CED

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THE MAGAZINE OF BROADBAND TECHNOLOGY / NOVEMBER 1989

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Technical standards— Are they good or bad?

Construction forecast: Sunny skies, hot temps

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November 1989

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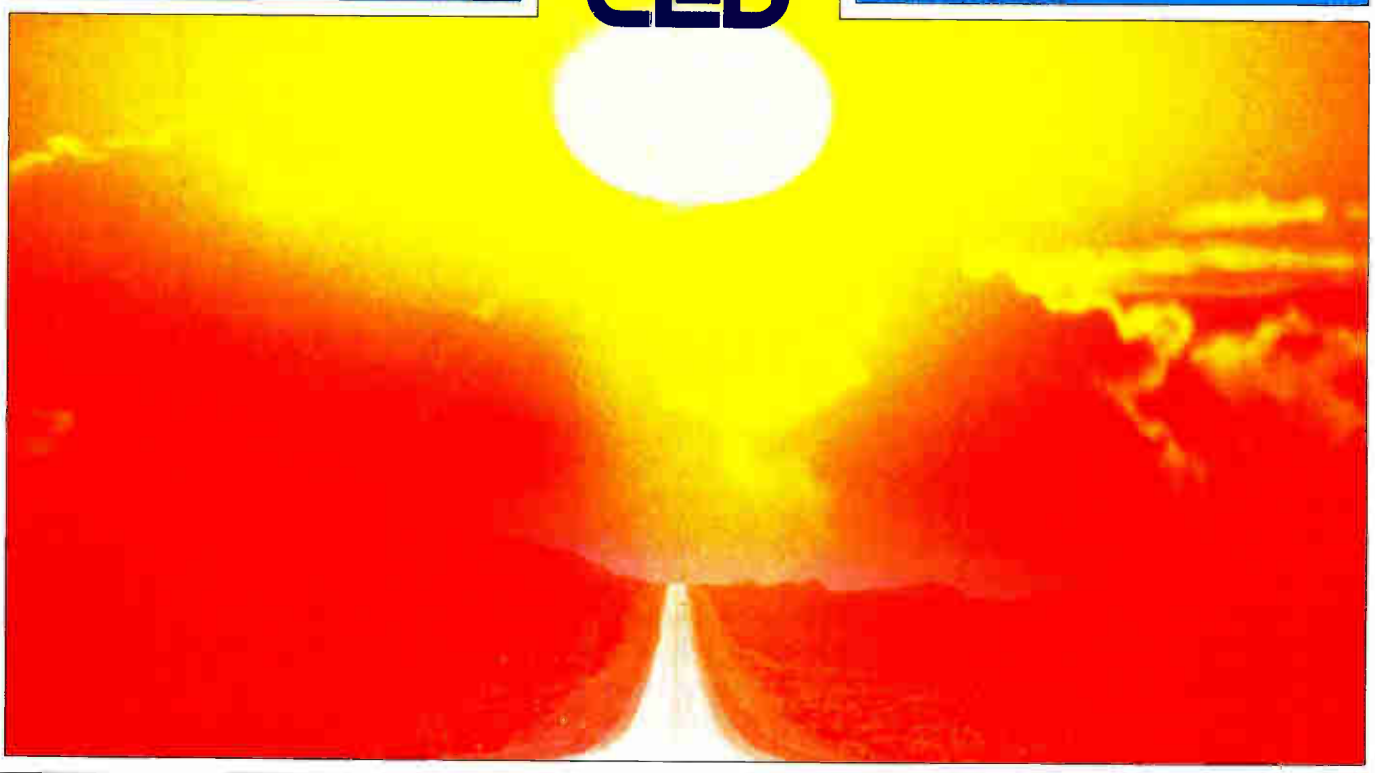
Volume 15, Number 12



About the Cover:
The future looks bright for the CATV industry's long-term construction activity as it heads into the next decade. What is anticipated for 1990 and beyond is the focus of this feature story on page 24.

CLI COMPLIANCE

Eliminate corrosion at the drop. See page 74.

DEPARTMENTS

CED. (USPS 330-510) (ISSN 1044-2871) is published monthly except twice in May by International Thomson Communications Inc., 600 S. Cherry St., Denver, CO 80222. ©November 1989, Volume 15, Number 12. Subscriptions free to qualified industry readers. All other one-year subscriptions are $36, prepaid in U.S. funds only. Second-class postage paid at Denver, CO. and additional mailing offices. CED is published on behalf of the cable television and broadband communications industries. POSTMASTER: Please send address changes to CED Circulation, 600 S. Cherry St., Suite 400, Denver, CO 80222. MEMBERS OF THE BPA.

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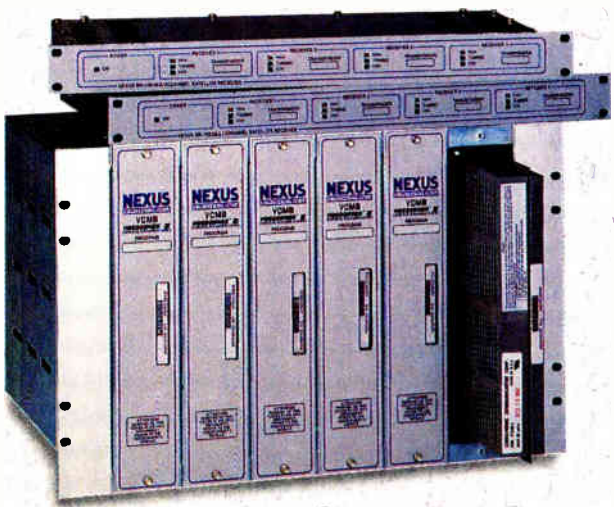

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Reader Service Number 3

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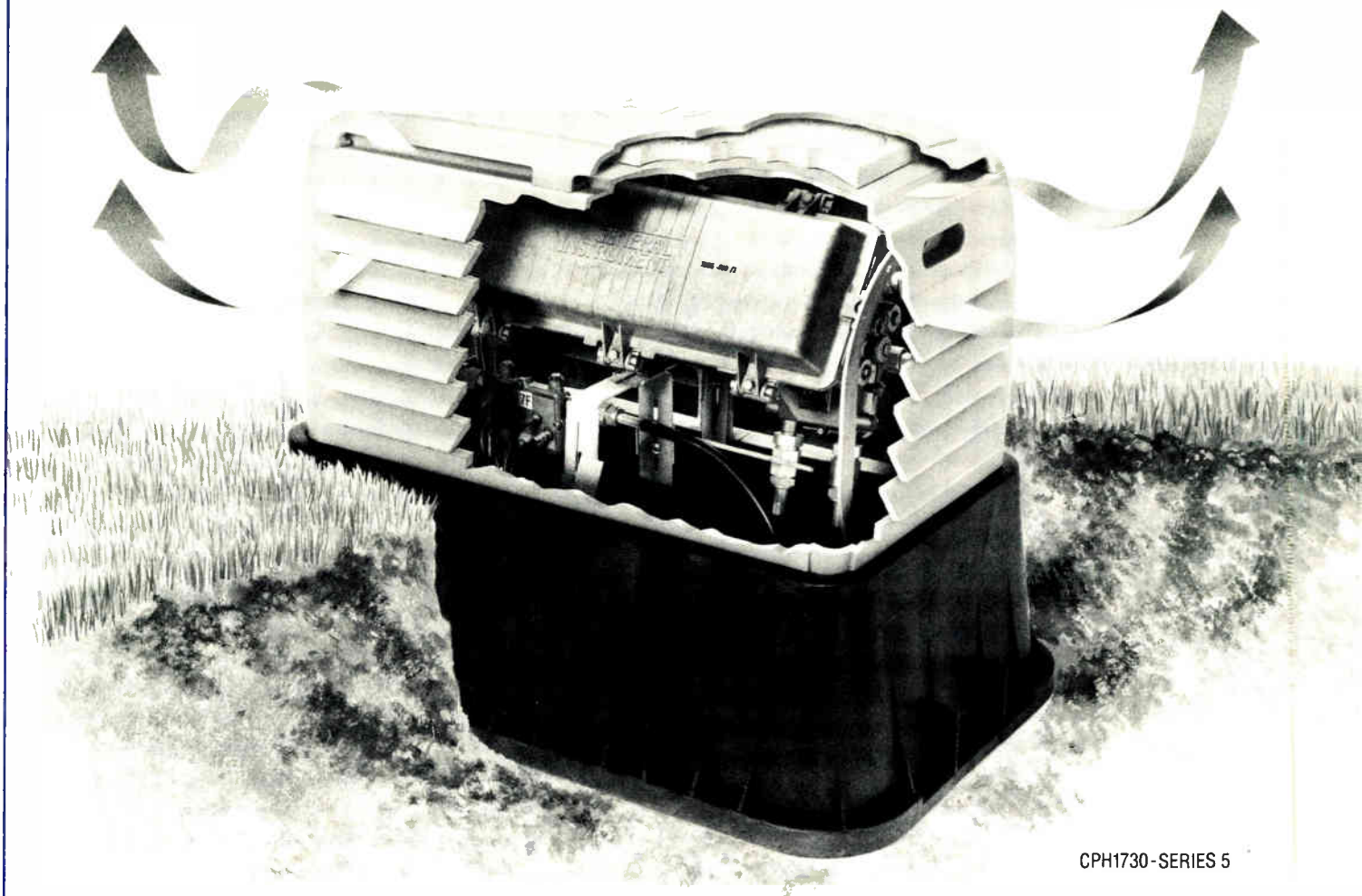

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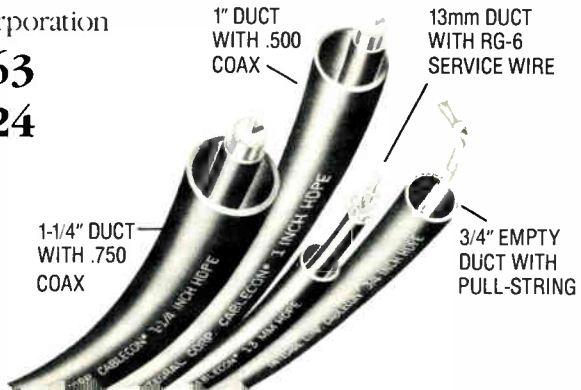

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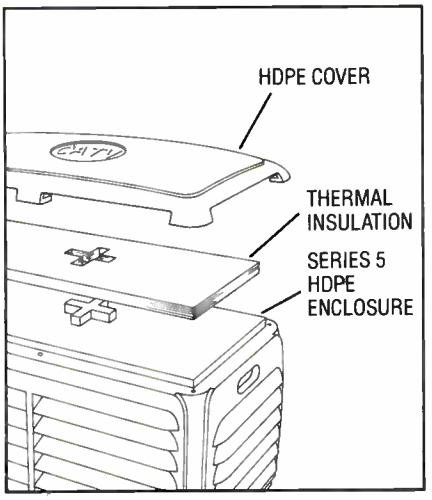

in your amplifiers, especially on the IC boards and power supplies. Independent field testing of "HDC" covers against competitive metal enclosures indicates this percentage could be even higher, depending upon the size of metal enclosure used in relationship to the amount of active and passive equipment spliced in it.

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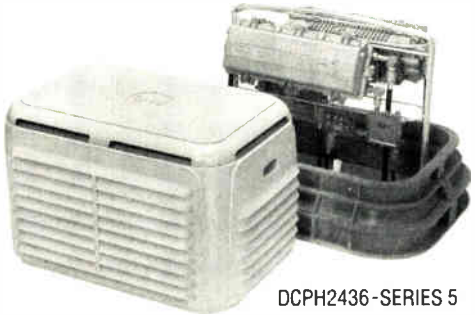

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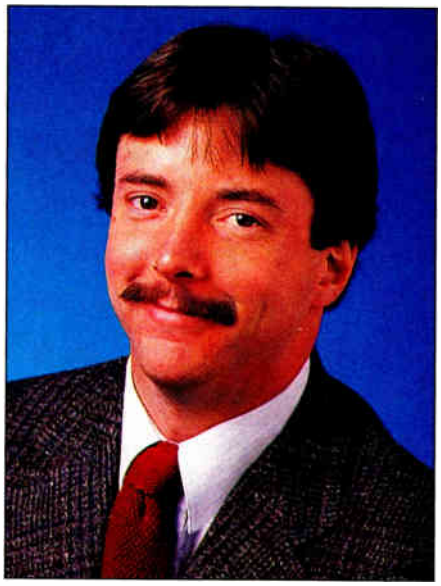
Reader Service Number 4

See us at the Western Show, Booth #1129.

Now we're finally getting somewhere

The possibility that actual testing of true advanced television hardware will in fact eventually take place was given a major jump start by two separate announcements that took place in October.

The first, and probably most important, was the establishment of an actual testing timetable by the FCC's Advisory Committee on Advanced Television Service. The schedule calls *for* testing to be kicked off by Faroudja in June 1990 and ceasing with the MIT system in September 1991. Richard Wiley, chairman of the committee, was true to his intention to get the ball rolling. He has set a tight agenda (see Color Bursts on page 12 for details); each proponent will have 10 days to move hardware into the Advanced Television Test Center facility, followed by 30 days of testing and five days to move it all out again.



One of those proponents will certainly be Zenith Electronics Corp., which will be able to infuse millions of much-needed dollars into its research and development program via the proceeds of the sale of its computer business to a French firm. Zenith, which has been struggling to keep itself profitable in the thin-margin world of consumer electronics, is expected to inject the majority of the sale receipts (estimated to be roughly $20 million, after taxes) and some additional money garnered through loans into its Spectrum Compatible HDTV research. Considering the lead that NHK already enjoys and the millions needed to see a system come to fruition, Zenith now seemingly stands poised to make a run at being named the North American standard.

Zenith wasn't the only one to receive a financial windfall, however. Faroudja Labs, creator of the NTSC-compatible SuperNTSC enhanced television system, is being funded through the testing process by no fewer than nine companies representing a wide cross-section of support: broadcasters, cable operators and equipment manufacturers (see Color Bursts, page 12). This kind of support will go a long way toward making something happen on the testing front.

Wiley's hard-nosed approach toward setting up the testing schedule should be lauded by all those who want to see advanced television become a reality. Critics will say that forcing proponents to test equipment before they are ready will ultimately result in the selection of a potentially inferior technology as a standard. However, that happened with NTSC—and look how far it brought us.

Besides, anyone who thinks the testing will really be over by September 3, 1991 should think again. After all, the committee concedes the testing "dates are tentative" and "there may be slippage in the schedule." Count on that fact; rest assured, the committee will have to renew its charter one more time (it's set to expire in late 1991) before its job is completed.

Nevertheless, the testing schedule is set and technologists are aware of their deadlines. That's a lot more than we had a few weeks ago.

Roger J. Brown

Roger Brown
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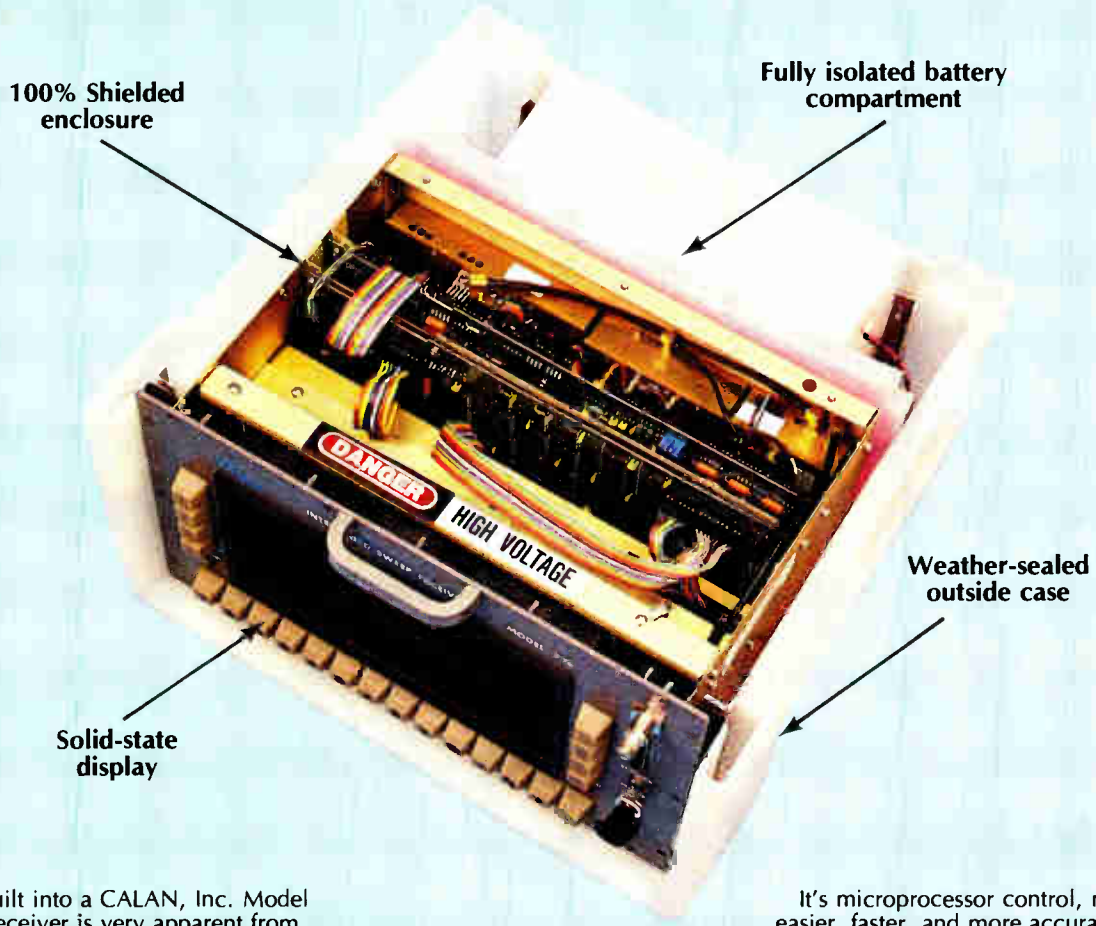

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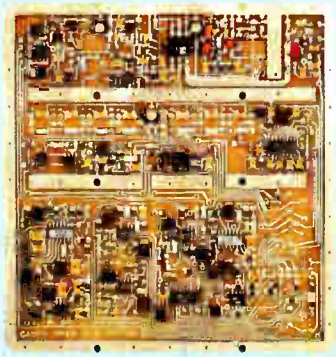

CALAN Surface-Mount RF Technology

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

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Reader Service Number 5

Advanced TV testing schedule established by committee

True to his word, Richard Wiley, chairman of the FCC's Advisory Committee on Advanced Television Service, threw down the gauntlet to the host of advanced television proponents in the form of a hard and fast testing schedule. Up first will be Faroudja and its SuperNTSC system, which will begin testing June 4, 1990 at the Advanced Television Test Center facilities in Alexandria, Va. The systems will be tested for both broadcast and cable-TV environments.

In addition to Faroudja, the testing process will include Sarnoff's ACTV-I and ACTV-II, along with PSI, NHK's MUSE 6 and Narrow MUSE, Zenith's Spectrum Compatible HDTV, Philips and MIT. Each proponent will have 10 days to move-in its equipment, 30 days devoted to testing and five days to move it all back out.

FCC Advisory Committee on Advanced Television Service

SEQUENCE & *PRO FORMA* CALENDAR

For Laboratory Testing of Proposed ATV Transmission Systems
By the Advanced Television Test Center & Cable Television Laboratories

MOVE-IN: 10 days — MOVE-OUT: 5 days

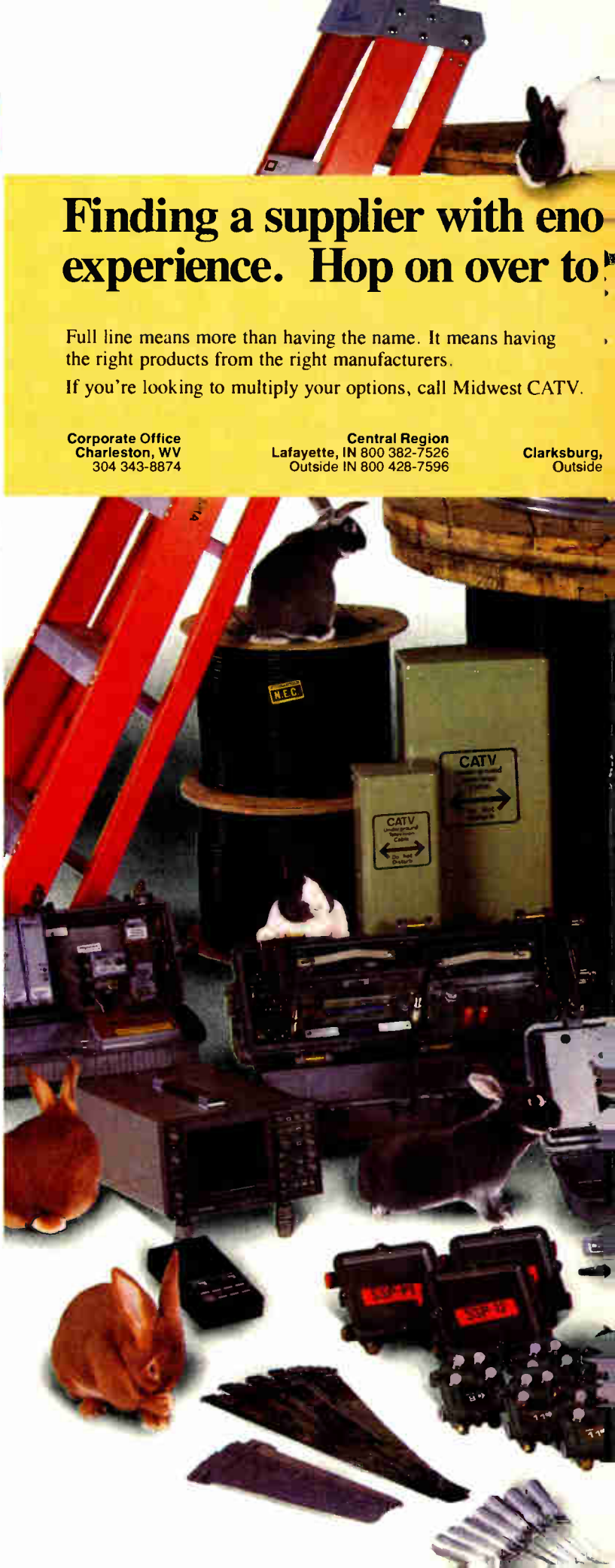
"ATV System Access Period" No.	Begin Interface Check	Begin Testing	Complete Testing	Proponent/ System
1990				
1	May 25	June 4	July 16	Faroudja
2	July 17	July 24	Sept. 4	Sarnoff (ACTV-I)
3	Sept. 5	Sept. 12	Oct. 23	PSI
4	Oct. 24	Oct. 31	Dec. 12	NHK (MUSE 6)
5	Dec. 13	Dec. 20	Feb. 8, '91	NHK (Narrow MUSE)
1991				
6	Feb. 11	Feb. 19	April 1	Zenith
7	April 2	April 9	May 20	Sarnoff (ACTV-II)
8	May 21	May 29	July 11	Philips
9	July 12	July 19	Sept. 3	MIT*

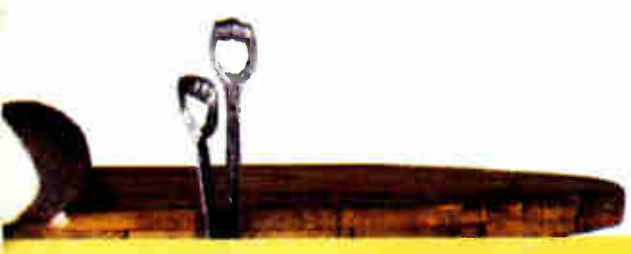
MOVE-IN: Proponent allowed to begin moving equipment into ATTC and setting up 10 days prior to INTERFACE CHECK: AC power and air conditioning systems will be in operation.
INTERFACE CHECK: Beginning on this date, ATTC prepared to supply video, audio, and data signals as previously agreed; each system allowed five days prior to testing for proponent and ATTC/CableLabs staff to verify interface parameters.
TEST PERIOD: Up to 30 working days allowed for conducting objective tests and creating the video tape record of the system's tests.
MOVE-OUT: Proponent allowed up to five working days to remove all of its equipment from ATTC.

Under its present form, the testing process will be completed September 3, 1991. However, contingencies will allow for some slippage in the schedule and most observers fully expect the testing to go on much longer, forcing the committee to renew its charter one more time. The committee's charter is presently scheduled to expire in late 1991.

The first major test for all proponents comes much sooner than next year. A $25,000 reservation fee per test slot is due in mid-November 1989, which will force financially-strapped proponents to commit scarce funds or ally themselves with one or more of the other proponents. In addition, full system descriptions must be submitted to the committee by the end of this year.

At the time the schedule was announced, NHK and North





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Reader Service Number 6

American Philips made adjustments to their HDTV plans. NHK has withdrawn its intention to test the satellite-delivered MUSE-E signal and will focus its attention on MUSE 6 and Narrow MUSE. NAP will examine a simulcast system and determine if that approach is better than its augmentation approach.

Zenith sells computer group

In an arrangement described as good for both companies, Zenith Electronics Corp. has agreed to sell its computer business to Groupe Bull of France. The exact purchase price will be determined at the closing of the deal, but company officials expect the price to be more than $600 million.

The agreement is an important step for Zenith, which has been struggling to be profitable while at the same time locked in an expensive battle to develop its Spectrum Compatible HDTV system. A portion of the net proceeds of the sale of the computer business, which is expected to top $20 million after taxes and expenses, will be directed toward the HDTV program.

At Faroudja, the news is good

Out in Sunnyvale, Calif., there was good news and bad news for Faroudja Research Enterprises, developer of the SuperNTSC enhanced-definition television system. The bad news was that it was selected to be the first proponent to be tested at the ATTC (see the above schedule). The good news was that it received broad-based financial support adequate enough to see it through the testing and product development phase.

The list of supporters is impressive: Capital Cities/ABC, Comcast Cable Communications, Continental Cablevision, General Instrument, Newhouse Broadcasting, Scientific-Atlanta, Tele-Communications Inc., Viacom International and Westinghouse Broadcasting.

SuperNTSC proposes to eliminate a significant amount of present NTSC video artifacts to display an enhanced picture. Faroudja labs, headed by inventor Yves Faroudja, would develop the system which would be compatible with present-day NTSC receivers. For full effect, the system requires the use of an encoder at the signal source and a decoder in the television. Faroudja has said he expects a decoder-equipped TV to cost perhaps $200 to $300 more than present-day sets.

The funding represents support from broadcasters as well as cable operators and cable equipment manufacturers, who envision SuperNTSC as an opportunity to at least improve television signals without investing heavily in new equipment and without obsoleting hundreds of millions of television sets. TCI, for example, proposes that the U.S. adopt SuperNTSC as a standard until a process digital transmission system can be developed in the next decade.

Cable embracing AM fiber systems

If the equipment manufacturers are to be believed, the cable industry is embracing AM fiber optic systems at a level faster than most people think. During the Atlantic Cable Show in October, Scientific-Atlanta announced that "bookings" for its AM system has already exceeded 100 orders in less than six months.

The S-A modular system, which consists of an optoelectronic transmitter utilizing a distributed feedback laser and an optoelectronic bridging amplifier, was introduced to the cable community at the Western Show in Anaheim last year. The fiber system has already been installed in ATC's Orlando system, Jones' Turnersville CAN system and Cox's Ocala system.

Anixter Cable TV announced several months ago that sales of its Laser Link product has topped 100 systems.

A novel method to get 2-way video

Cable pioneer Vic Nicholson introduced a new remote switching technology at the Atlantic Cable Show last month. Consisting of two new patents, the system, called BUSS (Bidirectional Unicable Switching System) would provide private one- and two-way channels to each cable subscriber, the ability to transmit 12-MHz signals for high quality pictures and 30 MHz of video for true HDTV, as well as a variety of other uses.

The system would utilize "inverse spectrum," which allocates the lowest frequency channel to the most distant subscriber on the feeder, thereby making amplification unnecessary. Nicholson said the addition of the cable would enable profitable rural cable system extensions into areas of 10 homes per mile.

On the hardware side, Nicholson announced that Remote Switching and Processing Converters would control the signals and provide for impulse pay-per-view, videophone and video security, among others.

Nicholson is actively seeking a manufacturer for his devices.

Eidak, TickeTV are compatible

- Two companies trying to wake pay-per-view out of the doldrums have announced that their respective technologies are compatible with one another. Eidak's Copyguard system and International Telesystems TickeTV scrambling/descrambling system have been found to work within the same environment.

TickeTV is a low-cost secure system that can bring PPV events to broadcast homes and non-addressable cable homes via a decoder at the headend and a set-top decoder costing less than $25. Eidak provides copy protection to films and events to prevent unauthorized taping of PPV programming by systematically varying the timing characteristics of video signals.

- Jerrold recently opened its Applied Media Lab to the press to show off its work on fiber optics, advanced television and digital video and audio. According to Lab director David Robinson, the company's research into digital video transmission will allow the company to decide by early next year whether it plans to build digital gear. Jerrold's research has focused on a nine-bit system, operating at 1.2 Gbps, 1.7 Gbps or 2.4 Gbps. To make such a product possible, there would have to be "dramatic breakthroughs," said Robinson.
- Midwest CATV has acquired the assets and inventory of Hudson Supply, which was unable to obtain a distribution agreement with any of the three major pole line hardware manufacturers, according to Steve Egerer, vice president and COO of Hudson, and Chris Sophinos, COO of Midwest CATV. Terms of the agreement were not disclosed, but Midwest will honor all open Hudson orders reissued to Midwest and many former Hudson personnel will continue to be employed by Midwest. ■

—Roger Brown

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Reader Service Number 7

Al Johnson

More than a technology

What is it about fiber optics that so mystifies and captures the attention of the cable industry? To many, it's a technology that promises better results for the consumer and is just that—a technology. But to others, it's something more. For Al Johnson, director of technical operations for Cablevision Systems Corp., fiber optics is a part of his day-to-day operations that has him intrigued, delighted and motivated to learn every facet possible.

"I'd really like to see fiber optics take off in this industry," says Johnson. "I think it's a great technology. It's one we should embrace and use and I want to make sure that we keep the interest of the vendors so they don't walk away from it. I'd like to be able to do whatever I can to keep that from happening."

In his current position, Johnson may be able to do that. Brought on board to Cablevision because of his fiber background, Johnson works with individual systems in using his fiber optic knowledge for different applications. Since one of his major responsibilities is to keep operational costs down to a workable level, any use of a technology that can reduce operating costs is important.

