contiguous channels. Figure 1 illustrates the response of the types of tiering filters in common use. Note that tiering filters require a "guard band"—a transition zone equal to one or more channel widths between the "trapped out" and "good transmission" regions. Since channels in the guard band suffer considerable attenuation, but not enough for hard security, they cannot be utilized as either premium or as quality basic channels. This fact must be taken into account when employing them in the overall trapping strategy. The most frequently employed tiering filters, and therefore, the most readily available are:

Figure 1



5KV-7 Frequency Response

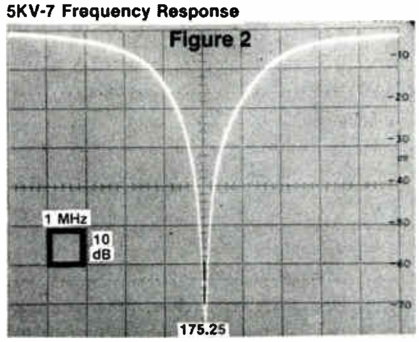
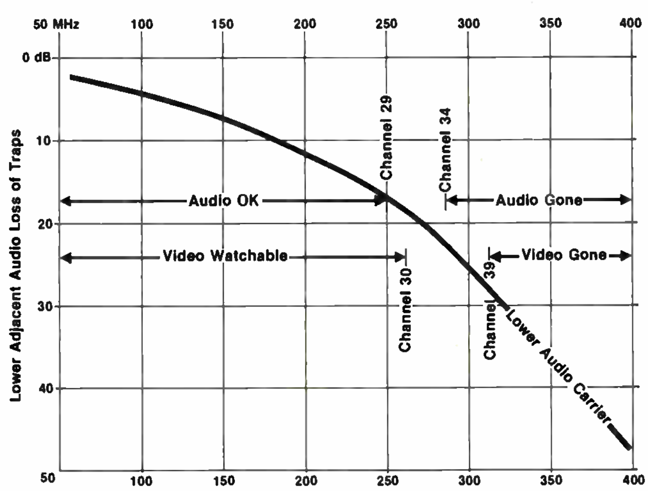


Figure 3
Effect On Lower Audio Loss Due To Video Trapping



- **The low band lowpass filter** suppresses channels 2 through 6 and most models pass channels A through 2 (108 MHz to 114 MHz) through hyperband channel 62 (444 MHz to 450 MHz). The guard band is the lower half of the FM band, which is usable with this filter in place. This filter is often used when all premium channels are placed in the low band and offered on an "all-or-none" basis or the low band channels are offered as one option in a more complex tiering structure.
- **The superband suppression lowpass filter** suppresses the super and hyperband and allow quality transmission of all channels at and below 13 (210 MHz to 216 MHz). For most standard models, guard band channels are 22 and 23 (216 MHz to 228 MHz). This filter is often used when all premium channels are placed in super-hyper bands or these channels are offered as one option of a more complex .
- **The midband trap** usually suppresses channel A video to channel H video (121.25 MHz to 163.25 MHz) with channel I(22) as the guard band. This is used for the midband premium option in systems with converters where all premium channels are grouped in the midband and sold on an "all-or-none" basis. Special versions of this type of filter can sometimes be found which trap fewer than eight contiguous channels. These become more difficult to build as the number of contiguous channels is reduced, and for four channels or less, economics often favor "screw-together" of low cost negative video traps. ■

By Glyn Bostick, President, and Bob Portmess, Microwave Filter Co. Inc.

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901 South Avenue
Horseheads, NY 14845
PERSONNEL: Barry Cokely, Operations Manager; Leonard DeRenzo, Director of Sales; Ken Wood, Director of Product Development
DESCRIPTION: LRC Electronics, Inc. is a major supplier of coaxial cable connectors, traps and RF leakage detectors.

Eagle Comtronics, Inc. . . . .(315) 622-3402
(800) 448-7474
4562 Waterhouse Road
Clay, NY 13041
PERSONNEL: Alan Devendorf, President; Joseph Ostuni, VP/Sales & Marketing; Chester Syp, National Sales Manager
DESCRIPTION: Super traps, decoding filters taps, addressable and programmable descramblers, converters.

GAMCO INDUSTRIES INC.

Gamco Industries . .(201) 381-0700
19 Walnut St.
Clark, NJ 07066
PERSONNEL: Fred Whiting, Executive Vice President; Shelia O'Sullivan, VP-Sales & Marketing; Carmine Amatucci, National Sales Manager.
DESCRIPTION: Manufacture passive and active line equipment: line extenders, channel droppers, subscriber traps, passive line and trunk amplifiers, full line of drop material.