Learning RF

However, Johnson's attraction to the optical technology didn't begin at Cablevision. His interest in electronics goes back to 1972 when Johnson joined the Air Force as a technician repairing air traffic control radar. During the next 10 years, Johnson watched the technical transition from tube-type equipment to transistorized to full scale digital-type products while also undergoing a transition himself from a technician to a manager.

"It worked out to the best," he states. "The Air Force gave me a pretty good education both from the technical and the management sides." Feeling like this gave him good experience for the civilian world, Johnson headed back to California after his service obligation was completed. While checking through the local paper in San Jose, Johnson came across an ad requesting an RF technician. Because his background was in RF, Johnson answered the ad and was offered a position with Catel Telecommunications as system manager of customer service.

For the next year, Johnson supervised the test department at Catel and learned a lot about the CATV industry as well as Catel's product line. Armed with this knowledge, Johnson was moved into sales in 1983, where he spent the next two years selling and marketing audio products for cable television. It was in 1984 though, that Johnson was able to work with a Japanese vendor on a digital audio product and about the same time was introduced to fiber optic technology.

"I've always had a large interest in audio," says Johnson. "And it was a lot of fun working on that digital audio product." Unfortunately, the cost of the terminal equipment was too expensive then and the interest died. "It was funny," muses Johnson, "that most everybody felt that the market (for digital audio) was about five years away. And I found a little satisfaction in that it sprouted back up in 1989. It's one of those crystal ball projections that came true for me."

But while the interest in digital audio wasn't there, fiber optics was beginning to capture attention. Because multimode technology was prevalent when Johnson first started at Catel, the switch to singlemode had Catel shifting gears to develop a singlemode product. "I found it to be a technology I became very, very interested in," says Johnson. "It was something I wanted to learn. It was something I felt the industry needed."

A tough sales job

Meanwhile, during the phase from multi- to single-mode fiber, Catel also had a switch in management and Johnson left the company. It was later, during a lunch with Vince Borelli of Synchronous Communications that Johnson performed "one of my toughest sales jobs I've done" and sold Borelli on fiber optic technology. "Vince didn't want to get into it because he had the same reservations about reliability that everybody else did," says Johnson. Once sold, Borelli asked him to come on board and, in 1985, Johnson joined Synchronous as vice president.

"I throughly enjoyed working at Synchronous," reflects Johnson. "We were small enough that I had three hats: sales, marketing and product management. But it was a very rewarding experience because it gave me the chance to really look at fiber optics. I mean, the company geared itself specifically to look at fiber optics and it gave me a very good understanding of the technology."

After spending three years with Synchronous, Johnson was offered his current position as director of technical operations for Cablevision. Since his background was in sales and marketing, the move to a cable system was "a big change" says Johnson. "But I think it's been a very good one. It's been educational to me." Previously, Johnson's concept of adding a channel (to a system) was to put a modulator in. Now, Johnson has a "whole different perspective on the industry. To be able to be on this side and see what goes on in the inner workings of a CATV operation has been fruitful."

Johnson's responsibility now is "to the company first," he states. "And if the things we do help us out enough that the industry takes notice of it, then we've helped the industry."

For Johnson, this helping out is part of the role he'd like to play in the future of fiber optics. "I'd like to help on the educational side," says Johnson. "If people are still a little afraid of the technology, I'd like to overcome their fear by being able to discuss my applications and how they worked out here at Cablevision." With Johnson's motivation and desire to see the technology implemented, he may be the type instructor the industry could use as it moves ever deeper into the optical world. ■

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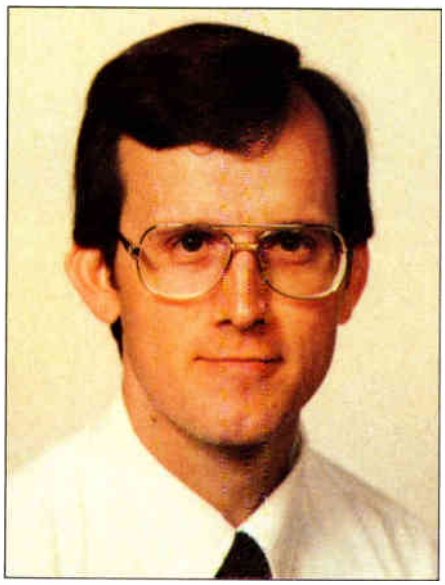

Envelope vs. synchronous detection

There is often confusion, when measuring certain video parameters, as to whether it is more appropriate to operate the test demodulator in the "synchronous" or "envelope" detection modes.

The envelope detector is probably the most simple detection system there is. An envelope detector, in its simplest form, is nothing more than a diode and a low pass filter in series with the signal, following the IF strip. The diode rectifies the signal, reproducing the "envelope" of the transmitted signal, and the low pass filter eliminates the residual RF carrier and harmonics that remain following rectification. The result is the original video waveform with some additional and unfortunate "baggage" in the form of nonlinear distortions, caused by the inherent nonlinearity of the diode used in the detector, and the addition of quadrature distortion.

The nonlinearities of the detector diode are fairly easy to understand and are usually the result of a decrease in efficiency of the diode at low (white) signal levels. Such nonlinearities can show up in the form of differential gain distortion.

By Chris Bowick, Director of Engineering, Headend and Earth Station Products, Scientific-Atlanta

Quadrature distortion in an AM-VSB signal is a bit more troublesome to understand. It can be thought of as a type of distortion that is imparted to the RF envelope (hence the baseband video waveform) due to superfluous phase modulation of the RF carrier which results from the carriage of only half of the modulation sidebands. If the TV signal were pure AM-double sideband, quadrature distortion would not be a problem. Since the television signal is vestigial sideband and is therefore missing most of the lower sideband (at RF), the resulting phase modulation of the RF carrier creates video distortions such as ringing on transitions, differential gain and chrominance-to-luminance crosstalk. The envelope detector, unlike the synchronous detector, has no way of eliminating these quadrature distortions.

The output of a properly designed synchronous detector, on the other hand, is free of quadrature distortion. In a synchronous detector, a phaselocked-loop is typically used to create a CW reference signal that is locked to the incoming RF carrier. The phaselocked CW reference carrier is then mixed with the incoming signal (which, by the way, still exhibits quadrature distortion on its RF envelope) to produce baseband video that is free of quadrature distortion.

Distortion elimination

Intuitively, the elimination of quadrature distortion is accomplished by a synchronous detector through recreation of the lower "missing" sideband information during the mixing process (a similar but reverse process to the way the AM-DSB signal was originally created), effectively eliminating the quadrature distortion riding on the RF envelope. The resulting video signal out of the synchronous demodulator therefore more closely resembles what is actually being transmitted by the modulator rather than adding its own differential gain, chrominance-to-luminance crosstalk and ringing.

It almost sounds as if the synchronous detector is the perfect solution. So, why would we ever want to use an envelope detector? The problem with synchronous detectors is that they are quite susceptible to any phase noise or incidental carrier phase modulation (ICPM) that might be present on the incoming RF carrier.

You may have noticed, for example, that in many cases, the video carrier transmitted from an agile modulator cannot be demodulated by a Tektronix 1450 demodulator while the demod is operating in the synchronous mode. If you try, the "unlocked" light on the front panel of the 1450 will often illuminate, and the unit will automatically revert to the envelope detection mode. This is not a fault of the unit, but results because the signal into the demodulator has so much low-frequency phase noise associated with it that the phaselock loop simply cannot lock to the incoming video carrier.

Figuring for errors

If the modulator to be tested is a crystal controlled unit (as opposed to synthesized) and is therefore well behaved with regard to phase noise, but it exhibits some amount of ICPM, then a measurement of differential phase, with the demodulator operating in the synchronous detection mode, could be in error. In essence, you would wind up measuring a meaningless aggregate of both the differential phase and the ICPM distortion of the modulator. In fact, Tektronix recommends that one method of determining whether or not a modulator exhibits any ICPM is to measure its differential phase using both the synchronous and envelope detection modes in the demodulator. Any difference between the two measurements could be attributable to ICPM.

So, which type of demodulator should be used for most video measurements? Where possible, the synchronous mode should be used. The exceptions are when measuring differential phase, chrominance-to-luminance delay, or other phase-related measurements. When measuring an agile modulator, where phase noise precludes the use of synchronous detection, envelope detection can be used instead. It should be recognized however that the envelope detector's performance could contribute significantly to the measured value. ■

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Reader Service Number 10

L.O. in the spotlight

For the first time in a long while, cable's local origination channels have become a topic of debate in Washington.

Unlike satellite-delivered program networks, L.O. channels typically include programming that is selected and often produced by the local cable operator, providing an additional source of localism in a community. In metropolitan areas, L.O. channels often provide news and other programming more narrowly tailored to the specific cable community than the broadcast television stations serving the larger region.

Unlike public access channels, which are themselves valuable in providing an outlet for all interested speakers and programmers on a first-come, first-serve basis, L.O. channels preserve the editorial discretion of the cable operator, so that a package of appealing programming can be assembled at the local level.

The development of satellite-delivered programming, beginning in the mid-1970s, overshadowed local origination programming for awhile. The unexpected blossoming of more than 50 satellite cable networks understandably diverted subscribers' attention from L.O. channels. Still, cable operators continued to seek quality programming for their L.O. channels. And cities continued to encourage the development of these channels. Anyone who has ever attended the local system ACE Awards will attest to the ever-increasing vitality and quality of programming on local origination channels.

By Michael Schooler, Deputy General Counsel, NCTA

Looking too good

And that's what's causing the problem in Washington. It's not that L.O. channels aren't good enough. It's that they're starting to look too good, at least to competing local broadcasters. Some cable operators are now beginning to provide a mix of quality programming—syndicated and locally produced entertainment, sports and news—that matches some of the best of what local broadcasters provide.

Viewers can only benefit from this enhancement of L.O. channels; until now, the number of locally programmed channels available in a community have generally been limited by the scarcity of available broadcast frequencies. But broadcasters have come to love this scarcity, which has always protected them from additional competition. For them, local origination channels are fine—as long as the programming on such channels isn't good enough to compete with theirs.

Starting the fight

What sparked the latest round of broadcaster complaints was the acquisition by the Rochester, New York cable system of a number of syndicated programs, which will be carried along with news, sports and other local programming on an L.O. channel that may look very much like a local broadcast station. Broadcasters—especially the Association of Independent Television Stations—are acting as if the very idea that a cable operator would seek to provide its own competitive local programming is outrageous.

There's an irony to their argument. When cable operators complained that the FCC's new syndicated exclusivity rules would deprive subscribers of programming that they enjoyed watching, the broadcasters argued that cable operators should go out and acquire local rights to programming themselves. Instead of relying on the compulsory copyright license, according to broadcasters, cable systems should produce their own programming.

But now that a few cable systems are following the broadcasters' advice by acquiring exclusive rights to syndicated programs and producing their own local news and entertainment programs, the broadcasters don't like that either.

The broadcasters apparently long for the good old days when the FCC imposed restrictions on cable programming in order to protect broadcasters from competition. There used to be regulations, for example, that kept cable operators from carrying recent movies and sporting events; that limited the number of distant broadcast signals that could be carried by a cable system; that forced cable operators to black out distant signals whenever they carried syndicated programs for which a local broadcaster had exclusive rights; and that required cable systems to carry all local broadcast stations. By the mid-1980s, all these regulations had been eliminated, and cable was able to expand enormously the amount and diversity of programming available to television viewers.

Syndex is here

Now, syndicated exclusivity is back. And the cable industry has indicated its willingness to accept reasonable must-carry requirements. Still, the broadcasters want to keep cable operators from carrying quality L.O. programming.

They've argued for some time that cable operators should not be allowed to own any satellite program services. And now the broadcasters are arguing that because cable operators might act in an anticompetitive manner, they should not be allowed to provide quality local programming either. These arguments are specious. There's no evidence that ownership of satellite program services by cable operators has produced anticompetitive results. (Indeed, as we'll discuss in next month's column, such vertical integration has enhanced competition in television programming.) There's also no reason to expect that cable operators will operate their L.O. channels in an anticompetitive manner—and if they did, the antitrust laws would be sufficient to deal with the problem.

What seems to trouble the broadcasters about high quality L.O. channels is not the prospect of unfair competition but the prospect of enhanced competition. Their licenses give them the exclusive rights to use scarce broadcast frequencies. But they don't give them the right to exclude other nonbroadcast providers of local programming, and there's no reason why they should. ■

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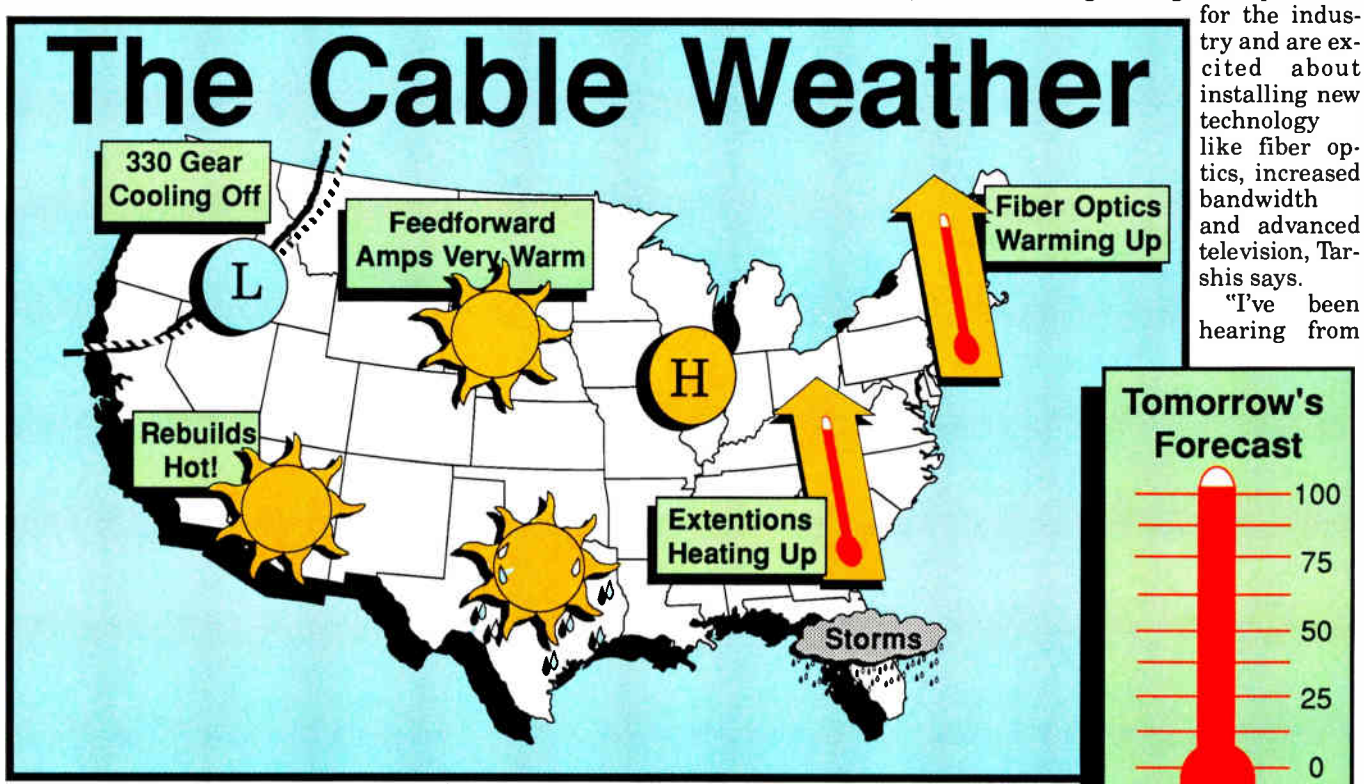
Forecast is bright for long-term construction

There's no question that the cable television industry is presently riding high through an extended period of profitability brought on chiefly by an unrestricted market and astronomical levels of capital expenditures by operators eager to rebuild or improve cable plants. But what is interesting—and certainly much different than past construction cycles—is that no one sees any considerable downturn in activity for the next several years.



Cable equipment manufacturers and distributors are used to seeing their share of good times. Back in 1982 and 1983, construction spending reached perhaps its all-time high as the franchise wars were reaching a climax. But then, the inevitable happened; spending levels dropped off and many manufacturers were caught with huge inventories and production capability that had to be curtailed.

The best of times

After deregulation took effect, spending again surged and has remained high, chiefly because high subscriber values made it economically feasible to reach into previously unpenetrated areas and/or to attract new subs via more channels.

The current rebuild cycle is now well into its third year. Many industry forecasters have predicted that operator capital spending would slack off until 1993, when the next round of franchise-forced rebuilds would take place. In other words, 1990 was the year when the valley portion of the peak-and-valley construction cycle was to occur.

However, research conducted by *CED* magazine suggests that the fundamental premise of peak-and-valley cycles doesn't hold any longer; that operators have shifted their thinking from the routine, bottom-line "don't do anything until the franchise is due to expire" mentality to one of long-term strategy, where customer service and competition become the driving factors.

For example, Lemuel Tarshis, vice president and general manager of Jerrold's distribution division, said he expects sales in 1990 to be about the same as they were in 1989, which by all accounts was a highly profitable year. And he expects the trend to continue: "I think a lot of factors are in play to cause that growth to happen more continuously and less precipitously," he says.

Why? Because operators feel good about the long-term growth potential for the industry and are excited about installing new technology like fiber optics, increased bandwidth and advanced television, Tarshis says.

"I've been hearing from most cable operators that their capital budgets are at or slightly above their '89 levels," continues Tarshis. "They're quite bullish (about the future) and so am I."

Over at Scientific-Atlanta, the feeling is similar. David Fellows, vice president and general manager of headend/earth station, fiber and distribution systems, sees the strong momentum of 1989 continuing right on into 1990. He believes the advent of AM and FM fiber optic systems has

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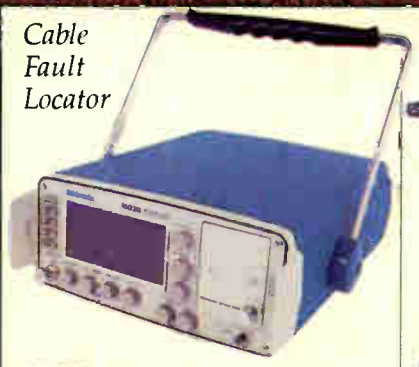

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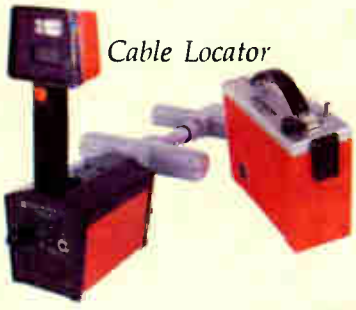

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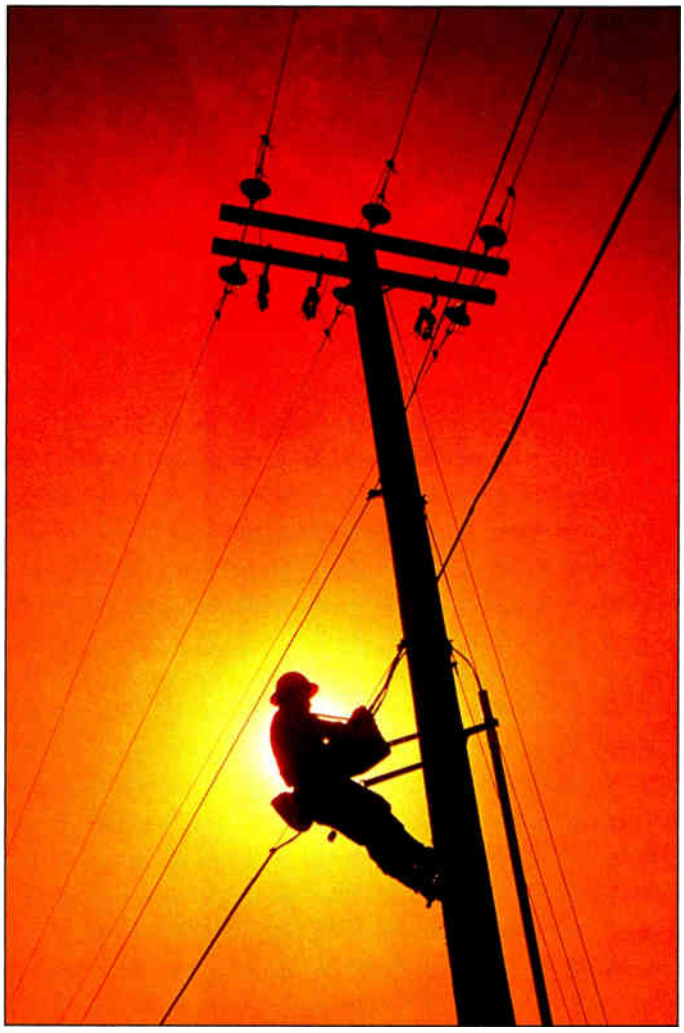
made upgrades more attractive. "Operators no longer believe fiber will obsolete their plant," says Fellows, "they understand fiber now. I'm very optimistic."

"It (1990) appears to be an excellent year," driven by operators' overall optimistic outlook for the future, agrees John Hastings, national marketing manager for C-Cor Electronics. Because operators are encouraged about the long-term health of CATV, they're spending money to upgrade plant, make it more reliable and add channel capacity, says Hastings.

"We feel the industry will be strong over the next 8 to 10 years," as long as nothing catastrophic happens, Hastings says. "The big question will be the European market."



Addressability will grow

Over on the subscriber product side, the overall outlook parallels those of the distribution camp. Steve Necessary, director of marketing at S-A, says sales of addressable set-tops will continue, with "modest growth" being driven by replacement of early-generation addressable boxes. "The combination of worn-out equipment, security issues and the demand for new and better features is driving the push for new addressables," he says.

At Jerrold, Tony Aukstikalnis, vice president and general manager of subscriber gear, expects a "slight increase" in overall sales, derived mostly from the sale of Starport addressable modules to Tele-Communications Inc. for the MSO's "on-premise" side-of-the-house program. Regarding conventional addressable set-tops, Aukstikalnis says some growth will occur in 1990, but will "take off" when system consolidation drops off and pay-per-view becomes accepted. "Operators will begin to focus inward and improve their systems," Aukstikalnis says, which will drive sales of both traditional set-top and off-premise addressable equipment.

Texscan, which has been working diligently to overcome its financial difficulties and regain market share, is also "extremely bullish" about 1990 and beyond. George Fletcher, vice president of corporate marketing, expects Texscan business to be up about 20 percent over 1989 sales (which were estimated to be about $30 million). He expects the growth not so much from increased market share as from an enlarged overall market size.

The cycle has changed

He, too, believes that the building cycle is different from the past. "The threat of telco (entry into the cable business) triggered a lot of construction and kept it moving," says Fletcher.

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Other factors, including efforts to improve cable's image by installing fiber optics and improving community relations, will keep spending levels high, he adds.

Equipment distributors share the optimism espoused by the manufacturers. Chris Sophinos, chief operating officer of Midwest CATV, expects business in 1990 to increase 40 percent over 1989. He believes the market, in terms of miles of construction, will be up five to eight percent. Midwest expects to make significant gains in market share in the West and Southwest to make up the difference.

Marty Ingram, vice president of product management and marketing at Anixter, expects sales to be flat, yet 1990 is shaping up to be "an excellent year." Construction levels will parallel 1989 and increases will come in drop cable sales and headend equipment as operators concentrate on offering improved signals, more channels and implementing fiber systems.

The hottest gear

Predictably, the hottest market is rebuilds and upgrades and the equipment of choice is 450 MHz gear, report the manufacturers and distributors such as Anixter Cable TV and Midwest CATV. "There's been a shift toward the upper end of the equipment (550 MHz gear)," says Jerrold's Tarshis. "The number of people interested in 550 has doubled over a year ago."

Fellows is seeing the same thing. "We're shipping a lot (of 550 gear). It's not unusual anymore," he says. While many more operators query the manufacturers about top-end gear, clearly the purchasing curve peaks at 450 MHz actives. In many cases, operators purchase equipment capable of passing 550 MHz but activate it to 450 MHz.

In fact, Fellows says approximately 65 percent of S-A's sales are 450 MHz equipment, 10 percent is 550 MHz and 25 percent is less than 450 MHz. He says many operators are choosing to buy 450 MHz gear, equalize it to 400 MHz and will later install fiber to get the additional 50 MHz.

"Rebuilds are 450 MHz usually and 550 MHz whenever practical," assents Sophinos. "And we still see a lot of 450 MHz going in places that (activate) only to 330 MHz."

Ingram believes that one factor that could turn out to be a real sleeper is system extension work. "All those 50-to 200-home extensions add up to large sales," he says.

In order to hit those extension areas with good signal levels, operators are buying advanced technologies like feedforward and power doubling like never before. According to Fletcher at Texscan, fully half of the 450 MHz equipment he sells, which accounts for perhaps 80 percent of all sales, is power addition or feedforward gear. "People are buying as aggressive a technology as we can produce," says Fellows, who also sees the trend to high tech amps.

Because of all this good news, manufacturers have kicked their production into overdrive to meet the anticipated demand. But the lessons they learned a few years ago still remain and order backlogs on popular equipment are still relatively high.

For example, strand and hardware is still difficult to get and is getting more expensive, which foreshadows that the situation probably won't be getting any better soon, according to Sophinos. Midwest is turning to Florida Wire and Cable, its domestic supplier, rather than count on traditional offshore sources to ensure that it has enough strand to meet demand.

Think way ahead

Because of all the shortages, operators planning construction need to bid their projects a full 90 days ahead of need, says Sophinos. "They no longer have as many alternative sources as they had in the past (alluding to the consolidation of hardware suppliers and distributors), so they'll have to think further ahead," he cautions.

"Operators need to contact vendors early and stay in touch with them," advises Frank Walker, marketing manager at Kennedy Cable Construction. He advises operators to order electronics early because the vendors can't fill all the orders from operators who wait until the last moment to order. Walker says that even the most essential item—the coaxial cable itself—is in short supply in the more popular offerings.

Another atypical driver of construction activity is all the attention over signal leakage rules, which will go into effect next July. Contractors, especially, see the difference. Walker at Kennedy says he's doing more splicing upgrades, more fiber optics work and believes that the leakage rules provided an impetus to start other, larger construction projects.

Harry Wahl, vice president of turnkey sales at Cable Services, also says that the concern over leakage level

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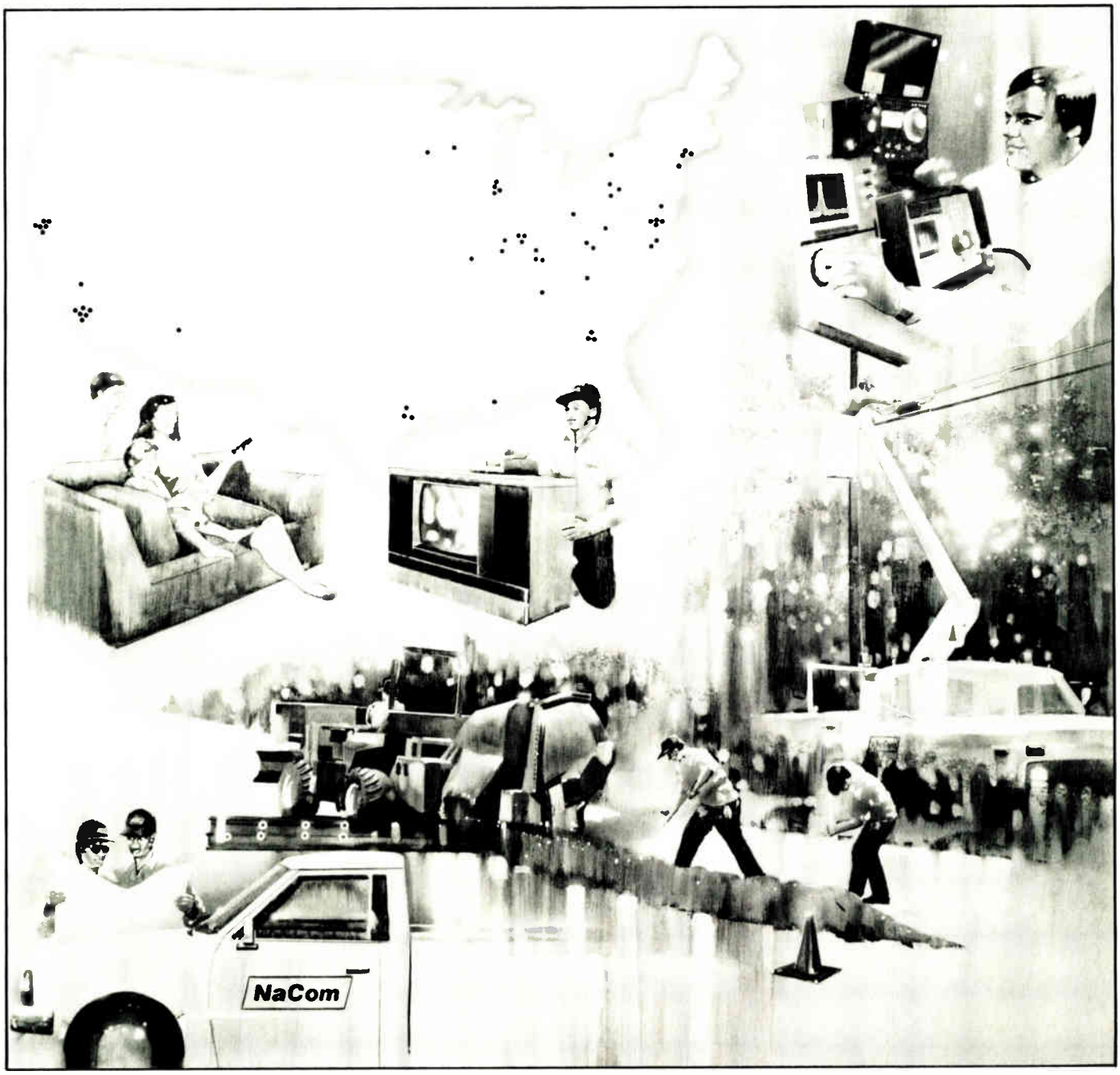

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compliance has brought his firm a lot of work related to improving drops.

Robert Long, president of Burnup and Sims' Cablecom, expects construction activity to keep his company percolating for some time. He thinks that MSOs are interested in improving reliability and service and have penciled in ambitious rebuild or upgrade agendas that will carry contractors well through 1990 at high levels. While he expects overbuilds to remain the primary driver of business, to some degree he points to social factors for some of the demand. For example, he says the population of Florida is expected to double by the year 2000, and "someone has to give them cable TV," he says.

The role of fiber

An examination of the traditional marketplace and the application of traditional equipment clearly creates an optimistic outlook within most industry players. Yet many become obviously giddy with delight when the prospect of fiber optic implementation and the burgeoning European marketplace are thrown into the mix.

Amplifier manufacturers are eagerly anticipating the technological breakthrough that is necessary to improve the performance of distributed feedback and other types of lasers before they'll admit they have high hopes for fiber systems. But many, including Jerrold and Scientific-Atlanta, believe the breakthrough will have to occur before significant implementation takes place.

For example, both Tarshis and Fellows believe that 1991 will be the year of AM fiber implementation. By that time, laser performance will improve, prices will drop and MSOs will plan for fiber via capital budgets, they say.

Both men also believe that the day is not far off when digital systems find their way into the supertrunks, usurping the role now played by FM gear. Tarshis says he expects "significant activity" related to digital systems by the 1990 Western Show (December) while Fellows says it may take two years. But Fellows, who up until two years ago designed and built digital equipment, says it may even happen faster than that. "It surprises me that good quality digital TV has come down (in price) that fast" already, he says.

C-Cor, however, is counting on being able to offer a digital product even faster than that. Through an agreement with Comlux, the venture hopes to debut a product in the next 12 to 18 months, says Hastings. "We're banking on digital," he says.

On the other hand, Texscan believes cable operators already have too much money invested in RF gear to make a quick switch to digital gear. Fletcher concedes that it will be experimented with but doubts that it will be implemented in any significant way for several years.

Desire to pass ever more bandwidth to the subscriber also promises to keep construction hopping well into the '90s. With ever more channel offerings and the potential implementation of bandwidth-hungry advanced television schemes, the manufacturers have designed amplifiers and housings that will accommodate active modules up to 1 GHz and beyond. Magnavox, Jerrold, S-A, C-Cor and Texscan all showed these capabilities at the last National Show.

The European opportunity

Finally, seemingly everyone is looking beyond the North American borders and toward the activity brewing in Europe and the Pacific Rim. While most don't expect any explosive growth to occur there (especially when contrasted to the U.S. market), most believe there is serious growth potential overseas.

Texscan's Fletcher casts a wary eye on Europe because of its excruciatingly slow growth and frustratingly complex political constraints. "They wait and see what happens here," he says. "Everytime there's a breakthrough, they slow down." Yet he concedes there is an excellent opportunity to deploy fiber there.

Aukstikalnis expects good growth to occur for his Jerrold product line. The new international set-top converter has been received well and growth along the lines of 30 percent to 40 percent is expected, Aukstikalnis says. "we think we're well positioned in Europe," having been there for 15 years, he adds.

With operators like Cox Cable seemingly so willing to spend the money it takes to improve its image, reliability problems and service to customers, it becomes obvious that 1990 will continue to see high levels of spending. But where the really good news lies is in the short-term future, where new products, more programming and advanced television promise to keep the good times rolling. ■

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Bigham Cable . . . . . .(904) 932-6869
Construction Inc.
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PERSONNEL: Harold Bigham, President
DESCRIPTION: Bigham offers aerial construction, splicing, balancing and installs. We also specialize in rebuilds.

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Cable Com, Inc.

Burnup & Sims . . . . . .(404) 482-7612
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DESCRIPTION: Turnkey CATV system construction including mapping, design, material supply and management, splicing, activation, sweep, balance and documentation. With offices in Iron Mountain, Michigan, Auburndale, Florida (813-965-2847), and Sacramento, California (916-429-7702).

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FAX . . . . . .(614) 222-0581
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Columbus, OH 43215-2353
PERSONNEL: E. Jack Davis, President; Bill Holehouse, Vice President of Sales
REGIONAL OFFICES: Lucy Espinoza, 8610 Broadway St., Suite 210, San Antonio, TX 78217, (512) 822-1303, FAX (512) 822-4015.
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1-800-233-8452 Nationwide

Cable Services . . . . .PA (800) 332-8545
Company, Inc.
Outside PA . . . . . .(800) 233-8452
FAX . . . . . .(717) 322-5373
2113 Marydale Ave.
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Excalibur Cable . . . . . .(800) 462-3811
Communications, Ltd.
FAX . . . . . .(703) 339-9834
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PERSONNEL: Glendon K. Allen; Eric Poth
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PERSONNEL:Steven M. Dyer, President; William P. Grieser, Sales Manager
DESCRIPTION: Florida Cable Works is a full service construction and installation contractor operating throughout the southeast. We offer aerial and underground new build, rebuild and installation services from planning and mapping through final testing and activation. In addition, Florida Cable Works is capable of providing all material and equipment on a turnkey basis.

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Kennedy Cable . . . . . .(912) 557-4751
Construction Inc.
FAX . . . . . .(912) 557-6545
P.O. Box 760
Highway 280 West
Reidsville, GA 30453
PERSONNEL: Frank Walker, Roger Kennedy Jr.
DESCRIPTION: Kennedy Cable Construction, Inc. provides field work, computer-aided design, engineering and drafting of different hybrid fiber optic—coaxial cable architectures. Systems can be constructed on a labor only cost or full/modified turnkey basis. Construction services include aerial, underground and submarine.

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NaCom . . . . . .(614) 895-1313
WATS (National) . . . . . .(800) 669-8765
1900 East Dublin-Granville Road
Columbus, OH 43229
PERSONNEL: Jerry Evans, VP-Const. & Engineering Div.; Bob Gemignani, VP-Mktg. & Corporate Development
DESCRIPTION: Full service telecommunication contractor providing strand mapping (AutoCAD) drafting & design; make-ready engineering; aerial & underground plant construction; fiber optic installation & splicing, residential installations; CLI detection & correction; pre- and post-wire MDU's; traps; audits; converter exchanges; SMATV; LAN's.

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The New George- . . . . .(404) 296-0804
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WATS . . . . . .(800) 631-6283
FAX . . . . . .(404) 296-0952
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Stone Mountain, GA 30083
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PERSONNEL: James MacGeorge, Vice President
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CABLE CONSTRUCTION, INC.

Rite Comm. Co.. . . . . .(704) 874-4202
WATS (National) . . . . . .(800) 327-0208
FAX . . . . . .(704) 874-0881
1008 Main Street West
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Valdese, NC 28690
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DESCRIPTION: Capable of providing for all your engineering and construction needs (including fiber optics). "Quality and performance done the RITE WAY."

Schenck construction

Schenck Construction . . .(206) 867-9694
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P.O. Box 3159
Redmond, WA 98073-3159
PERSONNEL: Edward A. Schenck, President; Bud Longnecker, VP/Aerial
DESCRIPTION: Aerial and underground cable TV construction; turnkey, and fiber optic installation.

Taylor Tele-Communications, Inc.

Taylor Telecomm. Inc. . . .(216) 784-2960
2040 E. Market
Akron, OH 44312
PERSONNEL: Sue Taylor, President; Tam Taylor, Vice President
DESCRIPTION: Cable installation contractor; underground construction, aerial construction, apartment pre-wiring, residential installation.

Using CADD to reorganize your headend

Currently, a topic of much discussion in many systems is how to make space for the growing quantity of equipment that must be squeezed into headend buildings. It can be said with relative certainty that most systems that have been in operation for a number of years are using a headend structure that was initially designed to house the immediate equipment needs only.

We're now faced with new equipment space requirements as we add channels and enhance others. A demand for space may come from the addition of commercial insertion, microwave and in some cases fiber optic equipment. We may even find ourselves replacing microwave equipment with fiber optics and having to operate the systems in parallel through a lengthy transition period.

By Pete Smith, Project Engineer, ATC, Cablevision of Central Florida

A new tool

It is easy to imagine that whatever direction you take in your efforts to gain more equipment space, there will be quite a lot of drafting involved as different ideas are placed on paper, changed and redrawn. A good way to avoid dedicating a full time draftsman to the task and still get a professional set of drawings is to use a CADD system.

CADD, an acronym for Computer Aided Drafting and Design, is software. Many versions have been written for personal computers. Using CADD and enhancing your PC with a few accessories will enable just about anyone on your staff to get right to the task

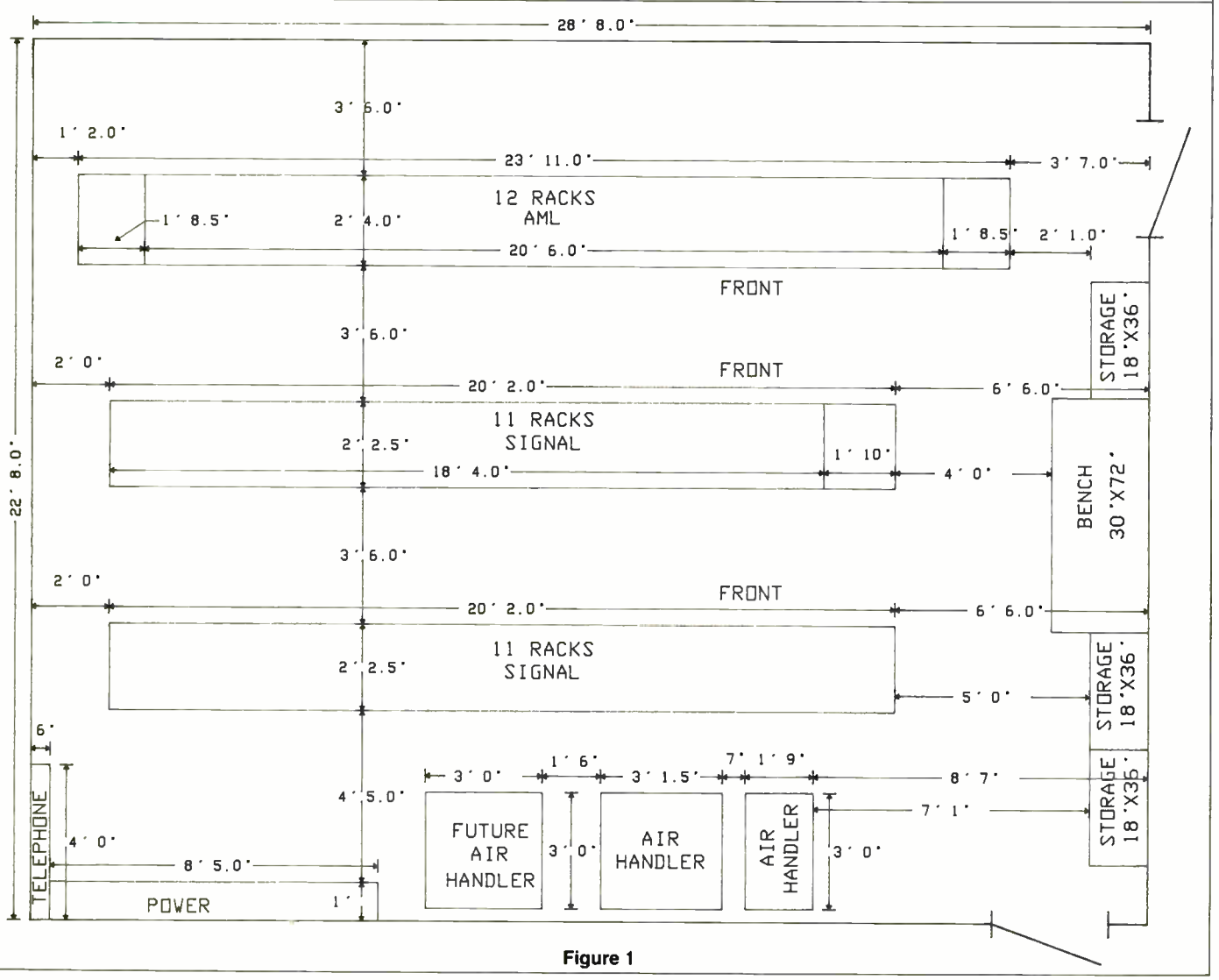

Figure 1

Setting The Pace!

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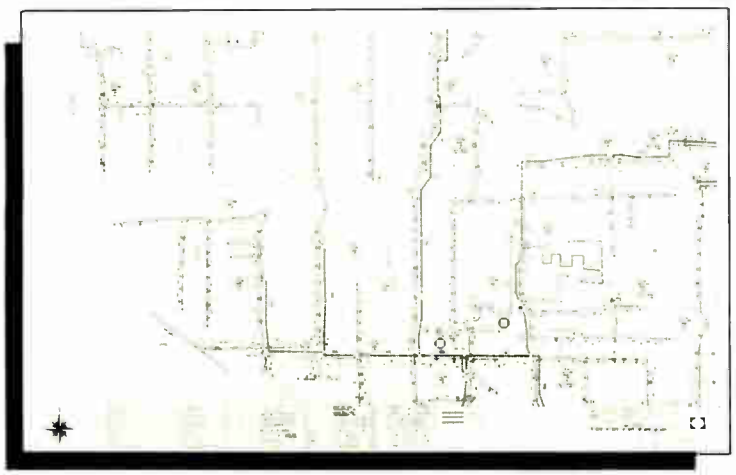

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Underfloor Electrical Duct

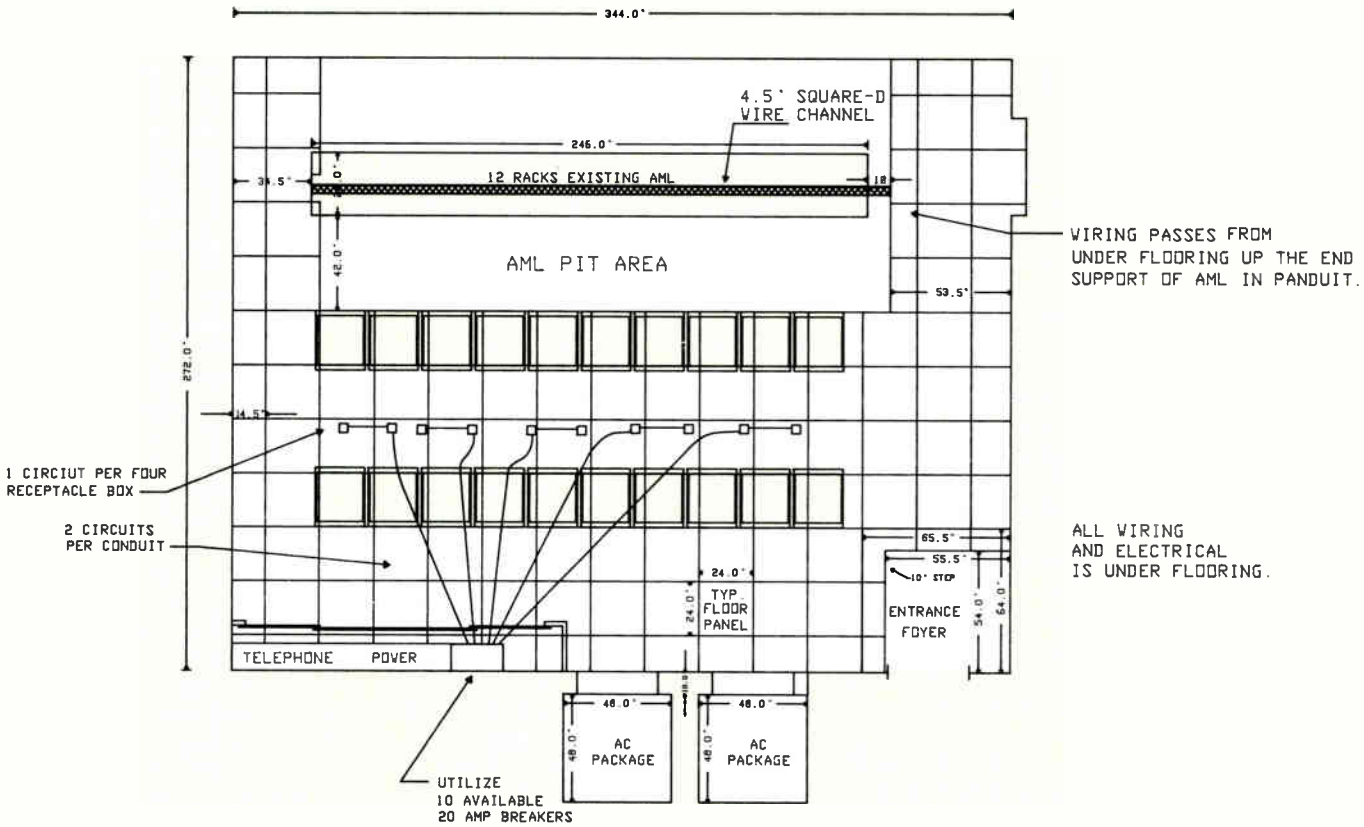

Figure 2

of redesigning your headend to gain more space.

A typical example

The headend structure at Cablevision of Central Florida, an Orlando-based system of ATC, was no exception to the crowding problem and over a period of years had been expanded several times to contain a growing list of equipment. Equipment had been added in a somewhat planned fashion that distributed the AML in three locations and caused operating equipment to be stacked on top of racks.

Future plans called for the full replacement of existing AML equipment with fiber optics. Floor space freed by that move would allow for the addition of quite a bit of electronics associated with signal improvement and expansion of services. It seemed possible that by rearranging the interior of the headend and better organizing the existing electronics, more room could be made for new equipment and a difficult and costly building expansion would be unnecessary.

70" Rack Planner

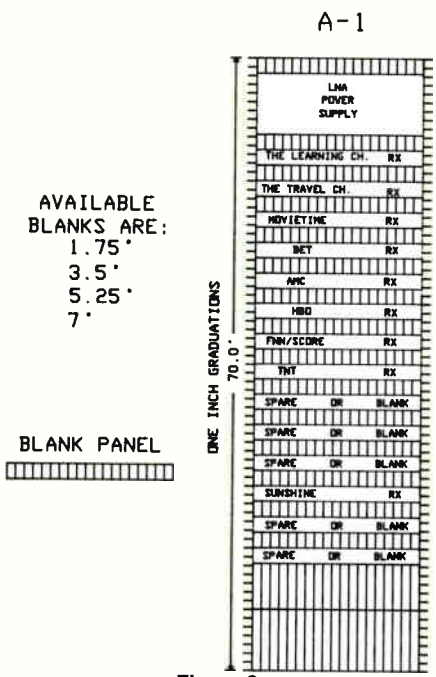

Figure 3

Considering that every inch of floor space gained or saved would be of great value, it's easy to imagine that a floor plan would have to be drawn and reworked several times prior to being accepted. Additional drafting was required after a decision had been handed down that all wiring would be diagramed and updated whenever a change was made. It was also decided that a wire numbering scheme would be developed and kept up to date.

Several members of the engineering staff, having become advanced in the use of personal computers, simplified matters by proposing the use of CADD. Computer trade publications were studied for recommendations and it was determined that CADD software packages can be as elaborate as those capable of designing a space shuttle and costing as much as $3,000. The staff was happy to find that there are several good CADD packages for under $500. From those, a two dimensional CADD software package by Generic was selected.

Hardware included an IBM compatible 286 PC with "mouse" inputting

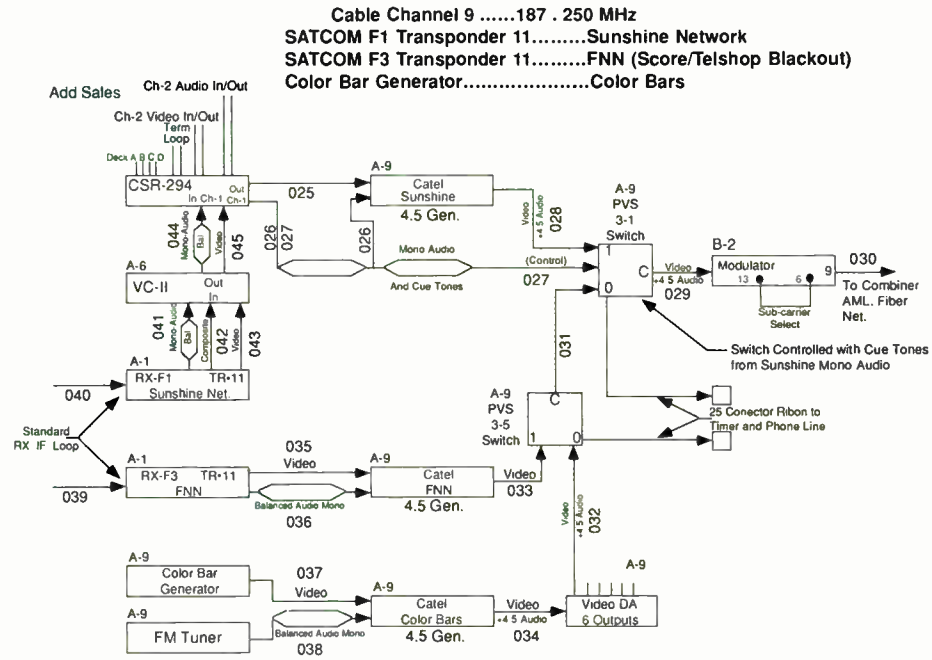

Figure 4

and a Hewlett Packard XY plotter to print results.

In selecting a PC, it is recommended that a hard disc be included to expedite loading the CADD program each time it is needed and to provide storage capacity for the completed drawings.

Consideration should be given to memory capacity (RAM) to insure that there is ample room to handle both the CADD software and sometimes complex drawings. It is recommended that VGA graphics be installed in the PC and an appropriate monitor selected. Because there are quite a few computer components on the market that are not compatible with each other, it is recommended that you make your purchases through a computer store if you are not familiar with

these products.

Saving time

With this package, laying out a fairly elaborate floor plan on the monitor and drawing it with the plotter required about half an hour for a skilled operator. A draftsman would require about an hour and a half for the same product. Using CADD, changes requiring a complete redraw take about 10 minutes. All drawings are stored on floppy discs for future reference.

Once the floor space requirements for each piece of equipment are determined, it's a simple matter to move them about on the scaled drawing displayed on the monitor. Figure 1 is a preliminary drawing to scale illustrating the direction the floor plan was taking.

Subsequent to the floor plan illustrated in Figure 1, a decision was made to eliminate the air-handlers from the interior of the headend by installing single unit air packages outside the building.

Headend Wiring Index

Wire	Runs From	Runs To	Carries
025	CSR in Ad Sales	4.5 Gen in A-9	Video Sun/Comm
026	CSR in Ad Sales	4.5 Gen in A-9	Audio Sun/Comm
027	CSR in Ad Sales	PVS Sw. 3-1 Sig.	Cue Tone Audio Sun
028	4.5 Gen in A-9	PVS Sw. 3-1-1	Video +4.5 Sun/Comm
029	PVS Sw. 3-1-C	Ch. 9 Modulator	Video +4.5 Sun/Comm
030	Ch 9 Modulator	Combining Net	VHF Ch. 9
031	PVS Sw. 3-5-C	PVS Sw. 3-1-0	Video +4.5 FNN/BARS
032	Video DA in A-9	PVS Sw. 3-5-0	Video +4.5 BARS
033	4.5 Gen in A-9	PVS Sw. 3-5-1	Video +4.5 FNN
034	4.5 Gen in A-9	Video DA in A-9	Video +4.5 BARS
035	FNN Rx in A-1	4.5 Gen in A-9	Video FNN
036	FNN Rx in A-1	4.5 Gen in A-9	Audio FNN
037	BARS Gen in A-9	4.5 Gen in A-9	Video BARS
038	FM Tuner in A-9	4.5 Gen in A-9	Audio local radio
039	TVRO Splitters	FNN Rx in A-1	Satellite Sigs
040	TVRO Splitters	Sunshin Rx in A-1	Satellite Sigs
041	Sunshin Rx in A-1	VC-II in A-6	Sunshin Mono Audio
042	Sunshin Rx in A-1	VC-II in A-6	Sunshin Comp Video
043	Sunshin Rx in A-1	VC-II in A-6	Sunshin Video
044	VC-II in A-6	CSR in Ad Sales	Mono Audio Sunshin
045	VC-II in A-6	CSR in Ad Sales	Video Sunshin
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Figure 5

To simplify the distribution of cooling air, and to provide a roomy place in which to organize interrack wiring, a decision was made to incorporate a computer floor. Figure 2 is the new floor plan as refined using CADD.

Records and documentation

The method of grouping various equipment types within the racks was left up to the technicians with the understanding that once committed, we must stay with the plan. The familiar "rack planner" was drafted in CADD and rack space planning became a simple task. Figure 3 is a completed planner produced with CADD.

Using CADD, the requirement for documenting all wiring was accomplished quite simply. A line diagram for each channel in the headend was created. By using a set of line diagrams, it's an easy matter for a relatively uninitiated technician to perform preliminary troubleshooting. Line diagrams are also stored on floppy discs for easy retrieval and updating. Figure 4 is an example of a CADD produced line diagram.

Each wire in the headend is numbered. In this case, three-digit numbers are assigned with that number placed on both ends of the cable. Using this plan, excessively wordy labels are avoided. Numbers are randomly assigned with the thought that a more disciplined numbering scheme would be burdensome. Numbers are kept in a master index that is a companion document to the line diagrams. (By the way, the same PC with word processing software installed was used to organize the master index.)

Figure 5 is a page from the index and if you refer back to the line diagram in Figure 4, you'll see how the two work together. Whenever equipment must be removed and replaced, reconnecting wires to the correct point is accomplished easily by referring to the index.

CADD has been in use in this system for over a year. During that time many uses beyond reworking the headend have come up. Managers find it particularly useful for creating color transparencies to be used in overhead projector presentations. Most drawings that would require a draftsman can be done with CADD.

If you would like help in justifying to management the purchase of a system to support CADD, any of your local computer stores will be more than happy to list the many practical uses beyond CADD. ■

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In the past fifteen years we've made some very significant contributions to the CATV industry. We've developed the most efficient standby power concepts. We've developed the powering technology that delivers the cable signal with unprecedented reliability. In fact, every major standby power innovation has come from Alpha, including complete status monitoring, automatic performance monitoring, uninterrupted power output, and more. But what makes us proudest is to hear people in the industry say we've brought respectability to the standby power business.

Standby power systems were introduced to make CATV signal delivery more reliable. Ironically, many of the standby systems were notoriously unreliable. They gave the entire industry a black eye.

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Reader Service Number 22

The right tool for the job

Remember the old adage of trying to fit a square peg into a round hole? To many in the cable industry, that's exactly what the technical community has been quite good at attempting to do. Since cable TV's inception almost 50 years ago, technology has existed by means of trial and error. If a problem existed, equipment was manufactured to solve it. Unfortunately, this "find 'em and fix 'em" method of product development created another problem—each manufacturer settled on its own particular design, and quite often equipment didn't interface quite the way it should.

This lack of cohesion evolved into an industry without technical standards. Because cables and connectors did not adhere to any predefined standards, it was not uncommon to hear stories of ill-fitting connectors being twisted, mashed and shoved onto the wrong size cable. Even converter manufacturers created an issue by using their own channel numbering on converters.

However, as technology progressed, so did the industry's way of thinking. Refusing to listen to the "old guard" of cable who had done quite well without standards for 40 years, many in the industry looked at standards as a means to obtain the elusive improved quality and reliability.

The benefits are many

"The net result, of course," says Tom Elliot, director of research and development for Tele-communications Inc., "is in the final analysis, we do a better job of giving service to our customers. What the aim is, particularly on the Interface Practices Committee, is to cut down on the number of service calls. That saves a few dollars, but maybe equally—or more important—it means there are less of our customers being irritated."

This desire for higher quality work resulted in the creation of the Interface Practices Committee a year ago. Elliot went to the Society of Cable Television Engineers (SCTE) and proposed that an interface committee be started to deal specifically with interfaces—connectors and other parts that are associated with that process. "We don't use the word standards," says Elliot, "it makes people nervous. We use the word 'practices' with interfaces."

Regardless of the name, the Interface Practices Committee convened for its first meeting at the SCTE Cable Tec Expo in June 1988. The committee brings together the user group, manufacturers and others who need to be involved with interface issues. As an example, in the case of connectors, prep tool manufacturers are involved, or in the case of 'F' fittings, manufacturers who make the stripping tools need to be in the loop also. Having these companies represented reduces the risk of having an interface that doesn't work properly.

What the aim is, particularly on the Interface Practices Committee, is to cut down on the number of service calls.

"It's an open forum type meeting," says Barry Smith, sales engineer for Times Fiber Communications. "All of the parts by themselves are excellent parts; nobody intentionally wants to make junk. But we don't always have the manufacturers of part 'A' talk to the manufacturer of part 'B'. This is a forum for them to talk to each other and for the operator to say, 'well, I've got this problem and can the group help on this interface?' "

Since the interface committee deals with several different, but interlocking, issues, the committee was further broken down into three subcommittees. The first, spearheaded by George Bollinger, an applications engineer with Comm/Scope, deals with the aluminum cable interface. Specifically, the subcommittee addresses issues on the feeder cable, connectors, equipment ports, sizing and choice of materials.

The second subcommittee, under the direction of Barry Smith, is the interface testing group. Obviously, the committee works on testing the interfaces and recommending standard practices for mechanical and electrical tests.

The final subcommittee is chaired by Bill Down, applications engineering manager for Gilbert Engineering, and focuses on the drop interface. This subcommittee works with the 'F' connector's sizing, connection and marking issues.

Common goals

For each of the subcommittees, the procedure to set a recommended practice is the same. "We have guidelines for this process," says Elliot. "It's a fairly thick document that describes the procedural process which is pretty well defined by lots of different industries. The Electronic Industries Association (EIA) has been doing this for years and they have a definitive set of procedures which we've borrowed from. There's also the SMPTE (Society of Motion Picture Television Engineers). So, clearly we've tried to follow the procedures that are accepted in the technical industry."

The first step in the procedure is the process of gathering all the information possible. That information is then analyzed and debated as to what is proper and what isn't before the information is circulated. "It's an iterative process," says Elliot. "Whereas it goes through numerous updates and eventually you arrive at a standard practice that people feel comfortable covers a range of things in terms of different types of metals and different tolerances of machining equipment works through different prep tools."

Once the review process is complete, the recommendation becomes an interim practice and would be allowed to stay in that status for up to five years. During that period of time, the practice is very likely to go through continual updating, improvement and refinement. If the recommendations are agreeable to everyone, then the interim becomes a practice in the true sense of the word.

Although only in existence for little over a year, the Interface Practices Committee is beginning to make headway. There are half a dozen documents

that have been voted on and approved by the subcommittees, including the following:

- Interface practice for 'F' male and female interface dimensions;
- Document for basic recommendation for performance and compatibility for drop cables, 'F' fittings, crimp tools, aluminum cable connectors and aluminum cable prep tools;
- Document on dimensional evaluation of flexible coaxial drop cables;
- Tensile pull test procedure for drop cable connectors;
- Hex crimp tool verification/calibration; and
- Aluminum cable cored depth.