Intercept Corp. . . . .(201) 279-2544
85 5th Avenue, Building #16
Paterson, NJ 07524
PERSONNEL: George Adbelmessieh, President; Peter Parikh, Executive V.P..
SALES OFFICE:
Intercept Sales . . . .(201) 446-1010
Wats (National) . . . .(800) 338-8727
Gedi Corporate Park
Englishtown, NJ 07726
DESCRIPTION: Engineers and manufacturers of pay-TV security traps, super traps, tier and multi-channel traps, scramblers, filters, keylock, converters, pedestals, directional taps, subscriber drop passives and cable speciality products.

Northern catv sales, inc.

Northern CATV Sales, Inc. . . . .(315) 426-1455
Wats National . . . .(800) 448-1655
P.O. Box 6729
Syracuse, NY 13217
PERSONNEL: Greg Tresness, Manager Tech Sales; Ed Manley, New Products Manager
DESCRIPTION: Distributor of CATV products, ARCOM traps and accessories.

PDI Passive Devices Inc.

Passive Devices, Inc. .(305) 493-5000
5149 N.E. 12th Avenue
Ft. Lauderdale, FL 33334
PERSONNEL: Donald Edelman, President; Barbara Edelman, VP/Finance; David Green, Sales Manager; Mike Odelman, Technical Sales Rep.
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DESCRIPTION: Pico Products, Inc. manufactures and markets a complete line of system components for CATV, SMATV and MATV including security devices, modulators, single channel amplifiers, channel converters, wall taps, pre-amps, and complete headends for TV signal distribution in CATV, SMATV and STV.

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SCTE

November 1 *Cascade Range Chapter* will meet to discuss video and audio signals and systems and transportation systems at the Holiday Inn in Wilsonville, Ore. Speakers will include Norrie Bush of Columbia Cable and Warren Beals of Tektronix. Call Norrie Bush, (206) 254-3228, for information.

November 2 *Appalachian Mid-Atlantic Meeting Group* will gather. Call Ron Mountain, (717) 684-2878, for info on meeting place and subject matter.

November 5 *Golden Gate Chapter* will administer BCT/E exams at the Viacom facility in Pleasanton, Calif. Call Tom Elliot, (408) 727-5295, for info.

November 8 *Central Illinois Meeting Group* will meet at the Sheraton Inn in Normal, Ill. to administer BCT/E exams in categories V and VI. Call Tony Lasher, (217) 784-5518, for details.

November 10 *Upstate New York Meeting Group* will gather at the Burgandy Basin Inn in Rochester, N.Y. to discuss video and audio signals and systems. Guest speaker will be Paul Beeman of Viacom Networks. Call Ed Pickett, (716) 325-1111.

November 13-14 *Old Dominion Chapter* will host a technical seminar at the Holiday Inn in Richmond, Va. Call Margaret Harvey, (703) 248-3400, for more info.

November 14-16 *SCTE National Headquarters* will host a technical training seminar at the Luxbury Hotel in Charlotte, N.C. The topic will be "Technology for technicians" and will be conducted by SCTE Director of Chapter Development and Training Ralph Haimowitz. The three-day seminar is designed for installer-technicians, field supervisors and service techs and will cover customer relations, safety, installation materials, cable and connectors, standard house drop procedures, customer education, testing and troubleshooting. Call the SCTE, (215) 363-6888 for info.

November 15 *Chesapeake Meeting Group* will host a technical seminar at the Holiday Inn in Columbia, Md. The seminar will feature BCT/E testing in categories I, II, III and IV. Call Thomas Gorman, (301) 252-1012, for more information.

November 16 *North Central Texas Chapter* will host a technical seminar on fiber optics, with representatives from Anixter and AT&T. Location will be given later. Call Vern Kahler, (817) 265-7766, for details.

November 16 *Razorback Chapter* will meet to discuss CLI at the Days Inn in Little Rock. Featured speaker will be Don Runzo of ComSonics. Call Jim Dickerson, (501) 777-4684.

November 16 *Mount Rainier Meeting Group* will administer BCT/E exams at Martha Lake Community Center in Seattle. Call Russ Eldore, (206) 251-6760, for info.