"Everything that's been done so far is referred to as an interim practice," says Joe Lemaire, broadband applications engineering manager for Raychem Corporation, and secretary of the Interface Practices Committee. "And an interim practice is not a standard or document that cannot be changed. The objective eventually is to create something called a practice and to do that we have to go through the SCTE board of engineering and also a rather rigorous voting and polling procedure among the participants of the industry."

Legal minefield

Unfortunately, although all the practices approved and set by the industry are only voluntarily enforced, another issue is raised by the entire procedure. Do manufacturers have to comply with the dimensions set by an interim practice and if so, is this in violation of antitrust laws?

> 'Just because it's a good idea, a real good thing, doesn't mean the law thinks it's a good idea.'

"Just because it's a good idea, a real good thing, doesn't mean the law thinks it's a good idea," states Wendell Bailey, vice president of science and technology for the NCTA (National Cable Television Association). "My point is, just saying this is good doesn't relieve you of certain legal obligations. If the whole industry says we're going to voluntarily buy only connectors that meet this criteria promogated by this body, vendors who make something slightly different and find they cannot make a sale in the cable industry (even though there is no legal requirement for anyone to follow this standard) can accuse you of collusive behavior and an effort to refuse to deal."

However, this thought did not go unheeded by those of the Interface Practices Committee. "We were quite concerned at the beginning of the committee," says Lemaire, "that anything we might accomplish would be an antitrust violation or concern."

In an effort to circumvent any possible litigation, the committee sought legal counsel and established the guidelines Elliot referred to earlier. Taking the lead from the EIA, the manual of procedures was drafted to minimize the possibility of antitrust violations.

"There's always the risk," states Lemaire. "The essence in the risk is to be as fair as possible. And to enable all reasonable or interested members of the community to participate in the

meetings. For instance, it's not necessary to be a member of the SCTE to participate in the workings of the committee."

To Jim Chiddix, senior vice president of technology and engineering for American Television Communications, "the manufacturers exist to serve customers. And if customers decide they want to buy products with certain standards, I think manufacturers will get involved and make the product customers want and maybe even get involved in something to establish rational standards."

And the manufacturers *are* involved in the process. At the last Interface Practices Committee meeting, held at the Atlantic Cable Show in October, 97 percent of those in attendance were manufacturers; the remaining 3 percent of the representation was by MSOs. "The manufacturers are an integral part of this process," says Elliot. "In fact, it would almost be a futile effort without their participation. They're the experts, they're the ones who know what machines can do and what they can't do."

So, although the risk is there, the need for standards is far more critical in many minds then the need for prudent behavior. "The bottom line," says Richard Green, president and chief executive officer of Cable Television Laboratories, "is we want to provide better service. We want to provide better, more functional interfaces with our subscribers and reliability and higher quality are major objectives."

Another problem associated with setting standards, or practices, is the possibility of stopping the "creative juices" of innovative products. "If you set a standard," says Bailey, "you have guaranteed mediocrity in the product at that moment in time."

Although he agrees with Bailey's statement, Chiddix does not see this as a fatal flaw. "What's to be gained in establishing standards in areas like 'F' connectors is much greater than what is to be lost," says Chiddix. "A manufacturer who has a real breakthrough is still going to come forward with it. It just adds a little more bureaucracy to the process. That's the price you pay for the good things you get out of standards and I think our industry has matured to the point where its time that we take a hard look at some of these things."

A good thing

One of the good things that has come out of the process is that 75-ohm traceability has been established at the National Institute of Standards and Technology (NIST), formerly the National Bureau of Standards. Actually a subcommittee of the Interface Practices Committee, the process was originally started by Ron Hranac, corporate staff engineer for Jones Intercable, after attending a Hewlett Packard seminar on network analyzers.

Because the analyzers had accuracy traceable to the NIST, but only for 50 ohm devices, Hranac asked about the possibility of 75 ohm traceability.

After getting a positive answer, Hranac began pestering manufacturers, recruited assistance, met with the NIST and eventually submitted a report to the NCTA Engineering Committee that said 75 ohm traceability was possible. However, the report also stated that it would take about five years to

establish traceability and would cost approximately $2 million.

"That was the sum of the report," says Hranac. "My own belief was that it could be done in a shorter period of time, for less money, because the cable industry had at its fingertips a number of resources that could do the legwork." And Hranac's belief held true. Approximately two years after submitting the report, 75 ohm impedance has been defined. The industry can now trace the accuracy of manufacturers of connectors and cable and the calibration of test equipment back to the standard.

"Really, the next step in continuing this," says Hranac, "is to pursue the traceability of power measurements. So that if I say I have one volt of RF across 75 ohms, I'm measuring it this way. Or one watt of RF across 75 ohms, this is the measurement.

"The third part would be noise measurement traceability in 75 ohms but the NIST is more inclined to go by comparison rather than establishing a secondary standard."

What now?

And the next step for the industry? At the Interface Practices Committee meeting in Atlantic City, Elliot stated that the committee had been asked to look into a range of other issues. However, Elliot also expressed his concern that if the issue did not address a specific interface that perhaps the committee shouldn't take it on. "We have to be careful of overloading the people already involved," says Elliot. "We don't want to push anything off the plate, but we don't want to overload the plate."

Also saying that there were some important issues the industry could benefit from, Elliot suggested that perhaps a different committee be established to address other standards issues. (Since the SCTE recently approved the proposed structural process of the Interface Practices Committee, any new committee would operate under the same charter.) Yet, in order to address some of the issues, it was felt by many in attendance that more operator involvement was needed.

"This whole thing," says Smith, "is for the operator, and their customers. We're just trying to build reliability." Because of this focus, Smith encouraged everyone in attendance to help operators become more actively involved in actually setting practices. As Elliot states, "any chronic problem—things that bother you everyday—but you can't do anything about it because of your particular niche—needs SCTE involvement."

Still, to Smith, the issue goes deeper. "I came from a tiny cable system and I didn't know any better on how fittings went together. But I didn't know I could call a manufacturer to help me. One of my personal objectives (with the practices committee) is not to tell the ATC's, the TCI's and the Jones' how to do things but to give the little guys, the smaller operators, that don't have research departments and engineering labs, a chance to get it right."

Perhaps CableLab's Green sums it up best. "In any event, these voluntary standards are time consuming. But when you reach an agreement, a consensus among the industry, you've got a powerful position because everyone's interest has been taken into account. That's the way to do it." ■

—Kathy Berlin

Battling the cable converter pirates

Signal security. It's not one of the "sexy" issues of the day, but it remains perhaps one of the most important topics on the minds of cable operators. Estimates vary, but no one disputes that illegal converters cost the industry hundreds of millions of dollars every year in lost revenues.

It's recognized that the black market is strong for cable converters and efforts to break up pirate rings have been widely reported. Yet many unsuspecting cable operators, converter repair houses and equipment brokers may actually be contributing to the problem by not fully understanding how pirates think and operate.

Where does the gear come from?

It's hard for even those responsible for the policing and security of these products to tell where most of the illegal boxes come from, and opinion varies. "It can come from a variety of potential sources," says Steve Necessary, director of marketing for Scientific-Atlanta. "Sometimes they are taken through actual theft and pilferage and that can happen anytime through the shipping process as well as when the cable operators own them. There are instances where you ship 100 boxes to a site and 95 get there. Well, those five went somewhere. They may have been run over by the forklift but, in fact, you don't know where those other five went."

"I'm not sure we have a percentage breakdown as to where the product originates," says Jim Allen, director of the National Cable Television Association's Coalition Opposing Signal Theft (COST). "But we definitely have a feel for various directions from where it's coming."

"In some of the cases (where) federal authorities got involved in the last year to 18 months, business records would appear to indicate that, indeed, there is a tie into offshore manufacturers, namely Taiwan and South Korea," Allen points out. "Usually, that type of equipment would be an add-on type of unit that looks similar to (original equipment)."

By George Sell, Contributing Editor

"There would appear there are pirate operations who are passing themselves off as either legitimate cable operators or companies, who solicit equipment not only from legitimate manufacturers such as S-A, Jerrold or Oak, but also from operators and legitimate third-party brokers," says Allen. "They use acronyms that are similar to legitimate cable companies, or names that are different only by one word, or an interchange of whatever title they are using for that particular entity."

"Thirdly, I guess there is a problem with the used equipment market, in that perhaps people are not being as conscientious of doing due diligence with the business that they are buying and selling from, because it would appear that there is obsolete and excess equipment in the marketplace that finds its way into third party hands."

Allen says there is also some concern with converter repair houses. "There hasn't been any direct substantiation of it, (but there is a concern that) not all the equipment that is sent in for repair is repaired or repairable, or claimed to be repairable, and a certain percentage that is allegedly headed for the scrap pile never quite makes it that far and ends up in the wrong hands."

Tracking methods

All converter manufacturers use serial numbering systems for warranty records and for tracking decoders and, in the case of addressable converters, both a serial number and an individual address code for each unit. According to Mike Kraus, manager of Jerrold's Kansas City repair facility, the system of numbering or coding each box means that each unit can be accounted for by a check list as it passes through the distribution system.

"They are serialized and bar coded and all that information is fed into (a computer). When it's initially shipped to the system, all that information is fed into the warranty system. A converter that was sold five years ago, I could go into the warranty system right now and tell you who it was sold to and when," Kraus says.

Scientific-Atlanta uses a similar system which tracks individual units as they are shipped to the customers and as those units move back and forth from the repair process.

This system can, in many cases, be used to control the illegal use and distribution of descramblers and addressable decoders. Manufacturers can assist anyone in tracking their units. Says LeRoy DeVries, director of field operations and technical sales for Oak, "If it is an Oak product, if (an operator) calls anyone within our company, we'd be more than happy to assist them to determine the status of the product. In fact, I use it for going back and finding out who we sold these products to and what they've done," DeVries says.

Independent repair facilities can also use this system that originates with the manufacturers. If they do, the tracking system continues to have integrity. Jack Hooper, general manager of Anixter's ACES converter repair/exchange program says, "We follow the manufacturer's serial numbering system. Every unit that goes out of here is recorded by serial number."

But the serial numbering and coding system isn't a foolproof tracking method. If a repair house does not use it, the trail can go cold. Some independent repair houses, like Cable Link, introduce their own numbering system. "We bar code our own units," says Stan Smith, a senior account executive at Cable Link. "We used to use a regular sticker with a sticker gun, but now we use a bar code and we track them that way. It tells us the system name, what kind of unit it is and our processing number."

Others, like SCI CATV Services, use the original serial numbering system only when the cable system does. According to Sales Manager Tom O'Brien, "It would depend on whether the system that sent them have logged every number and sent it to you. Everything is checked off to see that we have received everything they sent. Serial numbers are all logged on this end."

Other repair houses simply ignore the original serial numbers. Intrasteller Electronics is a repair house that also brokers used converters through

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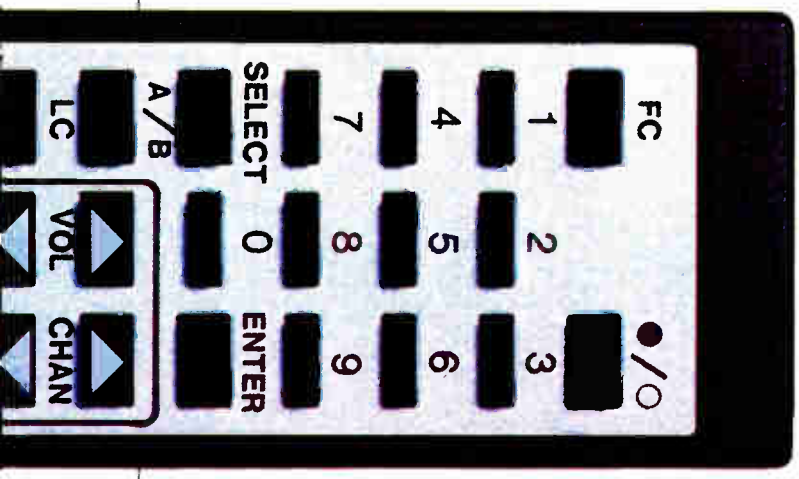

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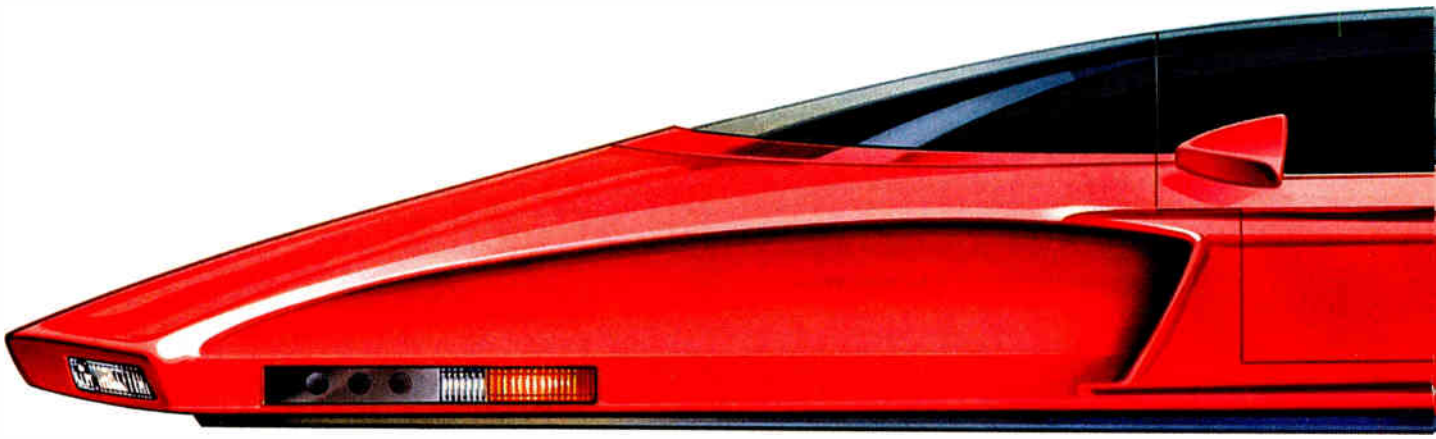

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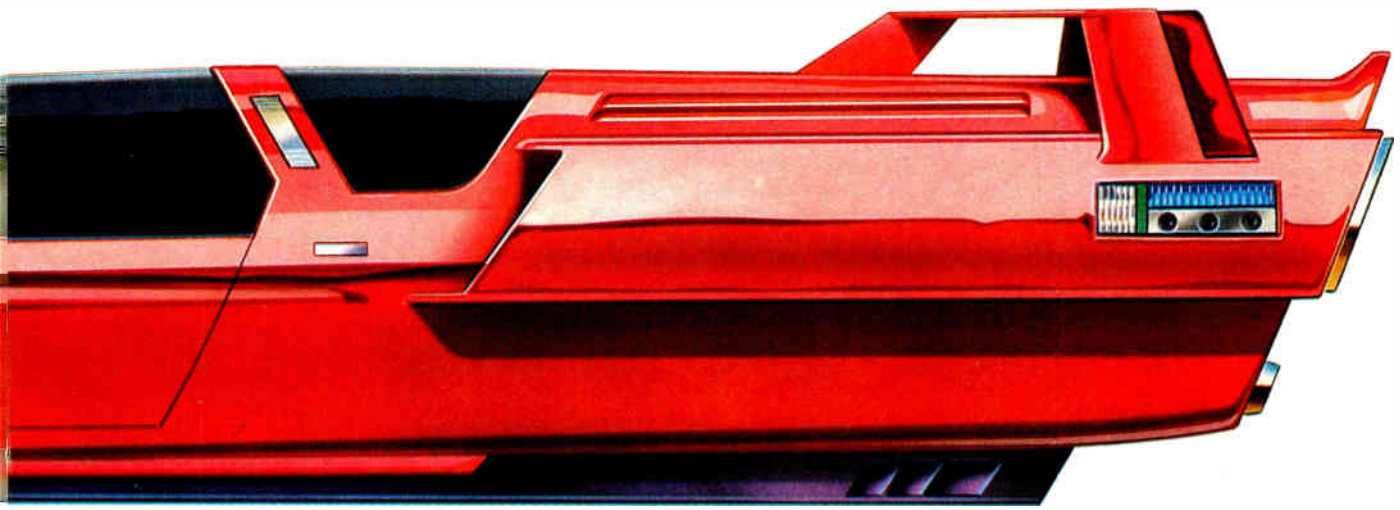

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its affiliation with Authorized Parts Company. Intrasteller believes the serial numbering system is not its concern. Tom Brannum says, "As far as the boxes leaving the (cable) system, that's really not our end of it. The cable system tracks it and if they lose track of their inventory, we don't know anything about it. They just send what they need to repair. Or if they need to buy some excess converters or if they have converters for sale, we help them out with that." Intrasteller does not use any system of serial numbering or coding of each box. "That's time consuming," says Brannum.

"There are not bar codes on most of the equipment we run through here. It's just not economically feasible. We go to the cable system and say, 'Your repair price is $12.95. If you want us to track the serial numbers for you, then it's going to be $20.95.' We don't have that in our budget. They (operators) give us 100 units to repair and we track that in-house to make sure that they get their 100 units back."

The serial number tracking system also breaks down when numbers are removed or obliterated. Because converters can be programmed to decode any or all pay services, Oak's DeVries cautions operators to be wary of units with altered or missing serial numbers. "Any company that is dealing with boxes that have had any type of damage or removal of the bar code labels should immediately question the company they are getting it from and it means that somebody has tampered with the box, and probably for the wrong purpose," DeVries advises.

"That is a problem," says Allen of COST, "and in most of the larger federal cases that we've seen most of the identification has been removed to the extent that you knew it was there to begin with but it is no longer legible."

Anyone who sells cable decoders should ask for credentials to determine that the buyer is a legitimate cable operator. One method is to ask the buyer if he has signed contracts for pay service. Says Anixter's Hooper, "If they are a cable system listed in the Cable TV Factbook, I think that is a pretty good credential. As for SMATV systems, I would not sell to them until I could satisfy myself that they're paying for the premium services that they are receiving. And the other thing I would check is the cable system in the area where this (SMATV system) is."

"When a company seeks to order equipment from us," S-A's Necessary says, "we run them through our normal credit procedures which involve running the Dun and Bradstreet report on that company and getting standard bank references and credit references or trade references."

Repair houses

Of course, when descramblers and addressable converters need repair they are often shipped to factory repair facilities. But large quantities of units are also shipped between cable operators and independent repair houses that act as outside contractors.

Perhaps the largest independent repair house is BradPTS. According to Jeff Hamilton, executive vice president, Brad sells and distributes new converters for Oak and Jerrold and remanufactures and refurbishes used equipment before reselling it to MSOs.

"Where remanufactured product comes into play is on units that are probably no longer being manufactured but the cable TV company has (those units) in the field, and they want to continue to use that unit, but it's not available from the manufacturer anymore," Hamilton adds.

"My experience is a lot of these people go to great extremes to conceal their true identity and, in fact, deceive people," says Hamilton. "What I see happening is people fraudulently portraying themselves as cable operators or distributors, and people don't take the time to check out the credentials of the people buying the boxes."

Not only are cable operators and independent repair houses subjected to calls from deceptive buyers, so are factory repair centers. "Occasionally you will get somebody calling in from a company that you've never heard of and not in any of the published directories," says Larry Neblett, manager of Tocom's repair facility in Matamora, Mexico. "You can generally tell when people are trying to put boxes on the black market, or at least tell when it's not just a simple repair effort."

"You can open up any hobby magazine today and see cable TV converters for sale by unscrupulous sources," Hamilton points out. "They have blind post office boxes and people who deal in deceiving people."

"They'll call up a cable operator and say they're looking for some S-A 8580 boxes and the cable operator may not take the time to check out the caller. I don't think the operator knowingly is selling to somebody who they know is going to turn them loose on the street. I've never found that to be true."

"We have people like that call us, too, for converters," Hamilton continues. "Our main warehouse for converters is in New York and we have a security man there who must authorize all sales of converters and his sole purpose is to make sure that converters leaving our warehouse are going to

Keeping your eyes open to fraud

The following guidelines, if followed, will help cable operators, repair firms and other entities that buy or sell cable decoders determine that they are dealing with legitimate buyers or sellers of basic or addressable converters/descramblers.

In most cases, a few simple telephone calls will get results. If fraud is suspected, contact Jim Allen, executive director of the NCTA's Coalition Opposing Signal Theft (COST), telephone (202) 775-3550, and/or law enforcement authorities.

Some other things to keep in mind:

1. If they say they are a cable operator, and are not listed in standard directories of cable operators, ask for a copy of their municipal franchise agreement and then check with the franchising authority.
2. Before any shipping, verify that the address it is being shipped to is the same address listed for the bonafide cable operator they say they are.
3. Ask for copies of their contracts with pay programming services and then confirm these contracts with that pay service.
4. If the buyer wants converters that use different types of descrambling methods, you should immediately be wary of the caller's intent, even if they are otherwise a legitimate customer.
5. Check their credit rating even if they offer cash deals or COD shipments. Legitimate buyers or sellers, as opposed to those on the legal fringe, should have good credit and good business practices.

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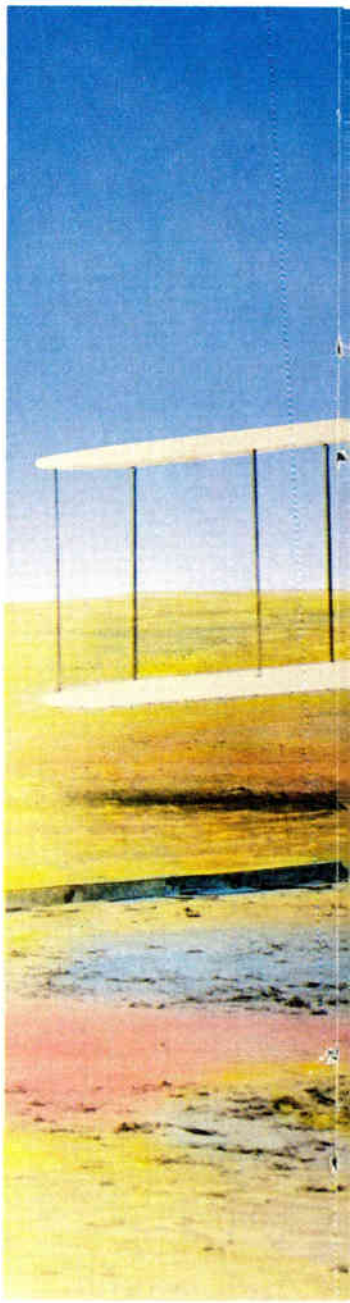

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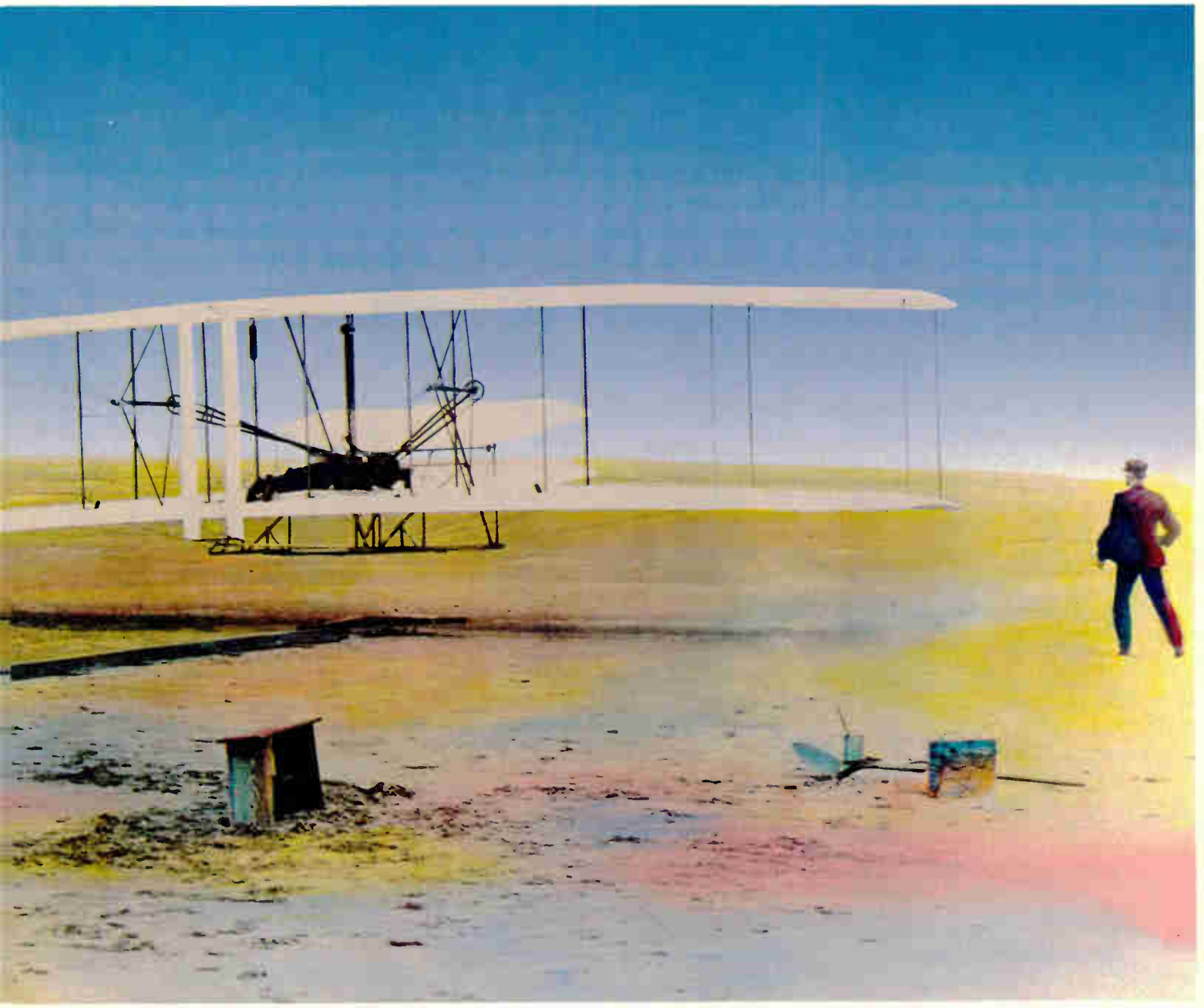

legitimate franchised cable operators."

Out the back door

Despite all the safeguards, manufacturers and repair firms can be burned by legitimate cable operators. "I hate to tell you," says Steve Necessary at S-A, "but there have been instances where even franchised cable operators have sold product out their own back door. We had one instance where we became aware of that and, obviously, we discontinued sales to that cable operator."

Necessary adds, "Obviously, none of us like to hear of that and I don't even like to tell you that that happened, but he met the criteria as well as any of us can. He was a good guy. Sure enough, he was running a small cable system. So, sometimes the temptation affects even the people who meet all the criteria."

In order to dispose of old equipment and recoup some of the capital loss, some cable companies will sell them, perhaps unknowingly, into the black market. "I have personally seen that happen with a couple of the major cable companies, major MSOs, where divisions of that MSO have gone out and sold them that way," says DeVries.

Also, cable operators need to be mindful that lax and unsecure warehousing of converter inventories can be a great temptation to unscrupulous workers. "I came from working at a system," says O'Brien of SCI CATV Services, "and I saw how some of the warehouses worked. I think there is a lot of room in some cases for improvement in security."

In order to dispose of old equipment and recoup some of the capital loss, some cable companies will sell them, perhaps unknowingly, into the black market.

When a cable operator, repair house or broker suspects fraud or theft of decoders, it should contact the NCTA's COST Program in Washington. "That's really the purpose of the COST organization," says DeVries, "to try to help cable companies identify the problem areas and resolve issues like that."

"As for the primary manufacturers, they are involved with COST," says Allen. "They have been very cooperative in assisting federal authorities who have asked for technological inspection or analysis of equipment that has been seized in some of these raids. I think they are much more aware perhaps than they were a couple of years ago as to the extent of the problem and how they might interface with the rest of the industry in attempting to combat this." ■

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The flexibility designed into this fiber optical network provides for bandwidth on demand. Starting with a single voice telephone channel to a system providing 2D + B telephony and data with expandable data up to DS3 line data rates. Television capability from slow scan to full motion high quality starting from 48 channel expandable to 192 channel selectable television programming. Extended features in video to encompass the ability to have pay-per-view features, and future HDTV program delivery. The media for transmission of these services is via a fiber optic cable network.

The flexibility designed into this fiber optical network provides for bandwidth on demand.