November 29 Satellite Tele-Seminar Program. *"SCTE Installer Certification Program Workshop"* featuring SCTE Director of Chapter Development and Training Ralph Haimowitz. Taped at Cable-Tec Expo '88 in San Francisco. the program will air from noon to 1 p.m. ET on Transponder 7 of Satcom F3R.

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The Magnavox Mobile Training Center seminars combine instruction in theory and practical hands-on training, using common gear and test equipment.

November 9-11 and 15-17 *Magnavox Mobile Training Center* will be in the Boston area. Call Amy Costello, (315) 682-9105 Ext. 389, to register.

November 21-23 *Mobile Training Center* will in Syracuse, N.Y. Call Amy Costello, (315) 682-9105 Ext. 389, to register or for more information.

JERROLD

November 8-10 *Jerrold Technical Seminar* will be held in Chicago at the Hyatt Lincolnwood. Call Jerry McGlinchey, (215) 674-4800 Ext. 4189 for info.

January 24-26, 1989 *Jerrold Technical Seminar* will be held at the Holiday Inn Central Park in Orlando, Fla. Call Jerry McGlinchey, (215) 674-4800 Ext. 4189 to register.

C-COR ELECTRONICS INC

November 15-17 *C-COR Electronics Technical Seminar* in New Orleans, La. Call Theresa Harshburger, (800) 233-2267 Ext. 326 to enroll or for more information.

January 24-26 *C-COR Electronics Technical Seminar* will be held in Los Angeles. Call Theresa Harshburger, (800) 233-2267 Ext. 326.

Illinois Bell
AN AMERITECH COMPANY

November 15-17 *Illinois Bell* will host a seminar in Westmont Ill. on fiber optic communications systems for the local loop. The course costs $775, including lunches, refreshments and all course materials. Call (312) 655-3096 for information.

December 6-8 *Illinois Bell* will again offer the course on fiber optic communication systems for the local loop, in Orlando, Fla. Call (312) 655-3096 to register.

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Growing national telecommunications company is seeking two highly qualified individuals with a strong technical background in CATV. Must be self-motivated, capable of troubleshooting and correcting headend, satellite receiving, and distribution problems. Must have headend and system design, activation, and proofing experience. Position will require relocation and extensive travel.

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INFORMATION SYSTEMS & NETWORKS CORPORATION, seeks an experienced RF maintenance and alignment technician for a permanent position in Newport, RI. Applicants must be totally familiar with single cable, bi-directional rf distribution systems, headend configuration, design, systems balance, sweep and proof of performance testing. A strong knowledge of data transmission is also desired.

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Reader Service Number 60

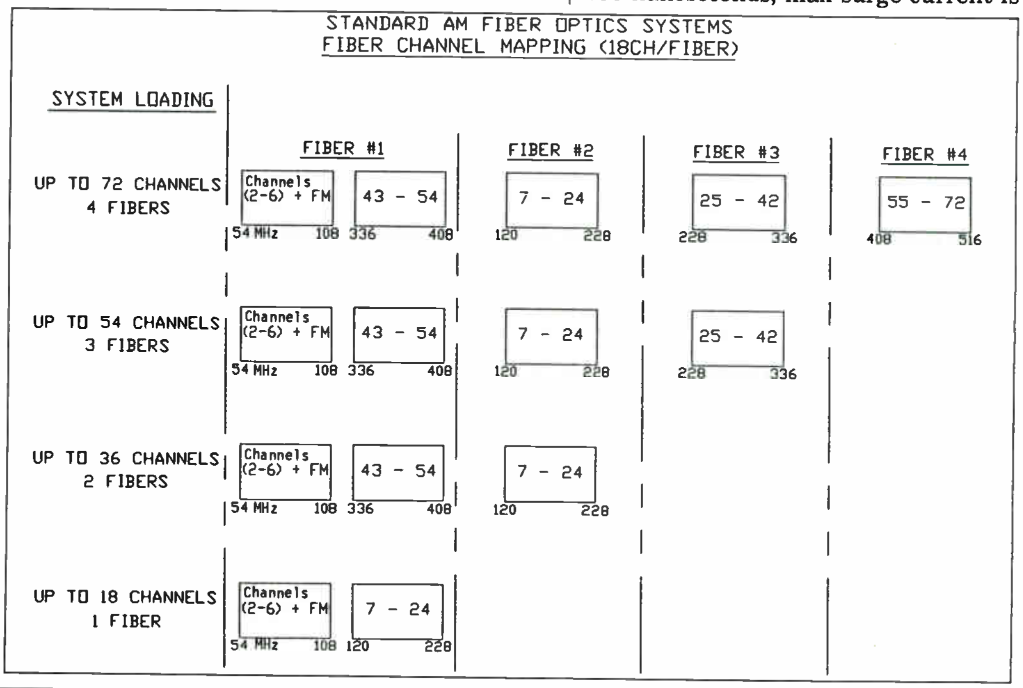
Catel announces price break for new AM fiber equipment

Things are moving so fast in the fiber optic industry, everyone needs to hold on to their hats. **Catel Telecommunications** announced a new, lower pricing schedule for its AM products.

The new TransHub III fiber system, which delivers 54 channels of video over three fibers, can be purchased for $30,000 (in volume). Dr. James Hood, president of Catel, said a two-hub configuration is also available, for a cost of $22,500 per hub.

The three-fiber configuration is necessary in order to defeat the second-order beat products that have become the limiting factor in AM systems, says Hood (see channel-loading chart).

A new RF voltage protection device has been developed by **Passive Devices Inc.** The Surgender (patent pending) has been designed to protect headend equipment, television receivers, VCRs, home entertainment centers and LANs from local lightning strikes. Attack time is 100 nanoseconds, max surge current is



5,000 amps and surge life is 200 surges of 500 amps. For details, call (305) 493-5000.

Cable systems plagued by a high number of subscriber no-shows during installs and other service calls might find some relief with **Telecorp Systems'** System 606 autodialing computer. The unit establishes initial contact, asks questions or delivers notices in a human voice and stores responses and follow-up, if necessary.

The System 606 requires only a single phone line and standard RJ-11 telephone jack and power outlet. The software allows the system to make up to 25,000 calls per month, according to Telecorp Systems. The system will interface with major billing systems, including CableData, CableTek, Toner, FDR and CMS. Call (404) 449-6991.

Two new indoor amplifiers and a line of new low-cost CATV headend systems have been developed by **Blonder-Tongue Laboratories.** The new amplifiers—the BIDA 300-30 and BIDA 450-30— are designed for signal distribution systems that use a cable drop as a signal source. They can also be used as postamplifiers for headends using passive combiners.

The new headend systems feature B-T's new ESHP A/V SAW-filtered channel processor and an improved ESHM-C modulator. Both units offer a 60 dBmV ouput level and provide for in-field channel conversions. Call (201) 679-4000 for information.

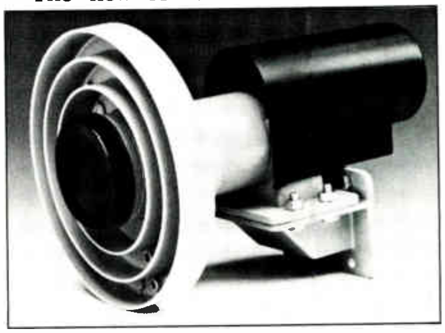
A new video sequencing device has been developed by **Multiplex Technology**. The Channelplus Genswitch Model GEN-SWI allows any of the company's Genlock message generators to be shared by up to eight video sources. Therefore, users of Genlock devices can now send messages to multiple video sources.

The device was designed with SMATV operators in mind. For example, hotels can send special messages to its guests on up to eight separate channels sequentially. After the message is entered into the generator, the user sets the timer to show how many video sources will carry the message. The system does the rest. Call (714) 680-5848.

Several new products, including new antennas, antenna positioner, and feedhorn have been introduced by **Channel Master**.

The new Extruded "T-Lock" Plus perforated antenna and EconoQuad mesh antenna are C-/Ku-band and Ku-band antennas, respectively. Both offer four-piece aluminum construction and weather-resistant black powder coat paint.

The new Allsat horizon-to-horizon antenna positioner features a compact gearbox assembly and tracks a full 180-degree arc to locate any geostationary satellite in operation. Excellent return accuracy allows tuning of 2-degree spaced satellites plus narrow-beamwidth Ku birds, says the company. It is compatible with all receivers using Reed Sensor or Potentiometer-type antenna position sensing.



Channel Master® Polarizer Plus Model 6785 C-Band Feed

Finally, a new Polarizer Plus C-band feed has been added to the Channel

Master lineup. Model 6785 adapts to any dish and attaches to both button-hook or multi-leg feed suppports. For information about any of the above products, call (919) 934-9711.