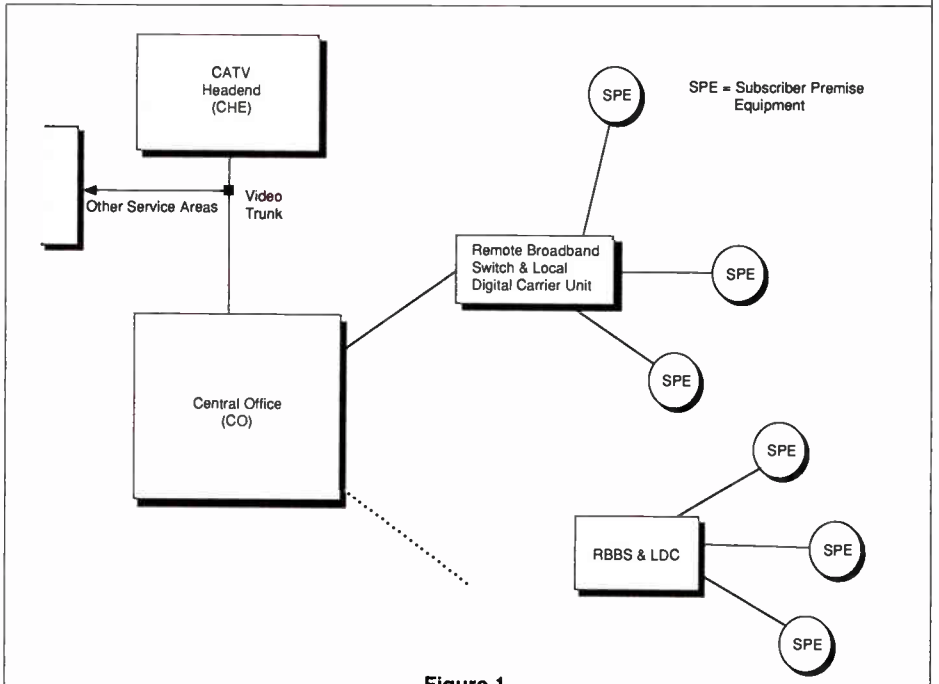
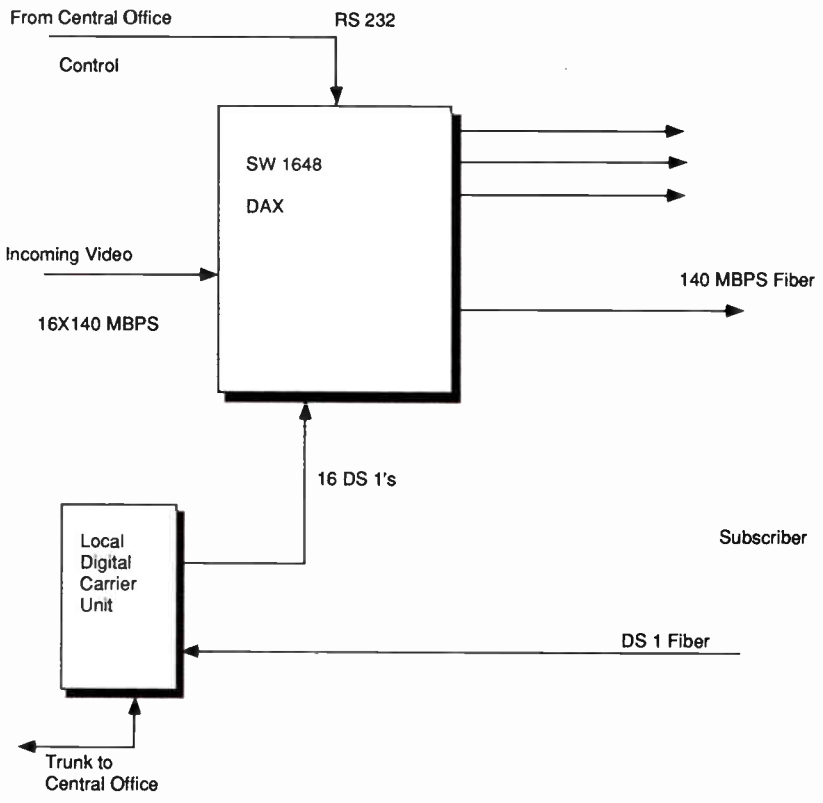


Figure 1



Integrated Video and Telephone Distribution
Figure 2

System description

The overall structure of the network is shown in Figure 1. The major network components are the CATV headend (CHE), the telephone central office (CO), the remote broadband switch units (RBS), a digital loop carrier unit (DLC) and the subscriber premise equipment (SPE).

At the CHE, the satellite down-link signals are demodulated to baseband

By Steffen Rasmussen, President, ABL Engineering Inc.

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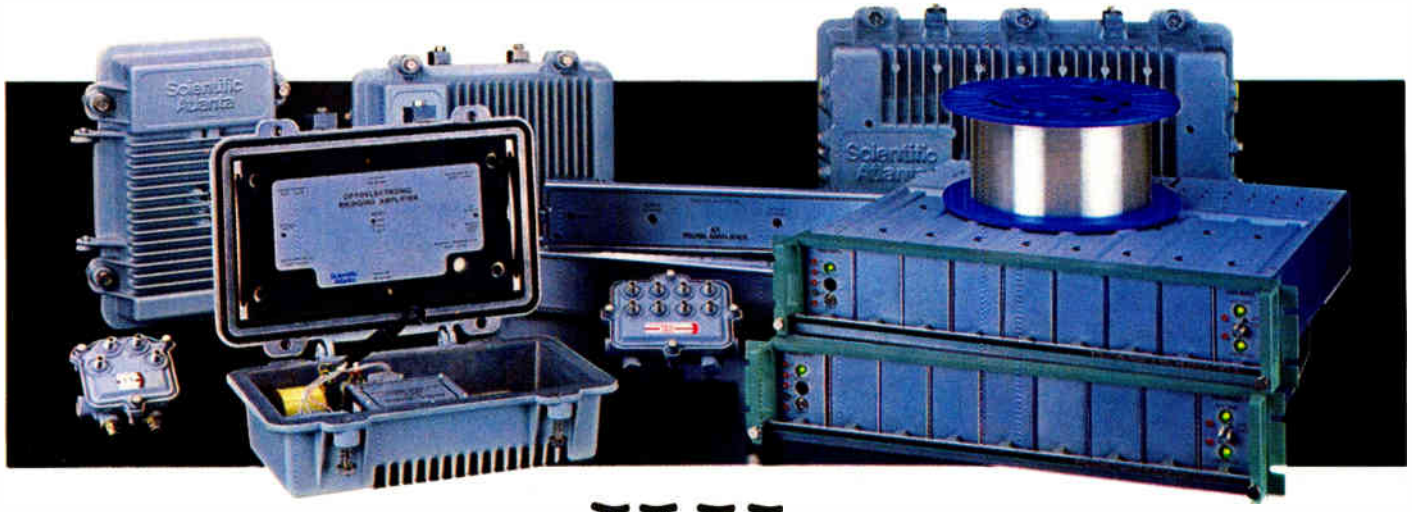

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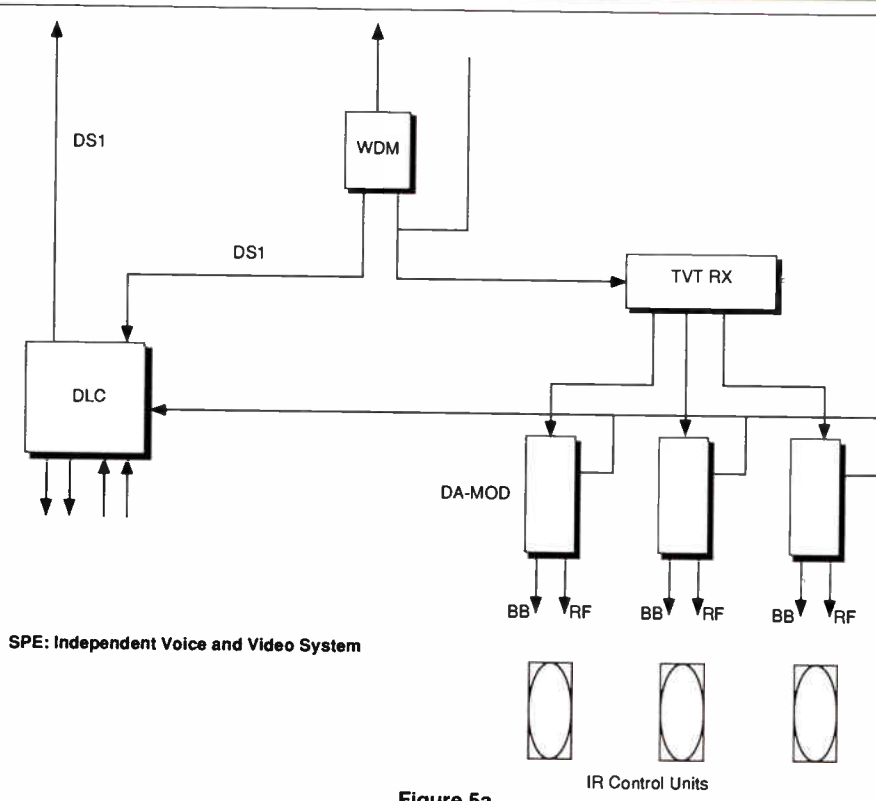


SPE: Independent Voice and Video System

Figure 5a

separate.

At the CO the voice and data information is integrated or time division multiplexed into the auxiliary data channels allocated for telephony and data in the digital video and audio information.

For further distribution of the digital data, it is sent to the remote switch sites and local digital carrier unit locations via the 565 Mb/s high data rate fiber optical transport systems, that operate short as well as long hauls.

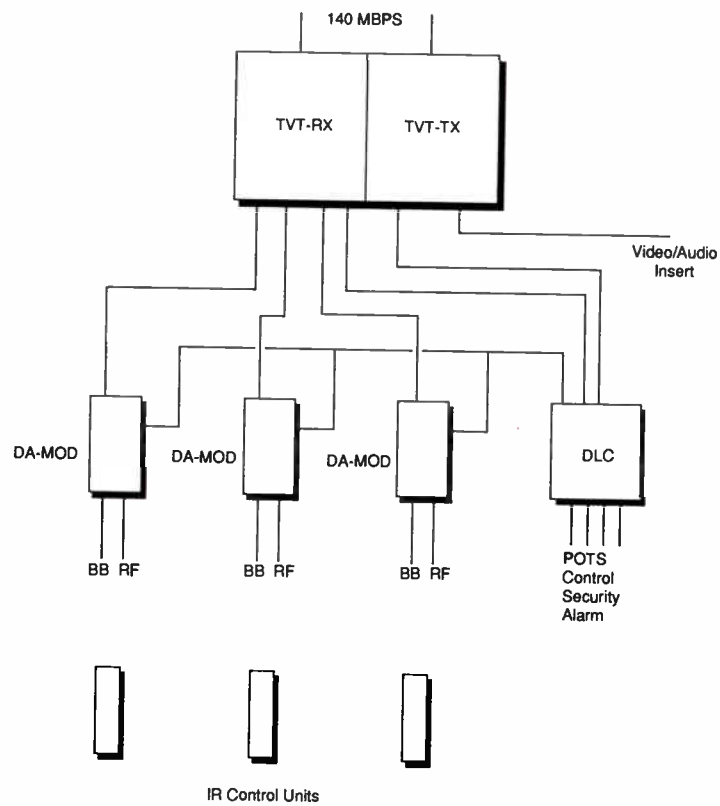
Remote switch centers

At the remote switch centers, the television, audio, voice and data information is demultiplexed and interfaced to the local digital loop carriers. The video and audio information is demultiplexed to 140 Mb/s level and interfaced to the broadband switch, SW 1648 DAC, a digital access cross connect switch as shown in Figure 2.

The DLC unit provides DS1 data streams where DSO slots are allocated per subscriber demand.

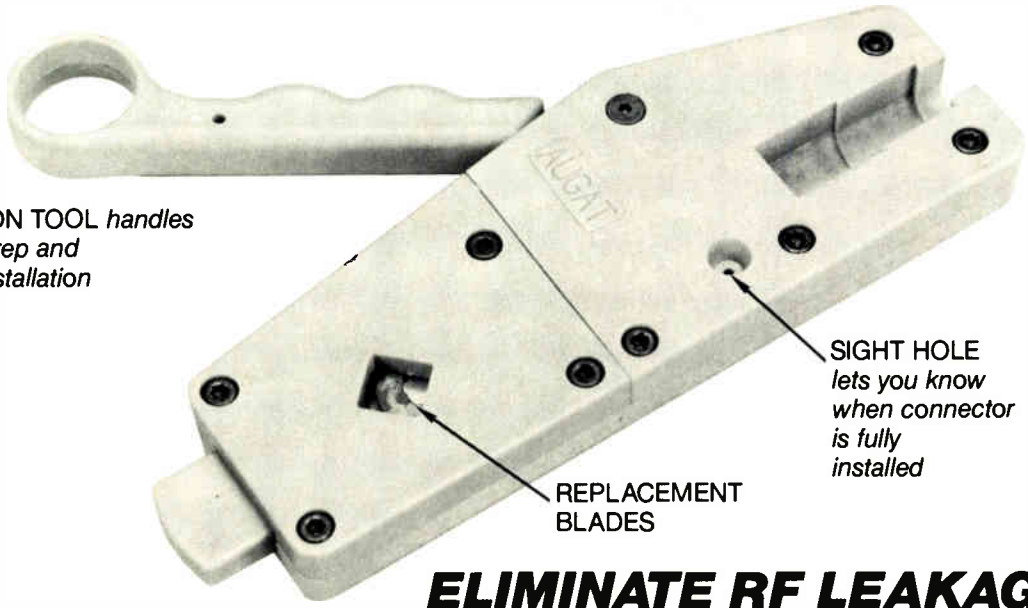
Each subscriber on the network has a 140 Mb/s of downstream data to his premise. Included in the 140 Mb/s data stream are three subscriber selectable 45 Mb/s videos, with associated audio signals and a 1.544 Mb/s data stream for voice and data.

SPE 140 Based System



SPE Bi-Directional Video

Figure 6



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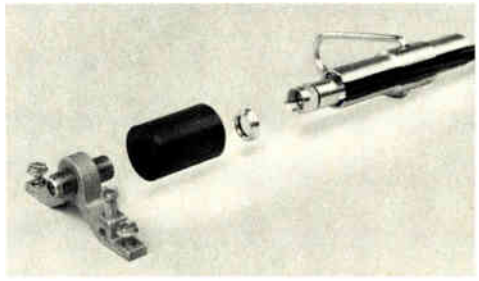

Security shield and security shield tool

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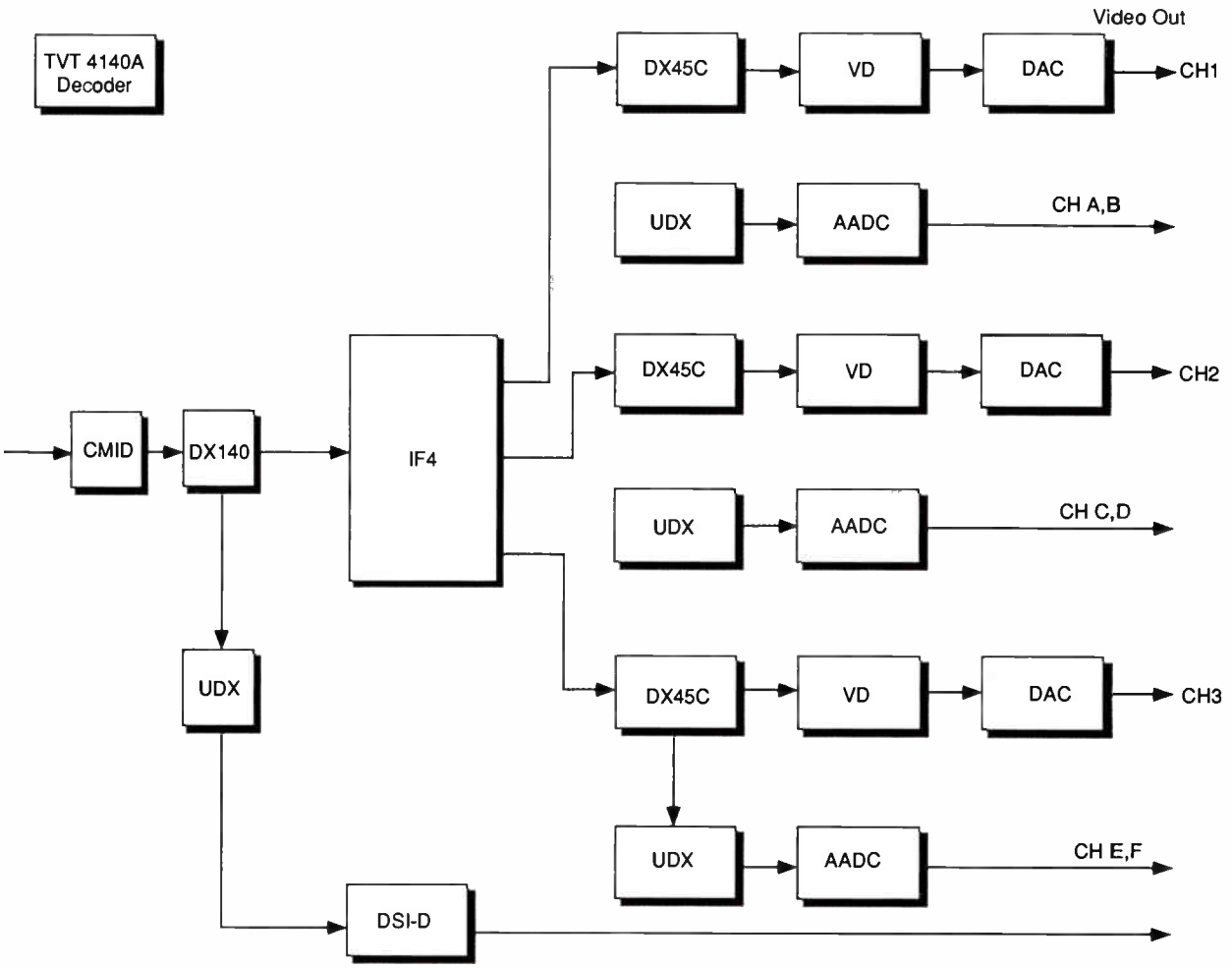


Figure 7

The data signals are carried on single-mode optical wave guides to each subscriber. In situations where the fiber cable will not support two separate fibers, wave division multiplexing will be used. The wave division multiplexing system will support bidirectional communications on a single fiber.

The upstream or return data stream will have one 1.544 Mb/s data stream for voice and data. If high quality return (bidirectional) video audio is needed, multiplexing of 45 Mb/s or 140 Mb/s data with video can be added to the subscribers return data as shown in Figure 3.

The delivery of multi selectable video is done through the previously mentioned SW1648 DAC, digital cross connecting switch. The SW1648 DAC switch product is designed to provide each subscriber with program selectivity of 48 channels of video, where any three of the 48 offered video channels are delivered to each subscriber. The SW1648 DAC connects a group of 16 subscribers to the network. The SW1648 DAC has feed-through capabilities (regenerating) for tandem coupling as new subscriber distribution stars are added to the network.

The delivery of multi selectable video is done through the previously mentioned SW1648 DAC, digital cross connecting switch.

The SW1648 DAC also interfaces the digital loop carrier unit to insert the 1.544 Mb/s data into the 140 Mb/s data stream. The SW1648 DAC interfaces the DLC unit and the video trunking system at an electrical interface of DS1 and DS4E respectively.

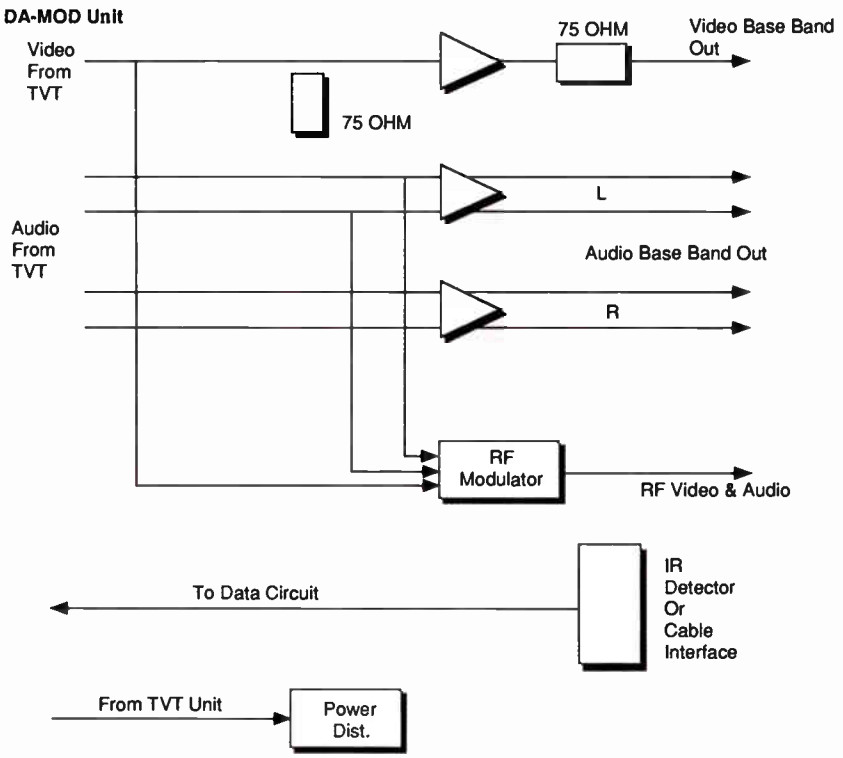
The subscriber side of the SW1648 DAC is fitted with optical equipment for either single-mode lasers or LEDs, depending on distance. The typical optical power budget for a laser based system is 36 dB and 10 dB for an LED based system. This will allow transmission distances up to 45 cable miles before regeneration is needed between local distribution points and subscriber premises. This will benefit by having one central office encompassing an entire metropolitan area or radius of 45 miles.

To facilitate program selectivity, the SW1648 DAC is remote controllable. The subscriber can select or scan video programming from the home console. Control signals for TV channel selection are routed back to the central office via the DLC system. Control

information from each console is sent back to the switch for reconfiguration of the downstream video. A master control computer for control of SW1648's is located in the central office and is tied into the telephone billing system to provide information on pay-per-view or statistical viewing preferences, as illustrated in Figure 4.

At the subscriber's premises, a TVT4140A receiver unit will be installed. (See Figures 5 and 6). The TVT4140A unit recovers the three selected video programs with associated stereo audio and the 1.544 Mb/s data stream from the 140 Mb/s optical signal, as depicted in Figure 7. The 1.544 Mb/s data signal is applied to the digital loop drop and insert unit. The video and audio is available from the subscriber's premise unit in either baseband or on modulated RF carrier to facilitate the subscribers equipment sophistication, as shown in Figure 8. ■

Part II of this paper will appear in the December issue of CED. *At that time, the following topics will be addressed: Headend equipment; Local switch sites; Subscriber premise equipment; System performance monitoring; Network cost performance; Future needs; and Pricing.*



Video & Audio Interface
Figure 8

Easier testing with a CATV analyzer: Part II

This series of articles began by describing a CATV analyzer as a portable, swept-tuned spectrum analyzer customized for making measurements in the cable-system environment. The basic measurement capabilities of the modern spectrum analyzer, together with sophisticated digital functions such as markers and the fast Fourier transform, make this instrument especially well-suited for cable applications such as headend testing, trunk maintenance and CARS-band measurements. A number of tests that can be made more easily using a CATV analyzer will be examined in this and upcoming installments.

Figure 1 shows the basic block diagram of a swept-tuned spectrum analyzer. The dotted lines associate front-panel keys such as *amplitude, frequency,* and *span* with the analyzer functions that they control. Notice that some keys are controlled by, or "coupled" to, other keys: *amplitude* to *attenuation*; and *span* to *sweep time, resolution bandwidth*, and *video bandwidth*. This coupling simplifies operation because adjusting one control automatically adjusts others. However, these functions can all be uncoupled to give greater flexibility in test situations that call for it.

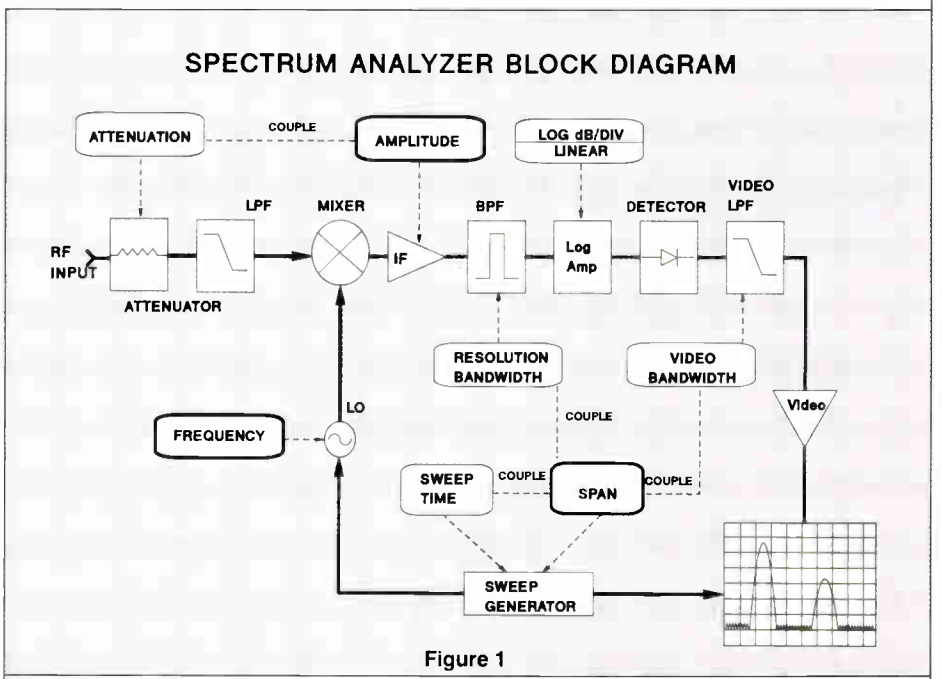


Figure 1

Amplitude measurements

If we follow a signal from the RF input into the spectrum analyzer, we first pass through the section associated with the *amplitude* key. This key controls the position of a signal on the CRT by adjusting the RF attenuation and IF gain in the signal path from the RF-input connector to the IF amplifiers. This produces a large amplitude range for measuring signals of widely differing levels: a range of 138 dB for 75 ohm operation and 145 dB for 50 ohm operation. A wide amplitude range is important for many CATV tests.

In Figure 2, for example, we see a measurement of carrier-to-noise ratio (about 60 dB for this case). The carrier amplitude was measured first, and then the noise floor was moved up from the bottom of the CRT for measurement, pushing the high-level carrier off the top of the screen. This measurement was done sequentially because the signal separation, about 83 dB, was too large for both carrier and noise to be displayed together.

Returning to the block diagram, we see that the IF signal passes from the IF amplifier through the bandpass filter to the log amplifier. The log amplifier gives the analyzer an 80 dB

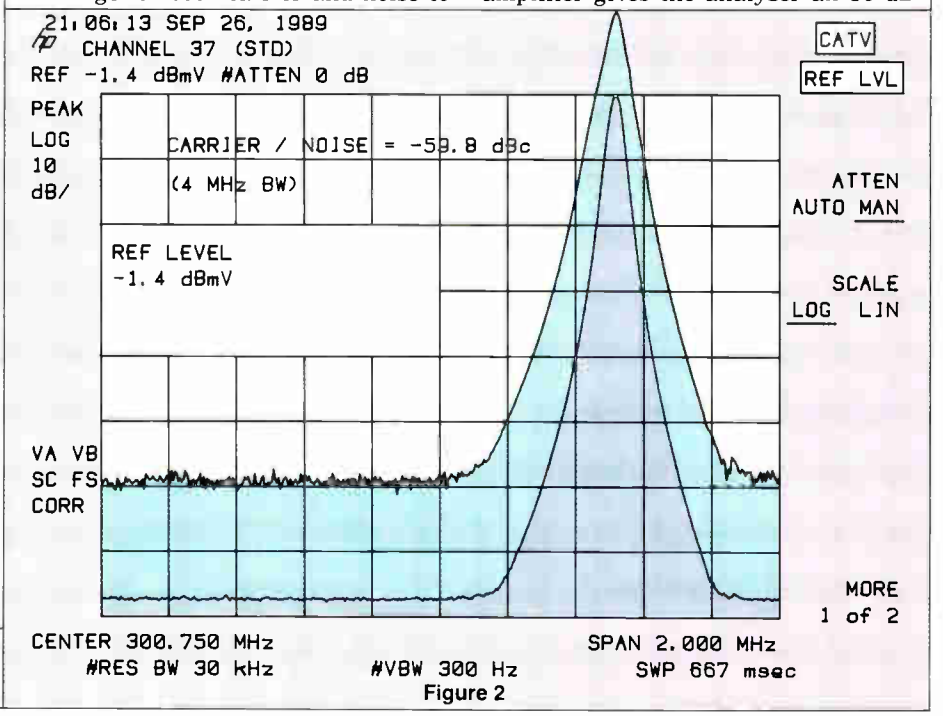


Figure 2

By John Cecil and Mary Jane Pahls, Signal Analysis Div., Hewlett-Packard

display range, compared to about 20 dB on an oscilloscope. Accurate amplitude measurements can be made in the first 70 dB below the reference level; however, the lowest 10 dB of the CRT range is useful for identifying low-level signals. The log amplifier changes its gain depending on the level of the input signal, compressing high-level signals so that high- and low-level signals can be displayed simultaneously, Figure 3.

The vertical scale of the CRT can be changed using softkey menus that appear in the amplitude key menu. Amplitude scale can be changed from logarithmic to linear units similar to those of an oscilloscope, with the reference level converted from power to voltage units; amplitude-scale units can be selected as dBm, dBmV, dBuV, volts, and watts.

The attenuator in the block diagram reduces the input signal below the mixer-compression level of +39 dBmV for 75 ohm operation and -10 dBm for 50 ohm operation. This ensures accurate display of the signal's amplitude. Following the attenuator, the low-pass frequency filter rejects high-frequency spurious signals that are outside the frequency range of the analyzer. The attenuator is usually coupled to the reference-level setting so that a signal at or below the reference level will not exceed mixer compression. You can change attenuation over a 60 dB range using a softkey; however, the analyzer does not allow a combination of reference level and attenuation that would cause mixer compression.

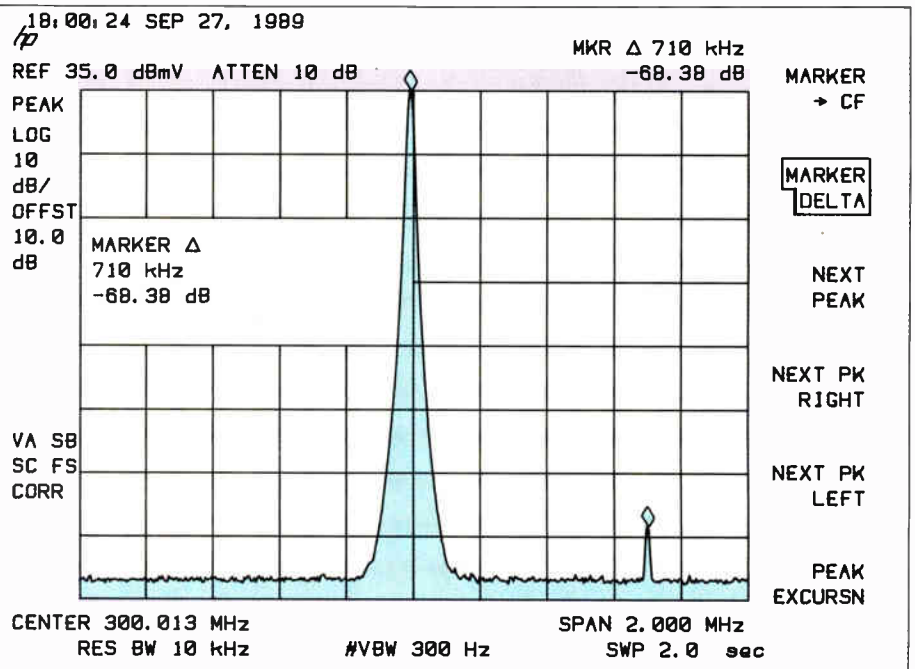


Figure 3

Frequency measurements

How does the spectrum analyzer measure the amplitude of individual

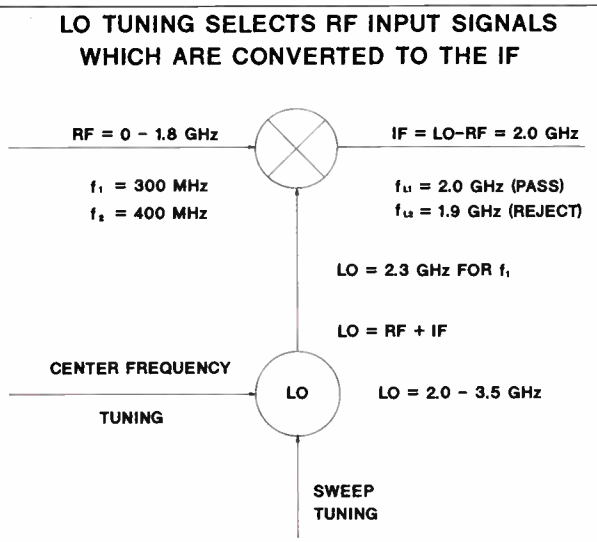


Figure 4

signals out of a broadband spectrum containing, for example, dozens of CATV channels? Figure 4, the input mixer, shows us. The RF-input and local oscillator (LO) signals combine in the mixer to create a fixed-IF signal. The fundamental tuning equation determines the LO frequency needed to mix with a specific RF signal to produce the IF: LO = RF + IF or IF = LO - RF. As the LO center frequency is tuned, the unique input frequency that can be converted to the IF changes. Tuning the LO, thus, tunes the RF input, and individual RF signals are selected for viewing on the CRT by tuning the LO. The example in Figure 4 illustrates how a 300 MHz signal is selected while a 400 MHz signal is rejected.

Compared to the frequency range of an oscilloscope, the frequency range of a spectrum analyzer is very wide. This allows the analyzer to display signals within a broadband spectrum such as the CATV band. Center frequency of the RF spectrum analyzer used in these examples can be tuned from 9 kHz to 1.8 GHz; of the microwave version, from 9 kHz to 22 GHz.

You can step between TV channels by changing the step-key resolution with a soft key that controls center-frequency step size. By setting the step size to 6 MHz, you can tune between channels simply by pressing the step-up and down keys.

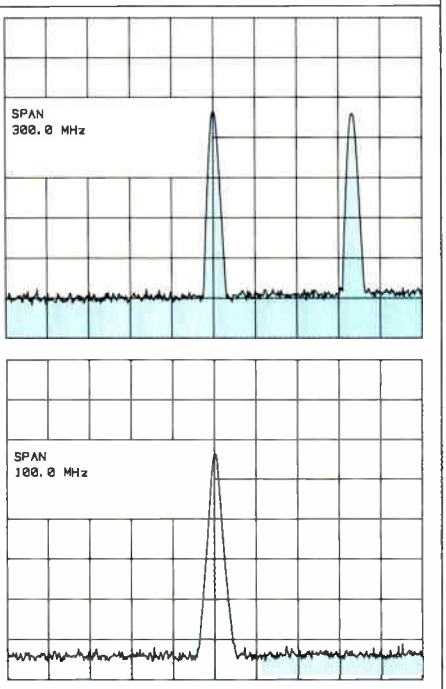
Span

Looking again at the input-mixer diagram, Figure 4, we can see how the spectrum analyzer displays a number of different signals simultaneously. As the LO center frequency is swept by the sweep generator, the analyzer opens a window for viewing RF-input signals in a frequency range determined by the swept-LO range. If the window size is wide enough to include the input signals, the analyzer will display them, but signals outside the window will be excluded. In Figure 4, the 2.3-GHz LO is swept ±150 MHz, creating an RF window from 150 MHz to 450 MHz around a 300 MHz center frequency.

With this 300 MHz span, both 300 MHz and 400 MHz input signals are displayed (Figure 5) because each generates the IF at different times as the LO is swept. However, if the span is reduced to 100 MHz, or ±50 MHz about the center frequency, the 400 MHz signal will no longer be displayed because the input window will range only from 250 to 350 MHz.

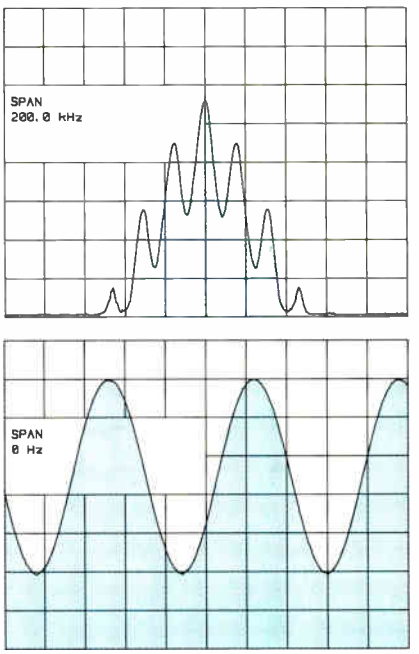
Altering the frequency span allows us to control the detail of the spectrum displayed on the CRT. In Figure 5, a span of 300 MHz allowed both the 300 MHz and 400 MHz signals to be displayed at the same time. If we widen the span further, 1,800 MHz for example, we could check for harmonics of both signals.

For more detail about an individual signal, however, the span must be decreased. So, to find spurious signals (beats) that are interfering with TV picture reception, you would narrow the span and look near the visual carrier.



a) (above) Increase span for broadband detail
(b (below) Decrease span for improved signal detail.

Figure 5



(a) (above) Measure modulation sidebands in a narrow frequency span
(b) (below) View the demodulated signal in zero span

Figure 6

Further reducing the span to 200 kHz (Figure 6) shows that the 300 MHz signal has 15 kHz AM sidebands. In this way, the 15 kHz horizontal-synch sidebands on the visual carrier of a TV channel can be measured. Even more detail can be seen in narrower spans. In 0 Hz span (Figure 6), the analyzer demodulates AM and FM signals for viewing signals in the time domain. We will discuss how zero span can be used to display low modulation rates such as 60 Hz power-line hum in Part IV of this series.

Resolution bandwidth

Although the frequency span allows us to choose spectrum detail for different applications, from viewing the entire CATV spectrum to analyzing the modulation of an individual channel, it is the resolution bandwidth that actually lets us see the detail itself. The bandpass filter in the IF path (Figure 1) rejects signals that are not at the IF frequency; those that are at the IF frequency are passed on. However, the

signals passed on do not appear as vertical lines on the CRT; instead, they copy the IF-filter shape, which is Gaussian or "bullet-nosed." The IF signal is actually swept in frequency because the LO is swept. Therefore, the swept IF traces out the IF-filter shape.

The IF signal exiting the IF filter has an AM-envelope shape (Figure 7). The peak detector (Figure 1) in the IF path rectifies the envelope; only the IF-signal peaks are passed on. The result is a video signal with the shape of the IF filter. The video signal is then displayed on the CRT.

The ability of the analyzer to separate signals on the display depends upon characteristics of the resolution bandwidth filter. Narrow bandwidths separate more closely spaced signals. The ratio of the bandwidth at -3 dB and -60 dB (typically 11:1) is called the shape factor and is important in determining signal resolution. The spectrum analyzer automatically sets the resolution bandwidth unless otherwise adjusted.

Figure 8 shows two resolution-bandwidth conditions for displaying two 300 MHz signals separated by 100 kHz. The signals are easily seen in a 2 MHz span with the 10 kHz bandwidth selected by the analyzer. They are still visible as the bandwidth is increased to 30 kHz, and just barely identifiable as the bandwidth is further increased to 100 kHz. This indicates that signals of equal amplitude can be resolved if their separation is equal to or greater than the resolution bandwidth. For cable television measurements, this implies that a filter bandwidth of 6 MHz or less is needed to resolve the visual carriers of adjacent TV channels that are spaced by 6 MHz.

In most cases, however, signals are not of equal amplitude. But the filter shape still affects the signal resolution. In wider bandwidths, a smaller signal can be hidden under the filter skirt of a larger signal. Reducing the bandwidth allows the smaller signal to be seen as the two overlapping traces show in Figure 9a. Because one 300 MHz signal has been decreased in amplitude by 50 dB, it can be seen only when the bandwidth is reduced to 10 kHz or less (the other trace is for 30

THE DETECTOR CONVERTS IF INTO VIDEO

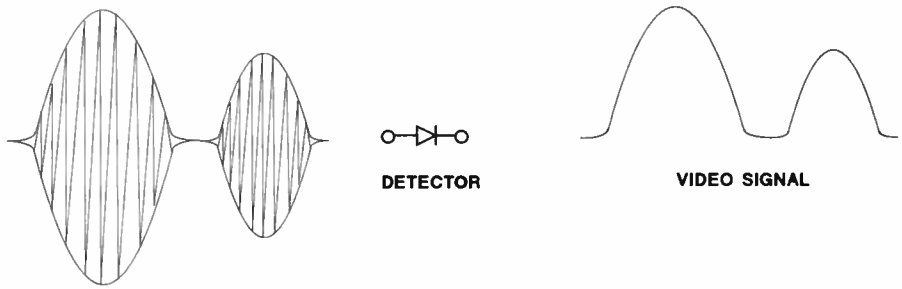


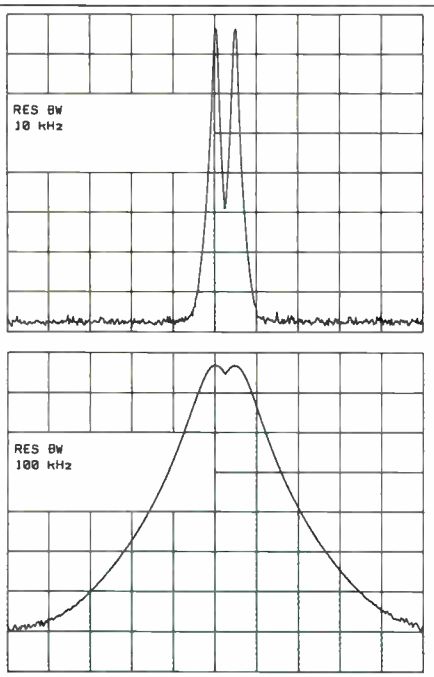
Figure 7

kHz bandwidth).

For a CATV example, a filter of 1 MHz or less is needed to resolve visual and aural carriers, even though the signal separation of 4.5 MHz is wider than a 3 MHz bandwidth. The aural carrier is 15 dB lower in level than the visual carrier, and is partially hidden by the filter response of the higher signal if the 3 MHz bandwidth filter is used.

A signal may also be obscured by an adjacent signal with an unstable center frequency, noise-generated sidebands or modulation sidebands. The offending signal broadens the displayed shape of the resolution bandwidth filter, which may in turn overlap other signals. In Figure 9b, as the higher level signal is FM-modulated, its spectrum is spread out and the resulting sidebands absorb the lower level signal.

Similarly, with the wideband-AM signals used in television, synch pulses and video modulation broaden the video-carrier sidebands. However, even when carriers have AM or FM modulation, adjacent signals may often be seen and analyzed if the resolution bandwidth is reduced.



a) (above) Bandwidth less than signal separation
(b) (below) Bandwidth equal signal separation

Figure 8

Sweep time

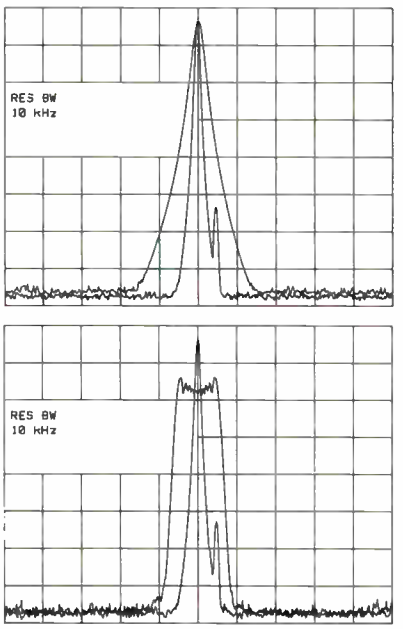
If the narrowest bandwidth filter gives the best resolution, why isn't it used all the time? The answer to this is practicality: the narrowest filter also requires long sweep times for wide frequency spans. If swept too fast, the filter attenuates and distorts signals. To prevent this, the analyzer automatically adjusts sweep time for different combinations of resolution bandwidth and span. As the frequency span is increased, the analyzer increases bandwidth and adjusts sweep time as necessary. If the automatic bandwidth setting is overridden, the analyzer adjusts the sweep for an undistorted signal. If a narrow bandwidth is used in a wide span with a manually chosen sweep time that results in signal distortion and inaccurate amplitude measurements, the analyzer gives an 'uncalibrated' warning message.

Unlike the resolution bandwidth filter, the video bandwidth filter following the peak detector in the block diagram does not resolve RF-input signals. Rather, it controls the frequency range of the video signal, smoothing or averaging noise peaks and other interference that may obscure or distort the displayed signal. The spectrum analyzer automatically adjusts video bandwidth relative to the resolution bandwidth setting, although this filter can be set independently, too. Like the resolution bandwidth, the video can be swept too fast, resulting in an uncalibrated message.

The video filter makes it easier to identify interference signals. Spurious signals of very low amplitude may be hidden in the noise displayed on the CRT. Smoothing the noise helps to locate these signals that could, for example, interfere with TV reception. Figure 10 shows a situation in which using a 30 Hz video bandwidth lowers the noise peaks enough to see a signal that could result from cable-amplifier distortion.

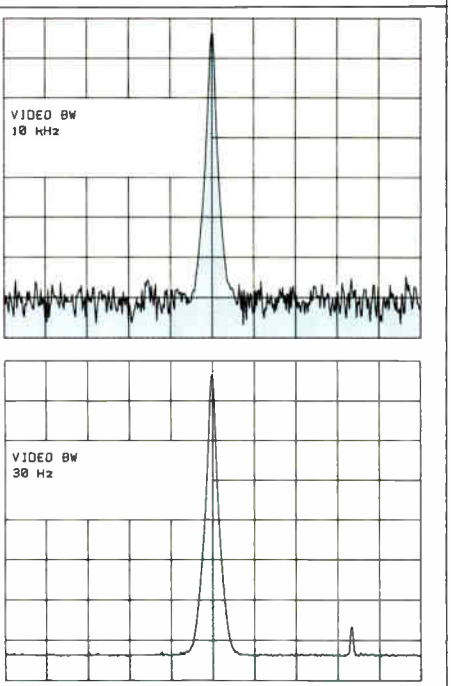
If more than one signal is within the IF bandwidth—that is, if the filter bandwidth is wider than the signal separation—the video signal may appear to jump around on the CRT. Because the signals have not been separated in the IF, they beat together (add and subtract) in the video section. The resulting trace is distorted, with a beat signal superimposed upon it.

When a video-filter bandwidth is used, the disturbance is reduced and the average signal level is displayed. This technique can be used to make composite triple beat (CTB) measurements. When multiple intermodulation signals or beats occur within the resolution bandwidth, the video filter will smooth the amplitude variations so that the average CTB level can be measured. ■



a) (above) Filter shape absorbing an adjacent signal
b) (below) Modulation sidebands obscuring an adjacent signal

Figure 9



a) (above) Wide video filter
b) (below) Narrow video filter

Figure 10

In the next article, we will touch briefly on the uses of the microwave spectrum analyzer in CATV measurements, and then focus in detail on amplitude measurements in the cable-system environment.

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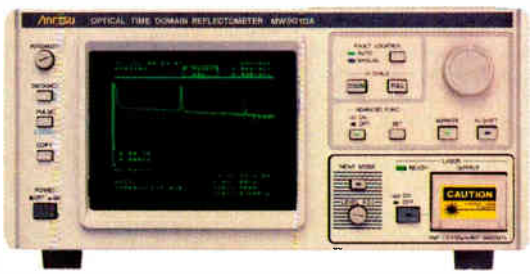

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Reader Service Number 41

Crosstalk elimination with ground control

Crosstalk between television channels was obvious during the early days of cable. One channel would be seen walking slowly across another right there on the screen! The classic cure was to tighten the headend chassis screws until it stopped. Bad cases required the largest of screwdrivers. Today the symptom can be as subtle as a stereo output losing separation, and the fact that it is a headend problem may be completely masked. Good grounding at the headend is known to eliminate crosstalk problems, but there are many ways to ground. Which ones work for video and radio frequency headends?

Video process and distribution amplifier systems and RF distribution systems have the highest resistance to crosstalk when special attention is paid to the local signal returns. Effective yet inexpensive strategies build in this resistance while a facility of any size is being constructed, and the concepts behind these strategies lead to effective ways of insuring that problems at an existing facility are not caused by crosstalk.

Surfaces

Video and RF signals travel on the surface of conductors. They do not *tend* to travel on the surface, they *do* travel on the surface. Metal just below the surface does not carry any current at all, and there is not any penetration of current through the metal from one side to the other; RF current always must go around. Specifically, current penetration in a copper strap at 6 MHz is about 1 mil or 0.001 inch. This tiny penetration decreases as frequency increases and is measured in micro-inches long before channel 2 is reached.

The ferromagnetic nature of steel exacerbates this "skin effect." Current penetration in steel is much less than in copper for a given frequency. In steel, as encountered in an equipment rack, current will travel in 1/17 the depth it would in copper. Penetration at 6 MHz is less than 60 micro-inches or 0.00006 inch. Since the intrinsic resistance of steel is eight times that of copper, at 6 MHz the net resistivity of steel is 135 times that of an identical piece of copper. A current flowing across one inch of steel will have the same voltage drop as it would flowing across over 11 feet of copper.

By Ronn Gunn, Lawrence Livermore National Laboratory

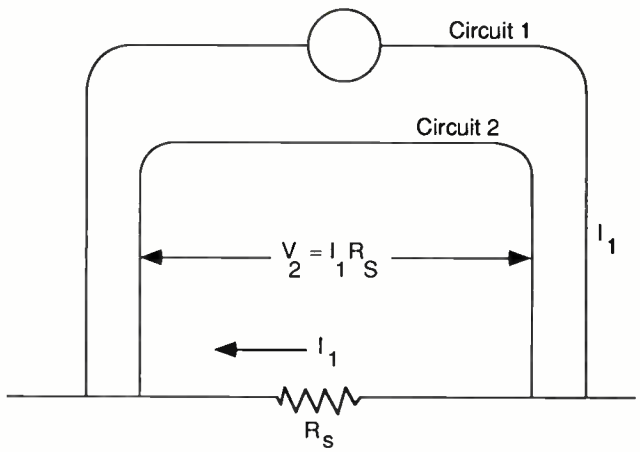

Figure 1

As the current-carrying cross section decreases, impedance increases. As the impedance of a circuit return rises, the return becomes a more significant part of the impedance of that circuit, and the impedance of any other circuit sharing that return. This kind of shared coupling is the classic definition of a ground loop, where there is no capacitive coupling, no inductive coupling, just direct drive from one circuit to the other as shown in Figure 1. If two circuits share a poor return they are directly coupled together and some crosstalk will result.

Circulation

All electrical circuits are just that: circuits. Current circulates. The biggest difference between a DC circuit and an RF circuit is that when a DC circuit is broken, current completely ceases to flow. In an RF circuit, the existence of stray coupling and radiation will allow it to continue to function at some level even if the main return is broken or of low quality. This "almost connected" mode of operation is deceptive because things seem to be working.

What has happened is that the impedance is higher than it could be, and this higher impedance return is a larger percentage of the total impedance of any circuit connected through it. Circuits with a poor return are touchy circuits. Worse, if two circuits share a poor return they are coupled together and crosstalk results.

Earth grounds

The fact that currents circulate is a vital thought when considering the role of earth grounds. Before resorting to heroic measures to install an earth ground, list the currents that will

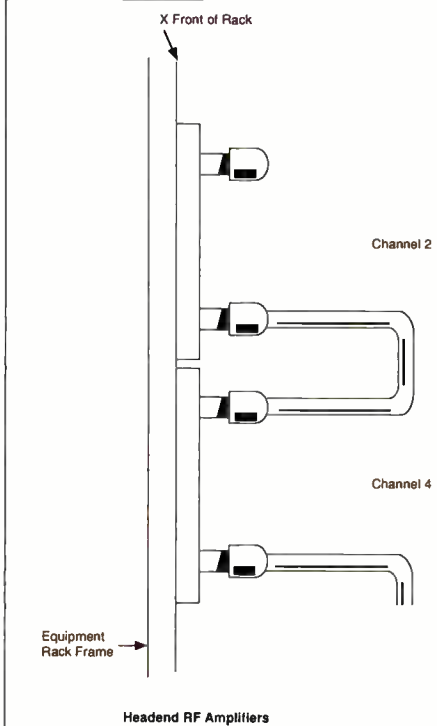

Figure 2

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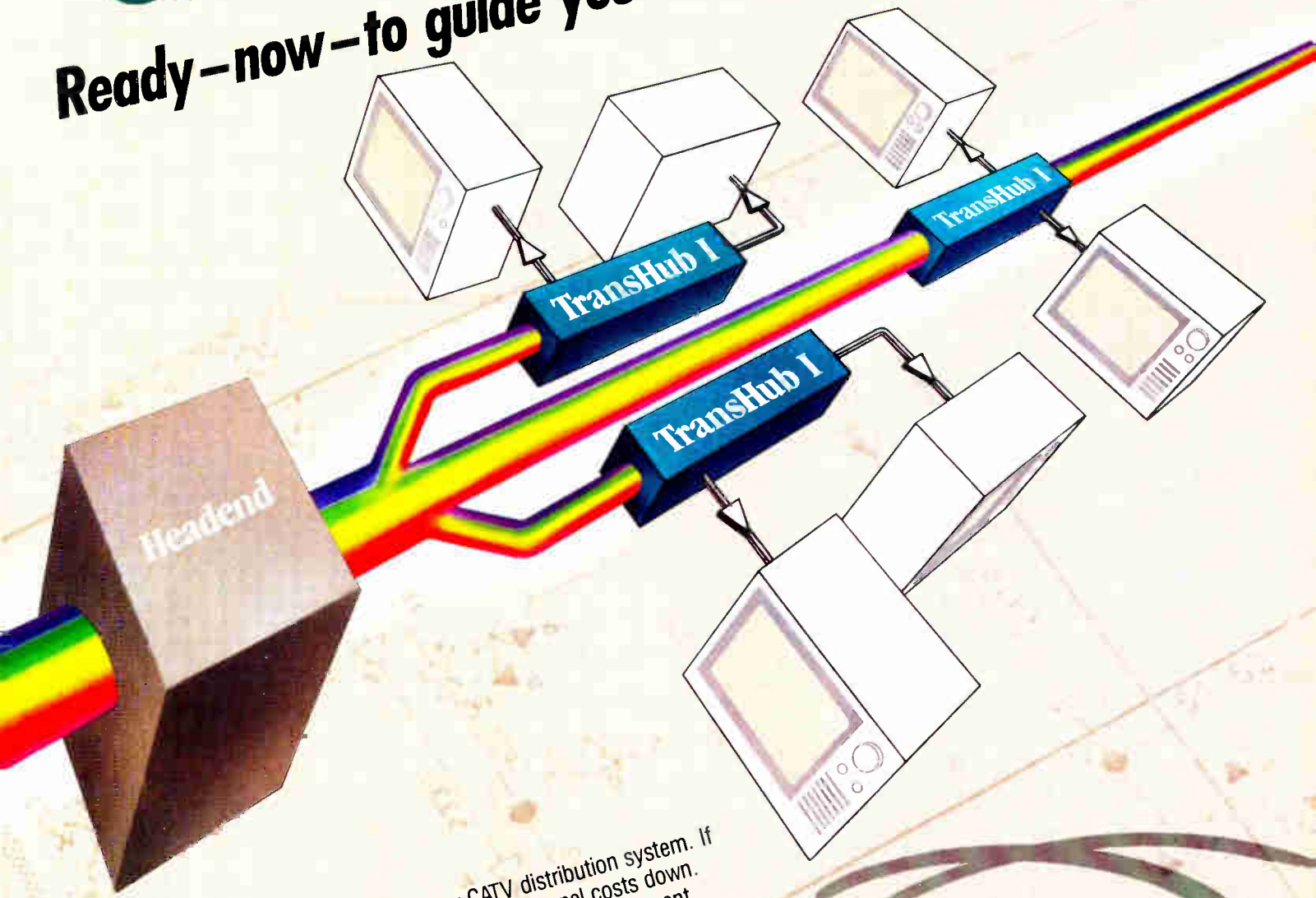

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circulate on it during normal operation. Is anything on the list a source or target for interference? Are there really any circulating currents on it at all? An earth ground should serve to shunt lightning, to limit the maximum voltage of the primary power system by limiting neutral (white wire) voltage, to drain away static charge, and to serve as a counterpoise for lower frequency radio antennas. There should not be any video currents on the earth ground, and there will not be any RF currents at television frequencies on the earth ground.

The earth ground is not necessary for the proper operation of video or RF systems because earth is not part of the circuit. Earth is part of the circuit only as listed above. Video and RF currents require a return that consists of an area of a good conductor like silver, copper, gold, aluminum (with care), or some other nonferrous metal. Aluminum is tricky to use because its oxide is an excellent insulator. Of all these, copper is the best overall.

If the primary power system is correctly installed, a video or RF distribution system has all of the earth grounding that it requires or can use. On the other hand, if an existing video or RF system is sensitive, unpredictable or is obviously suffering from crosstalk, then it needs good local circuit returns. Good circuit returns installed in a system will design these problems out for the life of the system.

National Electrical Code grounds

The NEC electrical safety grounds are designed to make the system safe at 60 Hz and do that job very well. These grounds are out of the circuit at video and RF frequencies, however, because they do not have enough surface area and they do not tie elements of the system directly together. They are the only grounds required by law, however, and so are often the only grounds installed. The system is legally grounded, but those green ground wires often go all the way back to the power panel grounding block on the other side of the room!

Circuit return currents will flow on the best conducting surface that is directly between elements of the system. If this most direct path is to the grounding block on the other side of the room and then back, a considerable extra impedance has been introduced

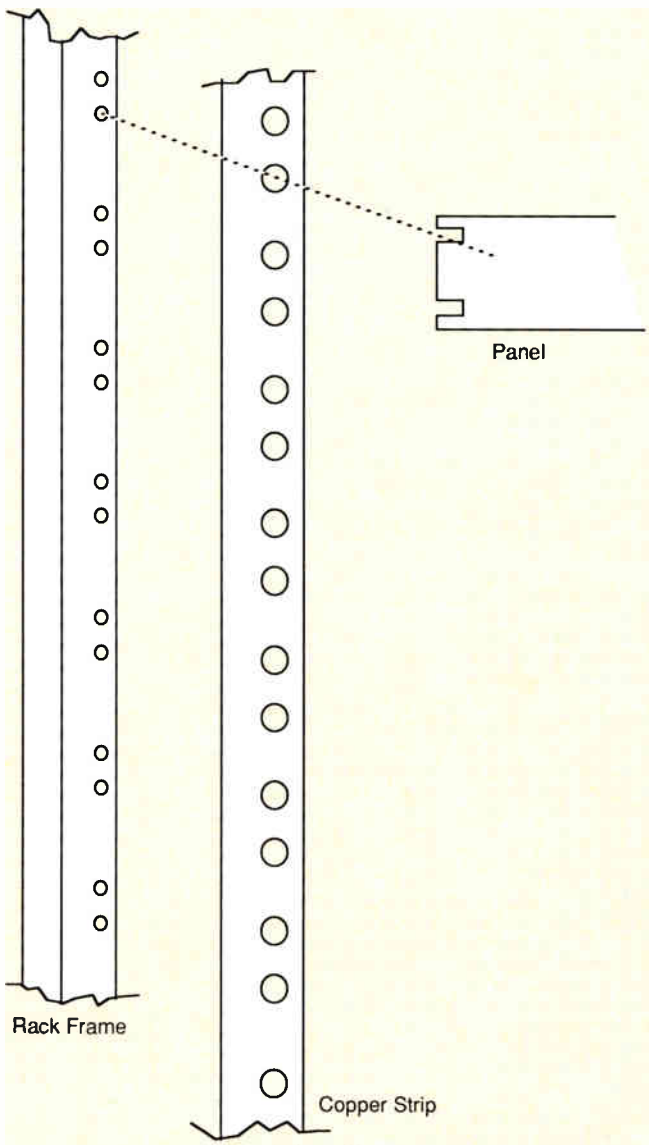


Figure 3

and significant ground loops will be created. This creates crosstalk. The key notions here are "surface" and "directly." The safety ground is the legal requirement but it lacks adequate surface for this purpose and is not direct.

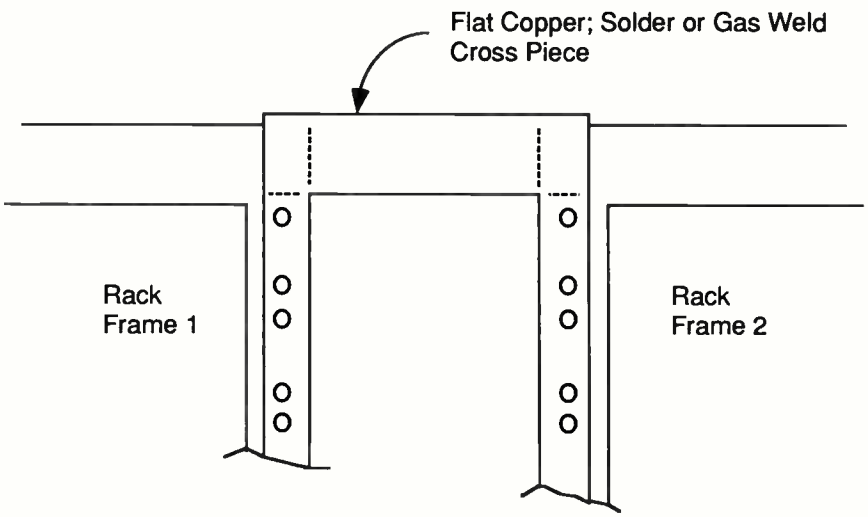
So a system may be adequately grounded for safety, and end up ungrounded for any other purpose. This is a correctable condition, once it is realized. The legal ground must be there for safety, and because it is not enough, more grounding for the purpose of creating real signal returns must be added. NEC grounds are minimums and code section 250-91 recognizes that there may indeed be a need for supplemenatry grounding.