A new solid state protector designed to improve the quality and reliability of CATV networks has been developed by **GTE**. The Smart Breaker is a combination bimetallic and solid state protector designed safeguard networks from transient spikes and blown fuses.

After the breaker opens and protects the circuit from damage, the Smart Breaker will reset itself and restore service automatically. If the overload persists, the Smart Breaker will switch from an "automatic cycling" mode to a "hold open" mode. The breaker can then be reset manually. For details, call (207) 642-4535.

A new satellite signal processor designed to make multiple commercial receiver hookups simpler and more reliable has been introduced by **Pico Macom**.

The SSP-10 amplifies incoming satellite signals in the 950 MHz to 1450 MHz range and directs them to five vertical and five horizontal outputs. The unit is 1¾ inches high and rack mounts in a standard 19-inch case.

Features include a primary power supply that powers both horizontal and vertical LNBs and a second standby supply that automatically kicks in if the primary supply fails. A voltage boost feature allows LNB voltage to be increased 2 volts for long-distance LNB applications. Call (818) 897-0028.

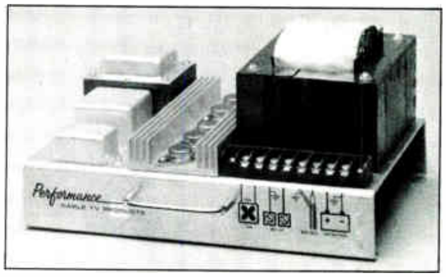
Viewsonics has introduced a new line of test equipment, including return loss bridges, RF terminations, mismatch standards, impedence transformers and RF detectors.

The return loss bridge features a 5 MHz to 600 MHz frequency range, 75-ohm impedence, directivity of 40 dB, bridge loss of 12.5 dB and short-open error of 1 dB maximum. The bridge comes with an RF termination for $100 each.

The termination device has a DC to 600 MHz frequency and return loss of 40 dB minimum and is priced at $15 each. The mismatch standard offers DC to 600 MHz frequency range, mismatach values of 15 dB, 18 dB, 20 dB, 25 dB and 30 dB and flatness of ±0.1 dB. They are likewise priced at $15 each.

The new "Speedy 30" has a 30 dB insertion loss and is priced at $4.40 each; the impedence transformer offers a 0.2 dB maximum insertion loss and is priced at $15; the RF detector features 22 dB return loss, 3-volt maximum inputm positive output polarity and frequency response of ±0.5 dB. It is also priced at $15. Call (800) 645-7600.

Performance Cable TV Products now offers the Model SB840A standby power supply, which has been designed to offer necessary backup for cable systems using feedforward, power doubling and other advanced amplifier designs.



Performance Cable TV Product's Model SB840A

The unit is compatible with most existing 60-volt ferroresonant power supplies. Output is 60V RMS with a current rating of 14 amperes. The 23-pound unit has a base measurement of 11 inches by 7 inches and is 6 inches high. It is designed to retrofit existing equipment. For details, call (404) 443-2788.

New people

Tony Weschselberger has been named senior vice president, domestic operations for **Oak Communications Inc.** Wechselberger, formerly VP of engineering for Oak will now be responsible for all marketing and sales activities, customer services and technical operations.

William Ross has been named VP of CATV at **AM Communications.** Ross is a 25-year CATV veteran and returns to AM after being employed elsewhere. ■

My Turn

Continued from page 14

nals to NTSC format.

Simulcast compatibility could present a challenge for cable TV. The extreme situation, requiring 12 MHz for each program carried, is not likely to occur, because of the dynamics. At one end of the transition period, ATV channels will not be added to all satellite relays and terrestrial broadcasting stations initially, nor at the same time. In fact, some program providers may choose not to change over to ATV at all. At the other end, cable TV may even discontinue NTSC transmission long before the broadcasters do, relying on transcoders where necessary to satisfy NTSC customers.

While channels 3 and 4 may be allotted for transmissions using low-power QUAM in many markets, they are not likely to interfere with the converter output channel, if Zenith's co-channel interference projections are confirmed.

Questions abound

There are a number of legitimate questions about the Zenith proposal that need to be tested under field conditions. Zenith speaks of "robustness" in terms only of immunity from external sources of interference. However, both the encoder and decoder involve several high precision processes. We need to find out whether such precision can be achieved and maintained at realistic cost. Cable TV will need to install specially designed ATV processors, demodulators. The Zenith HDTV signal will necessarily be processed and re-processed many times, in off-air heterodyne processor, satellite FM receivers, modulators, set-top converters, and VCR receiver/demodulator/modulator equipment.