Racks

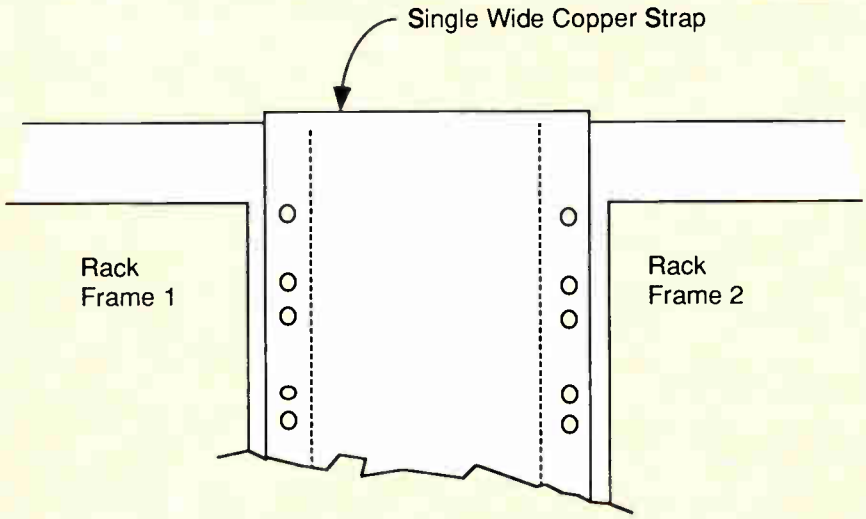
If the sheet metal is stripped off, the usual equipment rack can be seen as a skeleton beefed up to mechanically hold equipment. It has a narrow, poorly conducting surface, and has painted and bolted joints. A simple ohmmeter test may show that parts of it are not electrically connected to other parts at all. Consider it a hanger only and treat it as a video or RF non-conductor. Assume that there is no electrical connection between rack frame and rack sheet metal.

Remember that the ferromagnetic properties of steel significantly increase the resistance from point to point at video and radio frequencies.

After looking at all of the above it may come to mind that connections that have always been assumed to be there simply aren't. This perception is probably accurate. The solution to all of this is to intentionally install a central reference for the return currents of each system. This takes the form of flat copper that need be no more



Common Between Two Racks, Minimum Method
Figure 4



Two-Rack Common, Recommended Method
Figure 5

than 1/16-inch thick and which will still be effective even if only 10 mils (0.01-inch) or so in thickness. Larger pieces can be obtained from a metals merchant by asking for soft copper in rolls, alloy 110. Smaller amounts of thinner material can be conveniently purchased at hobby shops.

Copper for circuit returns should be as wide as practical at the facility central points, though even direct wires can help in some circumstances. The idea is to make sure the circuit returns are there, and that they are low in impedance. This is done by intentionally installing them.

An example

Figure 2 shows a cross section of headend RF amplifiers in a rack frame. What does each amplifier see as a common (ground) potential? As we have discussed:

1. The RF ground depends on surface connections only.
2. Racks are to be discounted for carrying return currents.
3. Currents going out on the coax center will return on any surfaces available, in this case the coax shield and, where that fails, the rack.
4. Connections to earth ground are helpful for other purposes but are irrelevant for this one.

The conclusion is that each amplifier in the chain sees a reference ground that is the voltage developed in the coax shield by previous amplifiers. This voltage is a consequence of the small but certain drop across the small shield of the coax and the variable and uncertain drop across the various crimps, threaded fittings and other electrical contacts that change with time in the cable to connector to chassis interfaces.

The voltage amplitude will be the product of the current and resistance. The current is essentially fixed, but if the resistance is lowered, the voltage will be reduced by the same amount. The practical answer therefore is to install a strip of 0.020 copper right down the front of the rack at surface X. The act of bolting an amplifier chassis into the rack will automatically clamp it down on the copper when the mounting screws are tightened. Holes to clear the equipment mounting screws need to be marked and punched in the copper as shown in Figure 3 to create a conducting "sandwich." When installed up the length of the rack, this will insure that there is an RF common signal return from amplifier to amplifier for the entire rack.

Larger installations

Adjoining racks of equipment pose another problem. Two amplifiers can physically be side by side, but a trace of the common chassis-to-chassis metal contact path may reveal the surprise: they are electrically many feet apart! In tracing this contact path, remember to assume nothing; to consider bolted and painted joints to be open; and to follow only surfaces. Regard surface-to-surface connections to be valid only when they can be seen.

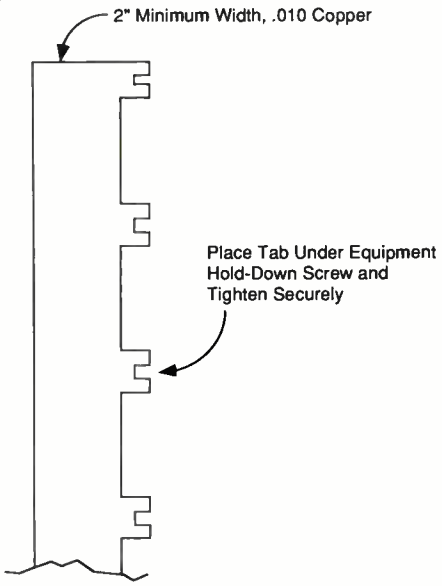
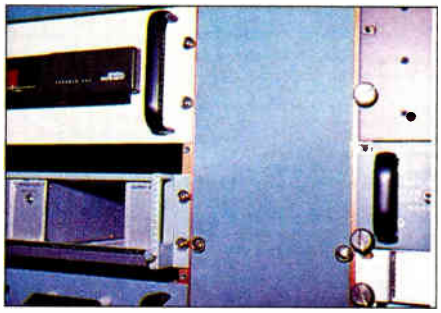
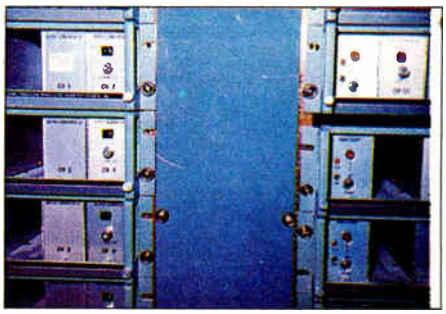


Figure 6

The way to bring these widely separated amplifiers together is to install a wide copper rack-to-rack connection from surface X to surface X as shown in Figure 4. This single copper cross piece will beat any pre-existing current return path by a wavelength and should be at the top or bottom or middle (best). A second cross piece would create a loop that is resonant at some frequency; probably one put out by one of the amps. When assembling copper pieces to carry these surface currents, good connections are essential.





A 7-inch wide copper strip is installed from rack to rack

Some rack designs will allow this job to be done fully and correctly with one wide copper strap, as shown in Figure 5. The photos show such an installation where a 7-inch wide copper strip at 0.02-inch thickness is installed from rack to rack, beneath the aluminum cover piece. Crosstalk dropped dramatically and permanently when these racks were refit this way. The local system common connection is no longer dependent on tiny coax shields to electrically tie the amplifier equipment together.

Retrofits

For existing amplifiers in a rack, a single #6 wire run under the mounting screws of each unit will decrease interaction by a minimum of 10 dB, guaranteed. A #6 copper wire has less impedance at 6 MHz than a 12-inch steel I-beam! The retrofit common shown in Figure 6 will permanently solve many problems, and even if there is no obvious problem at present, will allow the grounding factor to be eliminated when searching for the answers to future problems. ■

Drop shielding integrity

COMPLIANCE

FCC mandated CLI requirements have made shielding integrity for drop and hard line cables a concept of major significance in the design and maintenance of contemporary cable systems. Today's system operator must consider the drop as a hermetically sealed RF subsystem of the cable plant.

The highest probability of signal leakage occurs in the drop system. Higher signal levels at the tap and an average of six to eight connectors make the drop a likely source of egressive energy. The cable-connector interface is generally the most probable cause of breakdown of drop shielding integrity. In the newly installed drop, poor preparation of the cable and crimping of the connector can result in high contact impedances between the shield and connector. These poorly bonded junctions are point sources of signal leakage at higher frequencies. For the older drop, advanced corrosion can result in reduction in the tape and braid coverage which produce holes or voids in the shield coverage that allow magnetic coupling of energy to the outside.

Corrosion

Many system operators have undetected corrosion problems. The obvious cases are the blackened center conductor and breakdown of the braid, which can vary in degree from a thin oxide layer between the connector and shield to a reduction of the braid to a powder residue. It is common industry practice to replace the connectors on a trouble call when the tech finds a low or no signal level condition.

If replacing the connectors solves the signal level problem, then a corrosion problems exists at the drop. The corrosion in this case produces an aluminum oxide layer, a dielectric which reduces electrical bonding at the connector/cable interface. The resultant junction becomes a high impedance contact and signal loss occurs. If such conditions occur on a regular basis, the system operator should initiate a corrective action program to solve the corrosion problem.

Corrosion occurs on all systems and is to a large extent a function of the amount of water ingress into a system. Corrosion is a chemical reaction between the shield material (in most cases aluminum) and oxygen in the air. The presence of water acts as a catalyst to speed the process. Industrial processes near a cable system, salt spray from coastal areas, agricultural chemicals, and even salt from roads can accelerate the corrosion process.

Signal leakage components

To fully understand the phenomena of eggressive energy from a cable system, one must understand the components of leakage in a coaxial system. While a detailed technical examination is beyond the scope of this article, a simplified analysis reveals three major components of signal leakage as it is applicable to the CATV operator.

The first is current diffusion. This is the skin effect often referred to in basic electricity courses. The RF current in a coaxial cable shield flows on the inside surface of the shield. The depth to which the current flows or diffuses through the crystalline structure of the shield is inversely proportional to the frequency of the RF current. Thus the lower the frequency, the deeper the diffusion currents flow. For a coaxial cable, the amount of metal present in the shield is the determinant as to the effectiveness of containing the RF current and thus providing shielding. For the typical CATV frequencies, diffusion current is not a significant contributor to signal leakage. It can, however, be of significance for those operators of two-way plants with subsplit frequency applications.

Magnetic coupling is the dominant leakage component in braided cables. In simplistic terms this is defined as magnetic fields produced through holes or voids in the shield. At microwave frequencies, this phenomena is utilized quite effectively to produce antennas known as "leaky pipe radiators." While desirable in that application, a leaky pipe radiator is not what the system operator wants for a drop system. Magnetic coupling, being a function of the continuity of the shield, becomes significant in those cases where corrosion is advanced.

The third component of signal leakage is a capacitive coupling between adjacent systems. This is a common problem on telephone networks and is often referred to as crosstalk. It is of little significance for CATV.

The transfer impedance of a given cable is a useful parameter. The transfer impedance is defined as the ratio of the current flowing on the outside of the shield to the voltage induced on the inside of the shield. Since we are defining the relationship between a current and voltage, we can apply Ohms law to this ratio and express transfer impedance as an impedance. Because it is specified or measured over a given length of cable, it is measured in milliohms per meter.

Practically, the transfer impedance is a cable parameter which predicts the amount of signal flowing into (ingress) or out of (egress) a given cable. As a general measure, the lower the transfer impedance the better the shielding. The transfer impedance of a cable is frequency dependent. Often, cables which exhibit excellent response at one frequency may have out of specification performance at others.

One effective design tool that can be obtained from the transfer impedance parameter is a relative comparison of the improvement in shielding effectiveness of one cable type over another. Using a 20 log relationship of the ratio of the transfer impedances of two cables will yield the relative improvement.

Transfer impedance can also be used to predict the relative level for ingressive signals for strong, local off-air signals.

One cannot predict the actual shielding levels for a given cable from the transfer impedance parameter.

Corrosion protection

The most obvious means of combating the effects of corrosion on CATV drop systems is to eliminate or minimize moisture ingress into the drop. This technique requires the specification of a hermetically sealed RF subsystem.

Many practices exist today in devel-

By William J. Smith, National Account Sales, Times Fiber Communications

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oping the hermetically sealed RF subsystem. One such common methodology is the application of sealed connectors. These connectors, when properly applied, provide seals against the ingress of water into the connector/drop interface from either the front or rear of the connector. Depending upon connector design, two or three such seals are developed.

The CATV operator must insure that all of the connector manufacturer's installation instructions are followed judiciously in order to obtain maximum connector sealing effectiveness.

If the sealed connector chosen utilizes O-ring seals, then the material used in the manufacture of the O-ring must be such that it remains chemically and mechanically stable when exposed to a long term environment of ozone, ultraviolet radiation and temperature extremes.

A recent introduction to the CATV connector marketplace is a connector which incorporates a sealing mechanism which provides a triple barrier to moisture. This connector employs a compression seal formed by a circular crimp in lieu of the conventional hex crimp as the first seal. In this design, an internal O-ring seal as well as a front O-ring protect the connector/cable interface from moisture ingress.

Laboratory testing of the sealed connector has verified the effectiveness of the correctly applied sealed connector for the minimization of moisture ingress. However, there is a cost impact for the sealed connector with connector material costs which can triple that of an installation with conventional F-connectors.

A practice common to the telecommunications industry and beginning to find acceptance in the CATV industry is the application of silicone grease compounds to the connector to protect the body and internal parts from corrosion. In such an application, the choice of the silicone compound should be such that it remains stable over the intended operating temperature range of the system.

Another effective procedure is the application of flooded cables to protect against moisture ingress. Conventional flooded cables which employ polyisobutelene based flooding compounds for underground installs and those intended for aerial applications which are treated with asphaltic based compounds are effective in preventing moisture ingress in those cases where the jacket integrity has been or can be compromised.

Both compounds are designed to remain viscous over normal temperature ranges, remain stable in chemical properties, and be non-reactive with cable construction materials.

If a void develops in the jacket of a flooded drop cable, the flooding compound will flow or evolve into the void and form an occlusive seal or barrier which protects against the ingress of moisture.

Connector test program

To study the effects of corrosion on drop cable subsystems, a recent lab study was commissioned which tested a total of 336 cable/connector interface

pairs. Tested were sealed and unsealed connectors with cables treated with corrosion protectant as well as standard drop cables.

Each cable/connector pair was subjected to a three-hour soak in a sodium hydroxide solution. The sodium hydroxide solution was chosen to force an accelerated corrosion condition in the lab. For the case of unsealed connectors and standard coaxial cable, 20 out of 36 exhibited a black center conductor. For the case of protectant cables and unsealed connectors, four out of 36 exhibited a black center conductor. For sealed connectors and standard cable, three out of 48 resulted in a black center conductor. For the sealed connector and protectant cable, zero out of 48 exhibited a black center conductor.

Electrical transfer impedance tests were made to measure the change in transfer impedance from an initial measurement prior to and after a three-hour soak in the sodium hydroxide solution.

An equation which expressed the relative loss in shielding as a 20 log function of the ratio of the transfer impedance after the NaOH exposure and before was used to calculate the resultant signal leakage.

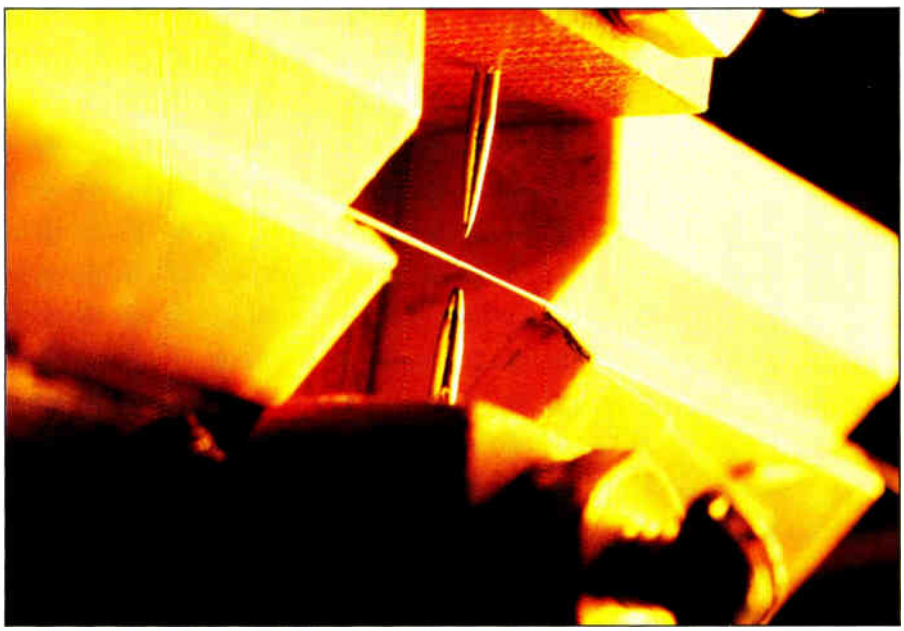
Unsealed connectors and unprotected cable test samples averaged a 27 dB increase in signal leakage. Sealed connectors with unprotected cables yielded an average 13 dB increase in signal leakage. Unsealed connectors and treated cables exhibited a 5.4 dB increase in signal leakage. Sealed connectors and treated cable resulted in a 3.1 dB average increase in signal leakage. The test results indicate that for the optimum performance in long term drop shielding integrity, a drop configured of protectant cable and sealed connectors should be specified.

Such a configuration is the most expensive in terms of material and labor costs. It is interesting to note that the more cost effective combination of conventional F-connectors and treated cables resulted in signal leakages only 2.3 dB above that of the sealed/treated specification. If one considers that either design provided a minimum average improvement of 22 dB over the performance of untreated cables and conventional connectors, the justification for the specification of either drop system is self-evident.

It is interesting to note that the application of sealed connectors to non-corrosion protected cables resulted in an average 14 dB improvement in shielding integrity as compared to the average 22 dB improvement for the unsealed connector/treated and sealed connector/treated combinations. It therefore could be concluded that corrosion protectant is a significant factor in improving drop system resistance to the effects of advanced corrosion.

In this discussion, several techniques for improving the corrosion resistance of drop cables have been discussed. With the nationwide average cost of a service call to replace a drop being $40, significant savings in operational expense could be obtained by initiating a corrosion protection program. Statistical evidence suggests that 25 percent of all drops replaced are due to corrosion. With the known increased signal leakage attributed to corrosion at the connector/cable interface, a positive attack on drop cable corrosion is essential to meeting the CLI criteria for signal leakage. ■

Getting it together: Fiber splicing options



Fiber undergoing fusion splicing

Photo courtesy of Corning Incorporated

Update the old saying about the links in a chain, and you've got a truism about optical-fiber transmission for cable TV. For all the performance benefits it offers—increased channel capacity, longer distances between amplifiers, reduced maintenance budget, simplified future expansion—a fiber-optic system is only as good as its splices.

By choosing the best splicing technique for your needs, and following proper procedures, you can realize the full benefits of optical-fiber transmission.

By Scott A. Esty, Market Development Supervisor, Telecommunications Products Division, Corning Incorporated

Why splice?

First, let's define the term "splice." A splice is a procedure, device or assembly that permanently joins and holds two optical fibers together.

In a fiber-based cable television system, splices are necessary for a number of reasons:

- to connect active system devices, such as the transmitting light source and the optical receiver, and passive devices, such as splitters and couplers to the fiber cable
- to link fiber cable segments together
- wherever it's impractical to install a continuous fiber cable from one junction to another
- whenever a fiber cable is accidentally cut.

Splices should not be confused with connectors. Optical-fiber connectors are used to join and disconnect fibers repeatedly in locations where periodic system access can be expected—due to maintenance, testing, repairs or reconfigurations of the system. Connectors are not used at permanent splice points because they are larger, more expensive, more time-consuming to install, and they yield higher optical losses.

Two splicing methods

There are two splicing methods used today. The first, called fusion splicing, uses an electric arc to fuse, or weld, the ends of the two fibers together.

The second method is mechanical splicing. Mechanical splicing uses epoxies or other mechanical means to join and hold the fibers together. Although most mechanical splices are designed to provide a permanent joint, they also can prove useful for quick, temporary jointing between fibers, as in emergency circuit restoration.

The reasons for choosing one splicing method over the other become clear as each technique is analyzed in greater detail. In general, the choice comes down to two factors: the required performance of the joints, and the number of splices to be made.

While the goal of both methods is the same, the means to that end differ considerably. Let's look at the fusion splicing procedure first.

Arc fusion splicing

Fusion-spliced joints potentially are the most stable and permanent. They also yield less optical loss and the lowest reflected light. However, fusion splicing is a sophisticated operation requiring more expensive equipment compared to mechanical splicing. Therefore, it's the best choice for high-volume splicing, and where permanent joints are required.

The first step in the fusion splicing process is preparing the ends of each fiber. After exposing the fiber ends from the cable structure, the operator strips away a small amount of the fiber's protective coating, from a few millimeters to a few centimeters.

To make a successful joint, the glass end face of the fiber must be made flat, smooth and perpendicular to the fiber axis. This is done by a process called cleaving. A small scratch or surface flaw is scribed at one point on the cladding glass of the fiber. Then, a well-controlled stress, or tension, is applied to cleave the fiber.

The quality of the cleave has a great impact on the amount of optical loss resulting from the splice. Most fusion splicing machines contain magnifying devices (such as a microscope) that allow the operator to visually examine the fiber from a side view, allowing him to spot any chips or poor cleaves.

The end of the cleaved fiber must have a flat, smooth surface without burrs at an end-angle less than 1 degree off perpendicular to the fiber axis.

If the cleave is judged to be satisfac-

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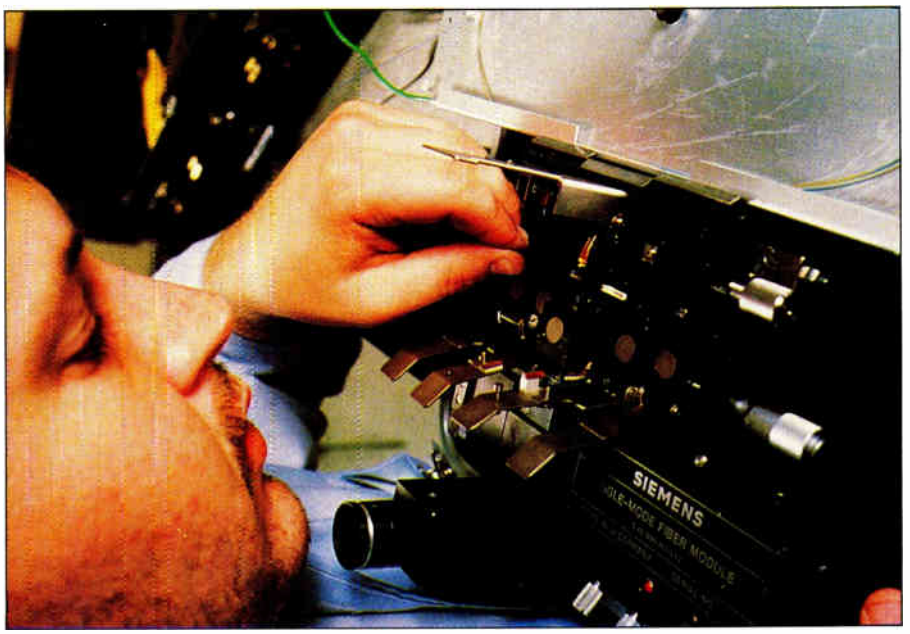
tory, the prepared fibers are clamped into the splicing machine and moved into position near the electrode that eventually will fuse them together.

Next, a low-power electric arc is triggered briefly to pre-fuse the fibers. This arc blasts any residual contaminants off the fiber surface, and also slightly rounds off the outer edges of the glass. In many of the latest fusion splicing machines, this pre-fusion step is incorporated automatically into the subsequent fusion cycle.

Then, the optical cores of the fibers are aligned by moving one fiber to line up with the other. One of three methods is used to monitor this alignment and measure the optical power loss of the subsequent splice:

1. **Profile alignment:** video cameras provide the operator with views of the core image from both the X and Y planes.
2. **Light injection and detection:** the coated fibers are bent slightly in optical modules that are part of the work station on each side of the splice location. Light from a photodiode is injected into the fiber on one side, and detected and measured on the other side.
3. **Measurement of backscattered light:** An optical time domain reflectometer (OTDR) is used to measure backscattered optical power along a fiber length. With an OTDR at the far end of one of the fibers being spliced, a signal is transmitted from the optical source; the splicing technician moves the fibers until the remote OTDR operator achieves a maximum backscattered power level beyond the splice.



An engineer feeds optical fiber into a fusion splicer

Photo courtesy of Corning Incorporated

Once the fiber ends have been positioned and aligned, a fusion arc from

the electrodes softens the glass. The fibers are pushed together mechanically along the longitudinal axis and fused.

When fusion is complete, some amount of fiber at the joint remains exposed, and must be protected to prevent damage from mechanical or environmental contact. The most common type of protection is a heat-shrinkable sleeve. The sleeve slides over the exposed area, and is heat-shrunk to contact with the existing fiber coating at both sides of the exposed glass.

State-of-the-art equipment has simplified fusion splicing to a rapid, craft-friendly procedure. A well-trained operator can make a successful splice in about two minutes. However, equipment costs for fusion splicing are high, especially when you're considering low-volume or temporary joints.

If expense is a concern, splicing equipment can be rented or leased to minimize capital costs. Another option is for companies to band together to purchase and use the equipment jointly.

Mechanical splicing

Mechanical splicing is less expensive than the arc fusion method when few splices are required, and is considered somewhat easier for installers to work with. However, mechanical splices usually result in slightly greater optical loss and/or more reflected light power. And, actual component cost is high when compared to fusion splicing.

While the exact procedures for mechanical splicing vary, depending on the splice used, there are two basic methods from which to choose.

The first approach, which we'll call Method A, is to remove the cable buffer tubes and fiber coating and then cut or cleave the fiber end, as in the fusion splicing procedure described earlier. The fiber then is placed in a customized work station. Next, an epoxy mixture is added and cured, or the fiber is glued or crimped into place, depending on the device used.

In Method B, the buffer and coating is removed and the fiber is glued into a sleeve or ferrule. Next, the glass fiber end face is polished in a jig against several different grades of fine-grit paper until the fiber surface is polished smooth. This method eliminates some of the uncertainty that goes with cleaving, but requires considerably more time per splice.

Whether fusion or mechanical splicing techniques are used, incorrect alignment and cleaving of the two fibers will result in higher optical power loss.

Power loss caused by the splice procedure is called extrinsic loss. Extrinsic loss can be broken down into four basic categories:

- **Lateral misalignment:** fibers that have not been correctly aligned along the optical axis
- **Angular misalignment:** angular offset of the jointed fibers
- **Contamination:** any contamination in a completed fiber joint may increase splice loss by causing light absorption, reflection or refraction
- **Core deformation:** any distortions of the optical core of a joint, such as the bulging caused by excessive or uneven electrode heating from fusion splicing.

Fibers from many different manufacturers can be spliced together using either method. Splice losses usually are not impacted significantly by the origin of fibers from most major manufacturers. What's important is controlling the external factors mentioned above. Proper alignment and splicing of the two fibers will avoid these power loss problems in either splicing method. ■

WHAT'S AHEAD

SCTE

November 11 *Cactus Chapter* will host a technical seminar on "Management Skills." For details call Harold Mackey Jr., (602) 866-0072, ext. 282.

November 14 *Central Illinois Chapter* will conduct a technical seminar. For info call Tony Lasher, (217) 784-5518.

November 14 *Mount Rainier Chapter* will host a technical seminar on "Safety." Call Sally Kinsman, (206) 821-7233 for details.

November 14-15 *Florida Chapter* will administer BCT/E exams for the Central Florida Group, Nov. 14 in Categories I, V, VI and VII. The Gulf Coast Group will host a technical seminar on Nov. 15. For info on either event call Denise Turner, (813) 626-7115.

November 15 *North County Chapter* will hold a technical seminar on BCT/E Category VI, "Terminal Devices," with Jim Farmer of Scientific-Atlanta at the Sheraton Midway Hotel in St. Paul, Minn. For details call Douglas Ceballos, (612) 522-5200, ext. 705.

November 15 *The Razorback Chapter* will conduct a technical seminar at the Days Inn in Little Rock, Ark. Call Jim Dickerson, (501) 777-4684 for info.

November 15-16 *Big Sky Meeting Group* will conduct a technical seminar on "Amplifier and Headend Equipment" with Bob Bird of Scientific-Atlanta in Greatfalls, Mont. Call Marla DeShaw, (406) 632-4300, for details.

November 15 *Dairyland Meeting Group* will hold a technical seminar. Call Bruce Wasleske, (715) 842-3910 for details.

November 15 *New York City Meeting Group* will host a technical seminar. For info call Andrew Skop, (201) 328-0980.

November 16 *The Upstate New York Chapter* will hold a technical seminar on "Transporation" featuring presentations on "Coaxial Systems" with Roy Schultz of Magnavox, "Microwave Systems" with Dane Walker of Hughes Microwave and "Fiber Optic Systems" with John Holobinko of American Lightwave Systems. The seminar will be held at the Burgundy Basin Inn in Rochester, N.Y. For more info call Ed Pickett, (716) 325-1111.

November 19-20 *Old Dominion Chapter* will conduct a technical seminar. For details call Margaret Harvey, (703) 248-3400.

November 28 *Satellite Tele-Seminar Program* will air "AM Fiber Optic Transmission (Part I)" featuring J.R. Anderson of Anixter Cable TV and Clive Holborow of AT&T Bell Labs. Recorded at Cable-Tec '89 in Orlando, Fla., the program will air from noon to 1 p.m. Eastern time on Galaxy II, transponder 2.

November 29 *The Piedmont Chapter* will host a technical seminar on "Safety and OSHA Requirements for CATV," plus vendor showroom and demonstrations. Call Rick Hollowell, (919) 968-4631 for details.

November 29 *Inland Empire Chapter* will conduct a technical seminar. For more info call Randy Melius, (509) 484-4931.

December 6 *North County Chapter* will hold a technical seminar at the Holiday Inn in Columbia, Md. BCT/E exams are tentatively scheduled. For additional info call Doug Worley, (301) 499-2930.

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January 16-18, 1990
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February 13-15, 1990
Charlottesville, Va.
March 20-22, 1990
Atlanta, Ga.

Scientific Atlanta

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November 8-10 8570/8590 System manager training.

November 13-15 Advanced systems hardware and advanced computer control system training.

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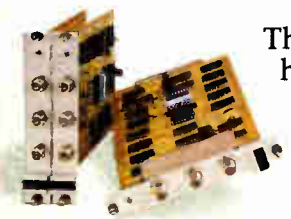

The Trilithic 7RS is a modular headend reconfiguration system. With it you gain total control and unmatched programming flexibility– Syndex or no Syndex.

Modular. Flexible. Expandable. Trilithic offers you a broad range of modular, interchangeable switch cards. You have the flexibility to tailor the 7RS functions to suit your needs and expand it whenever necessary. Much like a headend, the variety of configurations is almost endless.

Technology Working For You. The technology used in the 7RS puts total control at your fingertips. It can be operated manually or through any IBM compatible computer under control of scheduling software **or** by keyboard command for general reconfiguration.

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Our vast array of cards execute the following switching and other functions:

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- Baseband
- RF
- Contact Closures
- Satellite Receiver Frequency Tuning
- And much more

Our switching products interface with "CASEY"* software which offers features such as:

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- Contract information
- Trilithic switch interface
- Management reports
- Program data base interface
- Plus a lot more

* Trilithic is an authorized stocking distributor for "CASEY" software.