Nevertheless, by proposing a totally new transmission system, operated at greatly reduced peak power, Zenith has significantly advanced the prospects for a truly HDTV system. Attempting to force direct compatibility necessarily requires compromises. Without the constraints imposed by the 50-year-old, antique NTSC vestigial sideband transmission system, the Zenith encoding/decoding technique could be expanded later to even higher performance approaching the theoretical limits of human vision. ■

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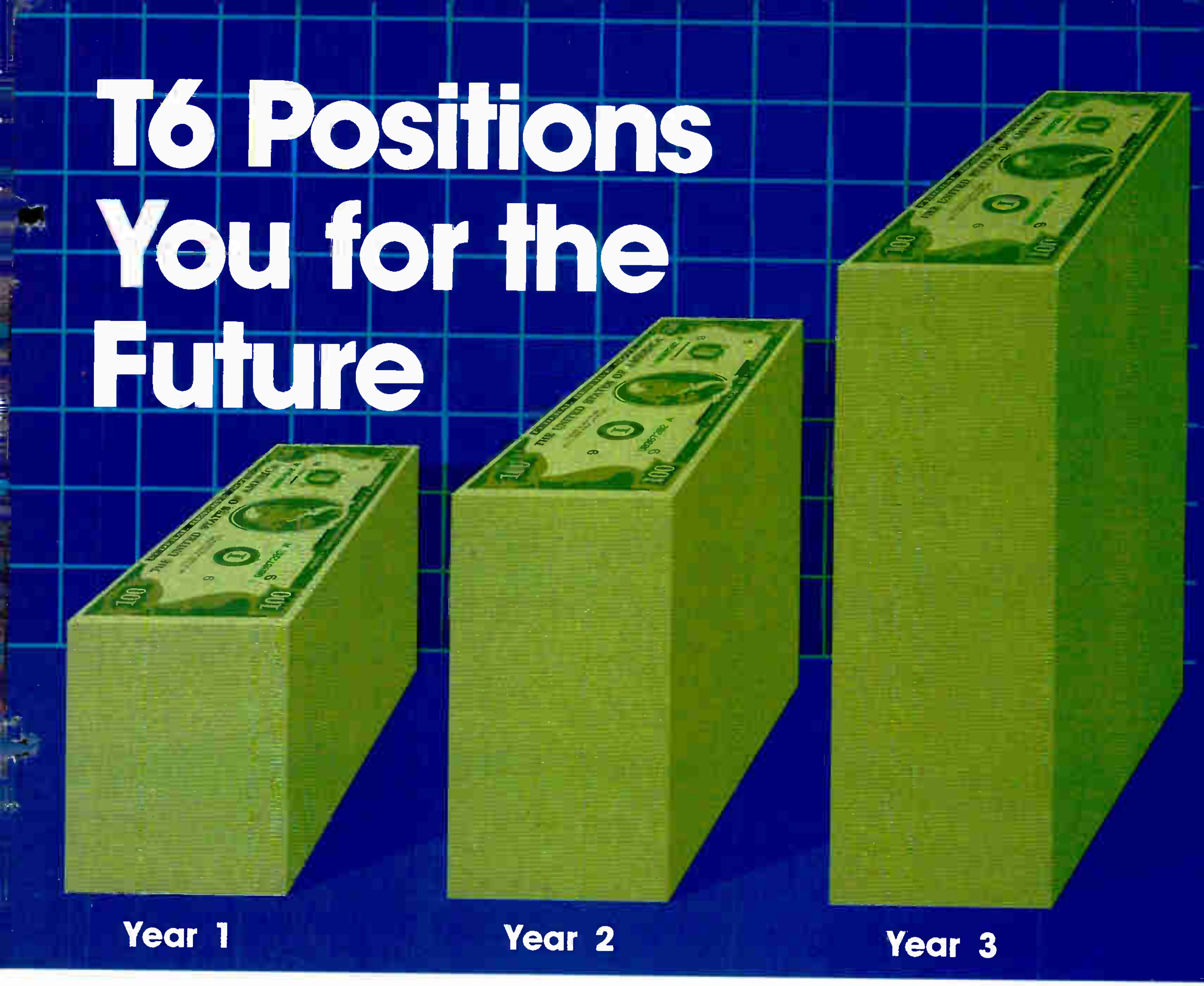

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