"CASEY" is a trade name of Telecommunication Products Corp.

Reader Service Number 55

For more information, about **the** Syndex solution, call or write:
Trilithic ■ 3169 N. Shadeland Avenue ■ Indianapolis, Indiana 46226 ■ 317-545-4196
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The CABLE POLL

™Midwest CATV, CableVision & CED

Three out of four system managers—basing their conclusions on feedback from subscribers and opinion leaders in their communities—believe there is very little or no demand for true high-definition television in their markets. That perception of a negligible consumer demand for HDTV rises to a startling 91 percent among managers of systems with more than 50,000 subscribers, significant because it likely would be in those larger markets where HDTV receivers first would be marketed.

In fact, the number who told Cable Poll™ interviewers they believe that "a lot" of demand exists for HDTV is so low as to be statistically invisible. This overwhelming consensus throws cold water on technology buffs who predict that consumers would replace their NTSC sets with HDTV receivers as rapidly as they bought color sets in the 1960s. Conversely, knowledgeable observers commented that the data may bolster the case of proponents of advanced TV systems, because the incremental cost of ATV sets would be lower and would cause less consumer confusion.

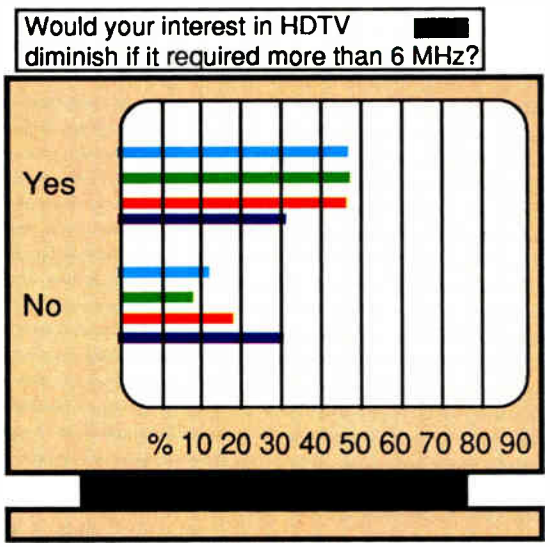
The data mirror the conclusions of a Congressional Budget Office report, requested by a Senate committee considering grants to companies involved with HDTV research, which said that forecasts of widespread consumer acceptance of HDTV have been overly optimistic.

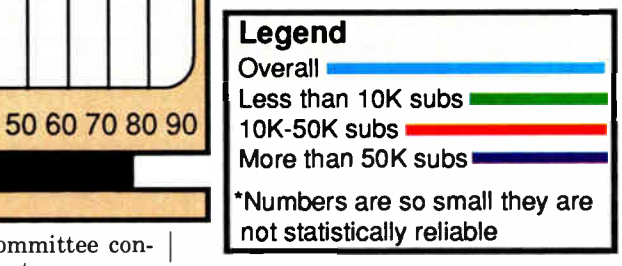
The Cable Poll™ reveals that operators principally are worried about the greater bandwidth that HDTV likely would require, and with equipment retrofit and upgrade costs that probably would be needed to accommodate HDTV.

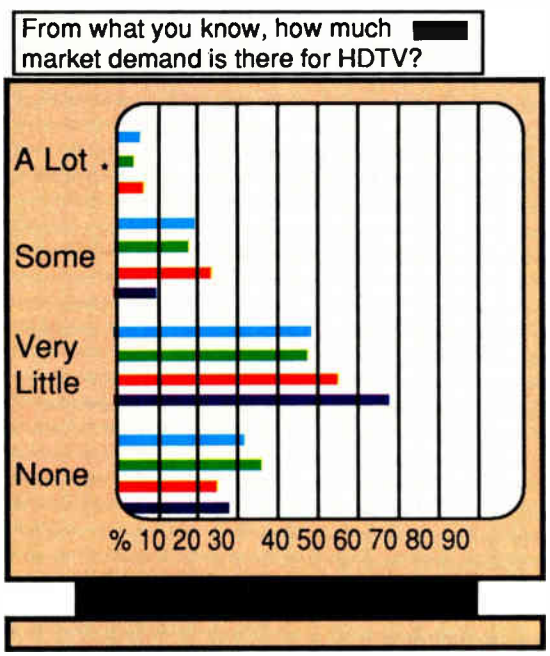
More than half of all operators surveyed said their interest in HDTV would be greatly diminished if the signal would require more than a standard 6 MHz channel. But operators of larger systems, apparently because they are not as constrained by channel capacities, were evenly divided as to whether HDTV's greater spectrum needs would cause a problem.

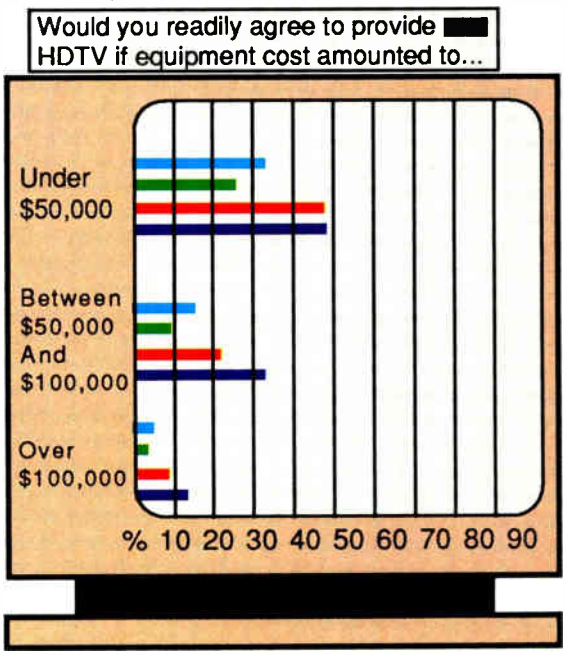
Based on responses to the Cable Poll™, $50,000 seems to be the point at which operators become price-resistant to HDTV. If that were the per-channel cost of providing HDTV, 35 percent of all respondents, and 50 percent of larger systems, would readily agree to provide HDTV.

The Cable Poll™ is conducted for Midwest CATV, *CED* and *CableVision* magazines by Ryan/Samples Research. Telephone interviews for this edition of the poll were conducted Aug. 14-19 with a random sample of 387 system management personnel obtained from CableFile Research. Cable Poll™ researchers are 95 percent confident that the results are an accurate reflection of the total industry within plus or minus 5 percentage points. ■









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U S WEST Communications is ready to become a player on your team! With our winning combination, you'll keep ahead of the game.

Our experience in fiber optic technology has prepared us to meet the needs of the cable television industry today. Our 14-state region covers one third of the nation, from Canada to Mexico, and includes Arizona, Colorado, Idaho, Iowa, Minnesota, Montana, New Mexico, North Dakota, South Dakota, Nebraska, Oregon, Utah, Washington and Wyoming.

U S WEST's Cable TV Industry Marketing Group welcomes the opportunity to work with your system engineers for possible video transport alternatives.

Reader Service Number 56

Teaming up with U S WEST Communications offers you:

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- Replacement of AML microwave links with multi-channel video services.
- Increased channel capacity.
- Superior signal quality.
- A streamlined ad insertion network.
- Field proven ANI/PPV Order Entry Service.

Come talk to us at booth **#1262** at the Western Cable Show in Anaheim, California! Representatives will also be available to review our ANI Order Entry product. If you are not planning to attend the show, please call us at **(303) 896-4691** or **(303) 896-2942.**

USWEST COMMUNICATIONS

Making the most of your time.

Fiber optic training aid available

The **National Cable Training Institute** has announced the release of its new course, CATV Fiber Optics. The 22-lesson course teaches CATV professionals both fiber optic theory and the application of fiber optics in cable television systems. Lessons in the course include: Fundamentals of Fiber; Types of Fiber; Integrated Optics; Transmitters; Receivers; Connectors and Splicing; How CATV uses Fiber Optics; Architectures for CATV; Construction and Maintenance; and CATV Fiber Case Studies. For more information on the course call, (303) 761-8554.

Quanta Corp. introduced its All Channel Message System (ACM) at the Atlantic City show in October. ACM is designed to place a video message on

Quanta's ACM-100

any or all channels simultaneously, either as a stand-alone message, or over the normal video program. Applications are syndex switching with advisory messages for viewers; a video emergency alert and preparedness system; pay-per-view promotions on affiliate channels; local scores on regional sports channels; and satellite-delivered system specific promotions, ads, and bulletins by channels. For additional info call, (801) 974-0992.

Also announced at the Atlantic City show was an entire line of syndex switching products by **Channelmatic**. Over 45 syndex systems, products and accessories are being offered because of the wide-ranging equipment needs and requirements of the operators, says Tom Walsh, vice president of business development for Channelmatic. The products were developed in recognition of the differences in existing headends and the switching configurations of each cable system. Products include non-synchronous and synchronous audio/video switching systems; clock controller switching systems; and systems for local and remote control. Call (619) 445-2691 for more info.

Wavetek RF Products has introduced several new products into the CATV market. Announced was the Low-End Frequency Extension (LEX) option for its Model 2510A, 1100 MHz and 2520A, 2200 MHz synthesized signal generators. With the LEX option, the low-end operating frequency range is extended from 200 kHz to 100 Hz for both the 2510A and 2520A.

Also announced is the variable modulation source (VAR) option for Wavetek's Model 2510A, 1100 MHz and 2520A, 2200 MHz synthesized signal generators. The VAR option uses direct digital synthesis to provide a continously variable internal modulation source from 1 Hz to 100 kHz with 1 Hz resolution. The VAR option serves modulation source needs.

Also released from Wavetek is the Model 5000/6000 Sweep Recovery System. The headend mounted Model 5000

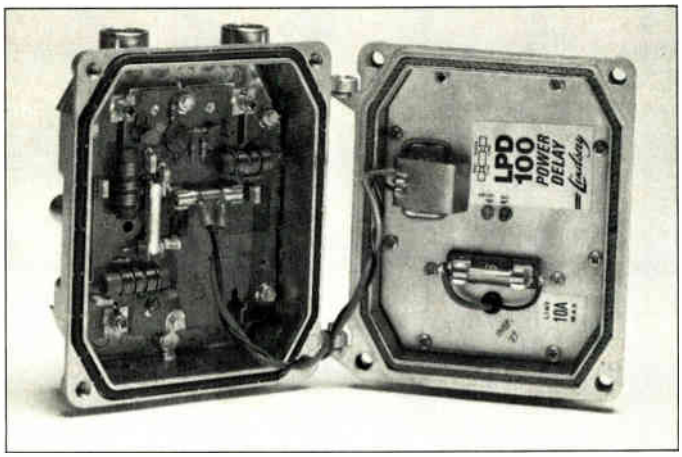
Wavetek's Model 5000

transmitter sweeps the system in any user defined frequency range from 2 MHz to 600 MHz. The Model 6000

Wavetek's FiberSAM

Sweep receiver displays the system response at test points throughout the system, with cursors and alphanumerics for analysis. A storage and normalizer function is provided standard. Up to seven references may be stored in non-volatile memory.

Available from Wavetek is FiberSAM, a cable signal analysis meter with a built-in fiber optic power meter. The FiberSAM measures optical power at 1330 nm and 1550 nm and is also a RF signal analysis meter. Features include auto-ranging attenuation, LCD



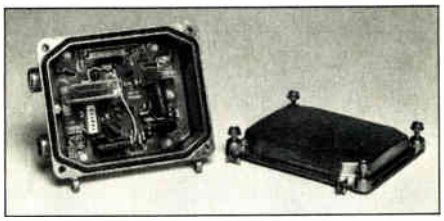
Lindsay Specialty's LPD 100

channel or frequency and measurement readout and microprocessor control. The FiberSAM measures optical power, RF signal level, carrier-to-noise ratio, hum, tilt, and video to audio carrier level ratio.

In other announcements, Wavetek has reached a selling agreement with **Telecommunications Products Corp.** to provide CLIDE leakage management software. The software may be purchased separately or packaged with Wavetek's CLM 1000 Leakage Field Strength Meter. Data can be transferred from the CLM 1000 to the CLIDE software. For more info on any Wavetek products call, (317) 788-9351 or (800) 851-1202.

New power delay module

Lindsay Specialty Products has introduced the LPD 100 Power Delay Module for power restoration in CATV distribution systems. The LPD module is activated when power is restored



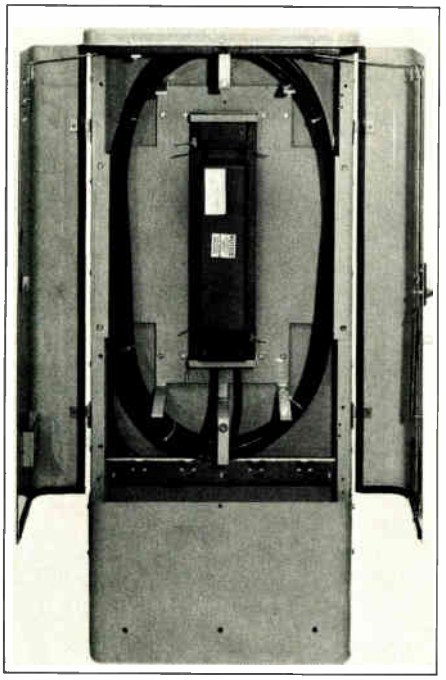
Lindsay Specialty's Midspan Adjustment Module

after an outage. The module eliminates high current surges by delaying AC

connection to the trunk amplifiers for two to four seconds, depending on the voltage at the insertion point. The LPD 100 module is compatible with the Lindsay 100 series family of active and passive hard line products and is housed in the lid normally used for the amplifier power supply.

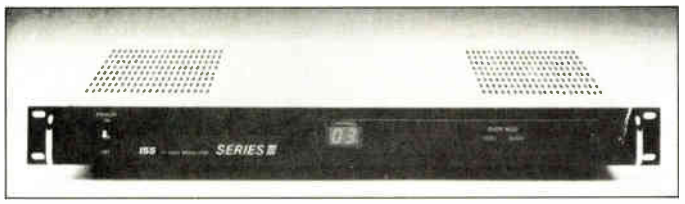
Also announced by Lindsay are two Midspan Adjustment Modules and a complete line of accessory compensators and equalizers. The Adjustment modules allow an operator to upgrade to high power/high bandwidth amplifiers without respacing. Up to two plug-in cards can be used to selectively attenuate peaks or change the slope of the cable spectrum. Models are available for both one- and two-way systems: the LMA 101 is for one-way systems whereas the LMA 102 module is used for two-way systems. The LMA 101 passes the entire bandwidth from 5 MHz to 550 MHz through plug-in locations. The LMA 102 contains diplex filters to route the subsplit frequencies around the plugins. For details on any Lindsay products call, (404) 633-2867.

Reliable Electric/Utility Products has announced the release of the OPFO-BD7 Fiber Optic Splice Cabinet. Designed to protect fiber optic splices in both burial and aerial distribution systems, the weatherproof cabinet includes the necessary hardware to mount most fiber optic splice closures. The fiber splice capacity is limited only by the size of the splice closure while cable management posts allow storage of up



Reliable Electric's fiber optic splice cabinet

to fifty meters of excess outside plant cable. For more info call, (312) 455-8010.



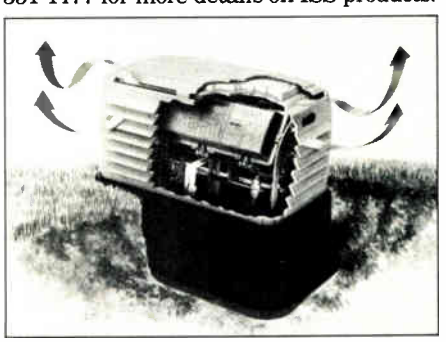
ISS Engineering's Series III

Available from **Times Fiber Communications** is sealed F connectors for CATV applications. Developed and manufactured by **Amphenol**, the connectors, for 6 Series and 59 Series applications, are one-piece weatherproof units which can be installed with one crimp. The connectors contain two weathertight seals inside, with a third seal formed when installed with a Times Fiber specially-designed round crimp tool. The connectors are designed with a built-in stripping guide and a nut design for easy identification. For additional info call, (203) 265-8500.

ISS Engineering's 4518 antenna system

ISS Engineering, Inc. is now shipping its third generation frequency agile modulator, the Series III. The Series III features a 10 dB improvement in In-Band carrier-to-noise and a 20 dB improvement in Out-of-Band carrier-to-noise, say company representatives. The unit will allow use of a 70-channel cable system without filtering.

ISS Engineering is also now marketing an 18-inch antenna dish, the 4518 Antenna System. The reflector is formed of compression-molded fiberglass-reinforced plastic. The 4518 System allows a company to provide satellite data transmission to multiple sites and is used in conjunction with the ISS PC-SAT™ Satellite Receiver card which fits into the slot of an IBM style PC. The 4518 System includes a Ku-Band feedhorn and LNB, and pole. Call (800) 351-1477 for more details on ISS products.



Channell Commercial's CPM 1730 Series 5 plastic enclosure

Channell Commercial has introduced the Series 5 Heat Dissipation Covers (HDC™) for use with the company's plastic enclosures for CATV equipment. Each enclosure is supplied with a ground skirt that acts as a foundation support system for active equipment and allows for storage of excess cable; hot-dipped galvanized bracketry and the necessary hardware to permit mounting of equipment without modification; and the applicable

Step up to higher power for longer reach with our latest broadband transmitter.

Hughes' advanced aerospace technology has created the world's most powerful CARS band linear solid state broadband transmitter with 8 dB increased output compared to previous broadband transmitters.

If you are one of the many resourceful cable operators who recognize the technical and economic advantages of using microwave to reach distant hubs, here's more good news.

A new Model AML-IBBT-116 transmitter is being introduced by Hughes Aircraft Company to close the performance and price gap—a gap that existed between the previously highest powered low-cost broadband block conversion type transmitters and the higher performance channelized types of AML transmitters.

Visit us at the Western Show, Booth #356.

This means you can now use an economical transmitter to transport up to 80 TV channels farther—in excess of 20 miles—signals that can be split for transmission in multiple directions, too. All from one unit which has sufficient power to be located indoors at the main headend, and is easily maintained with open-rack accessibility.

This transmitter incorporates a pilot tone for system phase locking, transmit monitor for monitoring and maintenance, and has built-in self test features.

For more information, contact Hughes Aircraft Company, Microwave Communications Products toll free: (800) 227-7359, ext. 6233. In California: (213) 517-6233. In Canada: COMLINK Systems Inc., Pickering, Ontario, (416) 831-8282.

Reader Service Number 59

Hughes AML is more than hardware.

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PLANT MANAGER—Rural northeast addressable technology. $29K.
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HEADEND/MICROWAVE—West coast top 5 MSO. $30K.
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CHIEF TECHNICIAN—SMATV, MMDS, MDU's. Midwest $35K.
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Fast paced, urban system with 68,000 subscribers has a new position available for an experienced technical operations person to report to the Technical Manager.

Responsibilities include oversight management of the Installations and Service Departments, leakage and vehicle maintenance programs. This system is preparing for plant upgrade and full scale audit. The successful candidate must have an Associates degree in electronics or its equivalent in experience, with at least three years cable construction, electronic and headend experience. Effective communication and interpersonal skills very important.

Attractive compensation and benefit package. Send resume and salary requirements to:

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Must have 5 years experience in all aspects of cable television engineering to include but not limited to CLI, AML microwave, TVRO, scrambling/descrambling, mod/demod and addressability. SCTE member with BCE certification a plus.

Non-smoker/EOE. Location-Riverside. Contact: Cathy Tong, (818) 796-2555.

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Trunk and Service Technicians needed for large M.S.O., starting construction in Michigan. Send resume to:

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IN THE NEWS

security device. Covers are available in either light green or beige. For info call, (800) 423-1863 or (800) 345-3624 in Calif.

Demolition tools

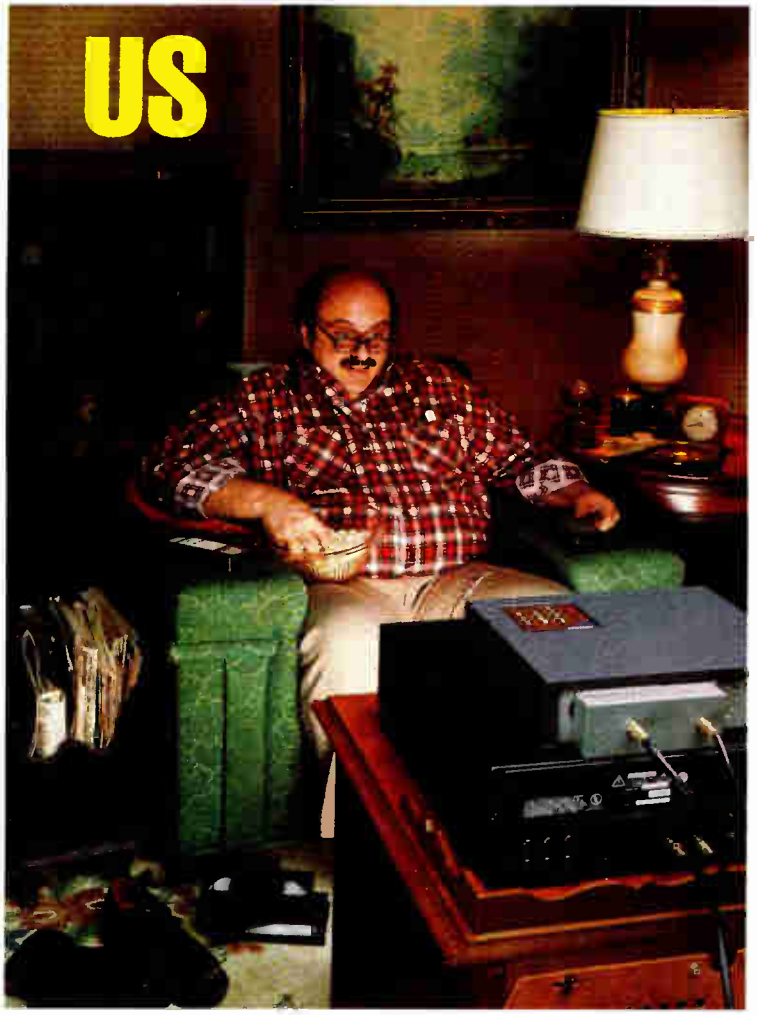
Allied now offers a selection of demolition tools for their Hy-Ram™ and X-Ram™ boom-mounted hammers.

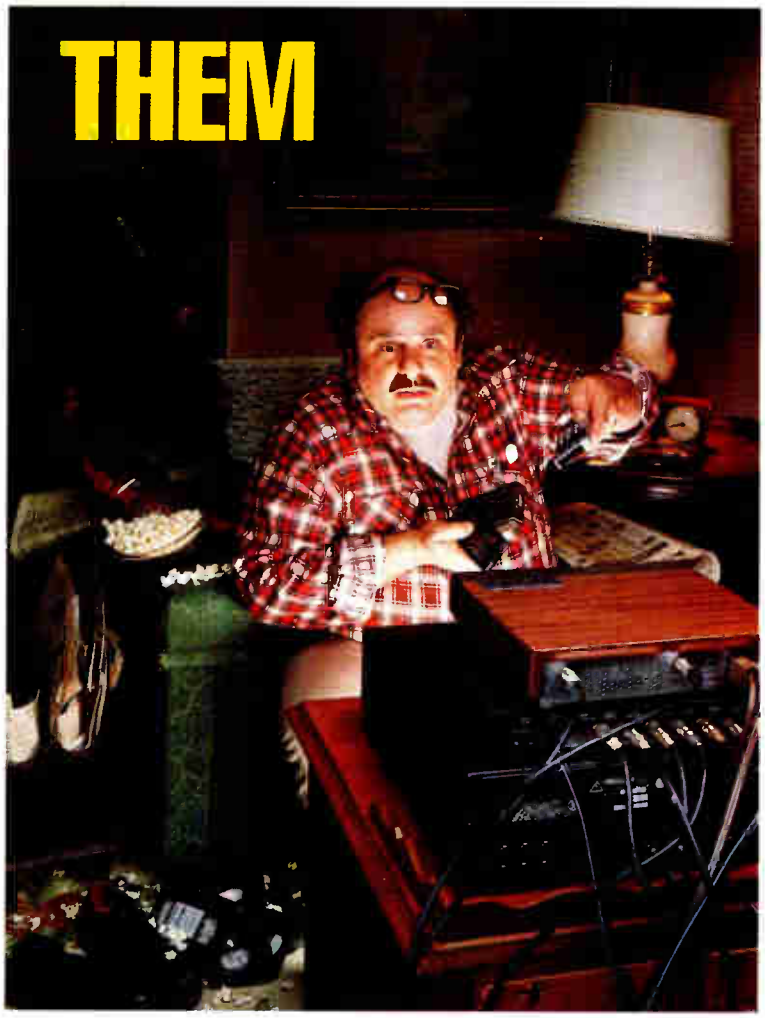
Allied's demolition hammers

The tools are made of a specially blended high-strength steel developed by Allied. The tools are also shot-peened, a process that compresses the outer surface of the tool to help reduce the possibility of fatigue failure. Allied demolition tools are available in relieved moil, offset wedge, blunt, bell, conical, cross-cut chisel and in-line chisel styles. For more info call, (216) 248-2600.

Available from Ditch Witch is the Model 1620, a 16 horsepower-class, walk-along trencher. The trencher features a hydrostatic ground drive and mechanical digging chain drive system and digs trench to depths of 48 inches at widths from 3 ¼ inches to 12 inches with optional pivot. Controls for the 1620 are color-coded to match the color-coded instruction/operation decals at the operator's station. All controls are grouped together within reach of the operator. The 1620 drive wheels can be steered while trenching and a Ditch Witch rotational horizontal boring unit can be mounted on the 1620 for job versatility. For details call, (800) 654-6481.

Channel Master® has introduced a line of VSAT Receive Systems. Designed for data, audio and video applications, the 0.60M, 0.75M, 1.0M and 1.2M compression molded reflectors can be matched with a line of mounts including non-penetrating roof mounts, wall mounts and polar mounts. A complete line of accessories, including Ku-Band LNB's, are available. For more info call, (919) 934-9711.





Consumer Satisfaction or Dissatisfaction?

Our answer is satisfaction.

With Pioneer's BA-6000 addressable converter, never again will your subscribers experience the frustration and inconvenience associated with their TV, VCR and cable converter. The advanced BA-6000 finally removes VCR incompatibility and multiple remotes from the picture.

Four VCR program timers and **volume control** are standard. Pioneer's unique **VCR Filter™** allows subscribers to record a pay program while watching a basic channel, or vice versa. A **built-in IPPV module** lets subscribers conveniently order events at the touch of a button. The BA-6000 even offers an **easy-to-read display** and a remote control with bigger keys and improved labeling.

The BA-6000 with volume control, packaged with the VCR Filter™, integrated IPPV and a SmartRemote™ offers the most comprehensive solution to consumer interface problems.

To get the picture on the Pioneer BA-6000 addressable converter, call **(800) 421-6450** and stop testing your subscribers' patience.

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Reader Service Number 61

We report on what the system managers

There are more than 6700 systems in the cable industry. And how each and every system manager feels with regard to topics affecting the cable industry is critical to the future success of the industry.

Midwest CATV, CableVision magazine and CED magazine have sponsored a nationwide, independent survey of system managers. We obtained their opinions on syndex, cable labs, CLI, customer service, customer relations, programming services, technician certification, HDTV, theft of service, equipment issues and management issues.

are talking about.

Now we're bringing the information to you via THE CABLE POLL. A unified voice for system managers of the cable industry.

For up-to-date information on the opinions of system managers, watch for THE CABLE POLL in CableVision and CED magazines.

The CABLE POLL™

Midwest CATV • CableVision • CED

IN THE NEWS

Ditch Witch's Model 1620

Available from **Trilithic, Inc.** is Cumulative Leakage Index Computing Software (C.L.I.C.S.) C.L.I.C.S. allows multiple entry modes for μV/m, dBmV, dB referenced to 20 μV/m and dB referenced to 50 μV/m. Real-time on-screen displays are updated with each entry for leaks per mile, CLI infinity, CLI 3000, leak level and leak fix categories. A report generator provides the FCC logs, repair worksheets and other summaries. For details call, (800) 344-2412.

Hameg Instruments has announced a low cost spectrum analyzer and tracking generator for testing head-end equipment, amplifiers, passives and measuring signal leakage. The Model 8028 Spectrum Analyzer connects with any oscilloscope to read signals as low as -40 dBmV with a 70 dB dynamic range at 12.5 kHz resolution. The analyzer is mounted in a 8001 mainframe and is priced at $1000. A companion Tracking Generator is available for $428. For more info call, (800) 628-6688 or (818) 597-0015 in Calif. (Holland Electronics Corp. is the Hameg cable products representative.)

A new line of weather resistant maintenance cards for CATV applications is now available from **Altair Corp.** Designed as maintenance tools, each card provides information about the equipment to which it is attached. All cards are laminated with 5 mil. plastic to provide protection from extreme temperatures, moisture, and to provide a rigid writing surface. Each card has a strapping hole for affixing to modules, wiring harnesses and handles. Trunk amplifier, line extender and dstand-by power supply cards are currently available. For info call, (303) 699-1634.

Other news

Midwest CATV has signed an agreement with **Wavetek RF Products** to sell the complete Wavetek line and distribute/stock all signal level meters. Other products stocked and distributed for Wavetek will include CLR-4 leakage detectors, MicroSAMs, RD-1 dipole antennas, and the SAM 1000/SAM 2000 signal level meters. For more info call, (304) 343-8874.

In a related announcement, **Mega Hertz** has also been appointed an authorized **Wavetek** stocking distributor. Mega Hertz will distribute, on a national basis, MicroSAMs and the SAM 1000 and SAM 2000 signal level meters.

Also included in the distribution agreement is the RD-1 dipole antenna and the CLR-4 leakage detectors for CLI compliance. Mega Hertz has been distributing Wavetek products nationally for the past year but have increased their distribution commitment. For details call, (800) 525-8386 or (303) 779-1717.

ITW Linx has announced the acquisition of marketing rights to **Tower** cable clips in the United States. Linx will maintain the marketing, pricing and distribution strategies Tower has followed. For info call, (312) 693-3040.

Multicom, Inc. has announced it will stock Jerrold's S145OR VideoCipher II, Satellite Receiver. Switchable to either C- or Ku-Band, the S145OR accepts signals from 950 MHz to 1450 MHz. The receiver features digitally synthesized video and audio tuning. For details call, (800) 423-2594 or (800) 342-8840 in Fla.

—Kathy Berlin

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