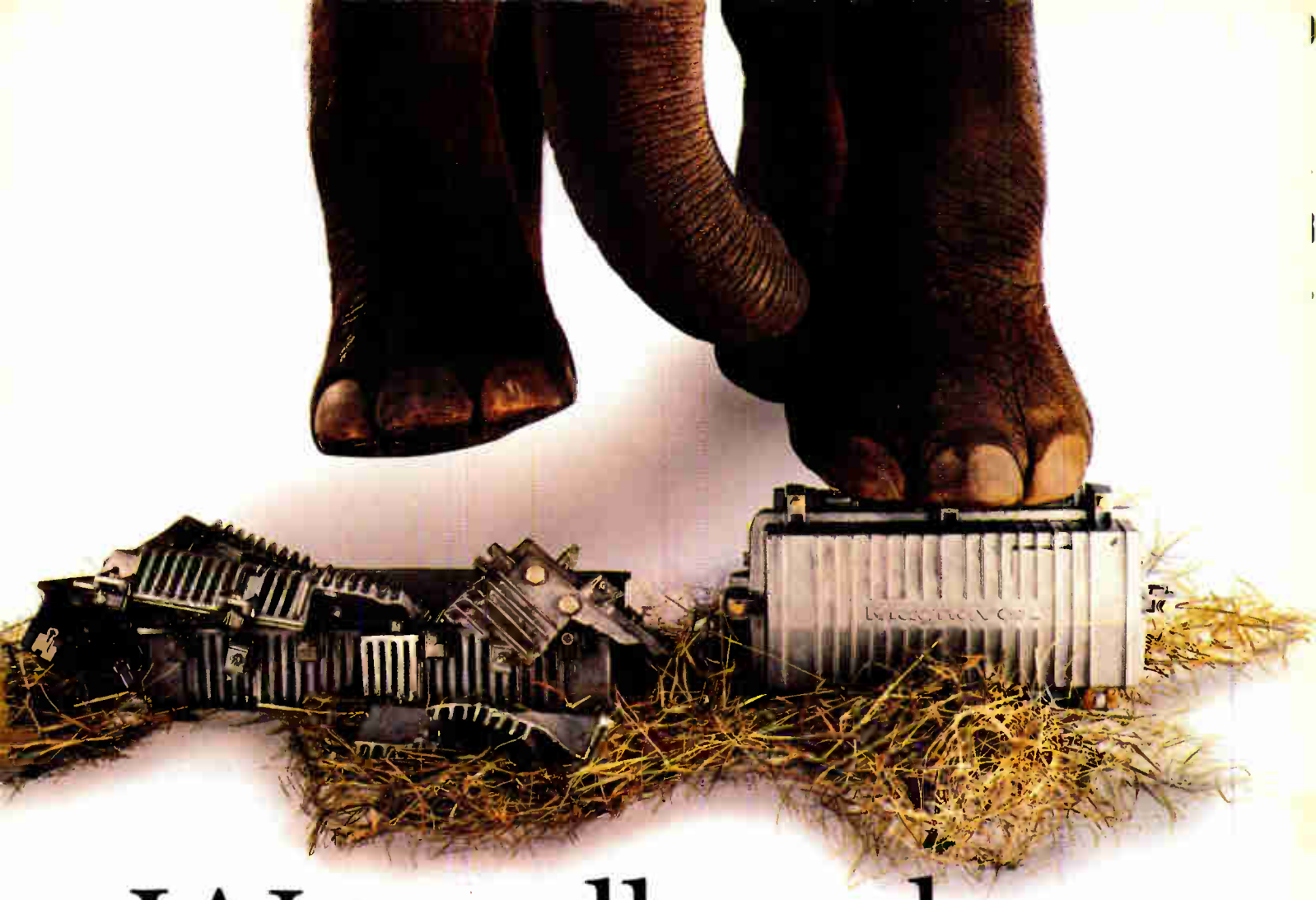
JUNE 1987

COMMUNICATIONS ENGINEERING AND DESIGN
THE MAGAZINE OF BROADBAND TECHNOLOGY

CED

C-band OR Ku-band: which is BEST for CABLE?



We're all under a Lot of Pressure!

YOU'RE UNDER A LOT OF PRESSURE.

Operating a cable TV system places you under a lot of pressure... the pressure to perform and to grow profitably. Especially since a minor equipment failure can cause a signal outage for many subscribers who remember only your mistakes.

WE'RE UNDER A LOT OF PRESSURE TOO.

We have to perform under pressure too, in order to make sure that our products will perform for you year in and year out.

So we design for performance and endurance, use heavy-duty parts, manufacture with care, and test our equipment every step of the way. This means that nobody makes longer-lasting equipment than Magnavox!

SERVICE WHEN YOU NEED IT.

When you purchase equipment from Magnavox, you also receive the best warranty and repair service available... from Magnavox Factory Service.

And when you need field service, troubleshooting, and technician training, our Field Engineering Team and Mobile Training Center will be there to help you.

A TRADITION OF RESEARCH & DEVELOPMENT.

As a subsidiary of North American Philips, we carry its strong tradition of R&D into cable TV systems, with Powerdoubling™, Feedforward, and DSS Status Monitoring Systems.

And our advanced modular design gives existing systems the cost-effective flexibility to upgrade and add features.

WE HELP RELIEVE THE PRESSURE.

An unhappy subscriber never forgets. So don't lose profits and customers to unnecessary service calls. Install Magnavox equipment. Your system will operate smoothly and profitably, year after year!

Magnavox CATV SYSTEMS, INC.

A NORTH AMERICAN PHILIPS COMPANY
100 FAIRGROUNDS DR., MANLIUS, N.Y. 13104

FOR MORE INFORMATION CALL:
(800) 448-5171 In N.Y. State (800) 522-7464
Telex 937-329 Fax (315) 682-9006

Reader Service Number 1

GROWING STRONGER ALL THE TIME

Broad acceptance and rapid growth are familiar rewards for a company that provides the American marketplace with a superior product. "Build a better mousetrap..."

The company is Trilogy, and the product is MC²

The impact of MC² alone – with its air dielectric assuring a 93% velocity of propagation – has set a new industry standard for coaxial cables. Manufacturers of foamed cables have had to increase their diameters in order to approach the attenuation characteristics of MC²

Overnight success stories in the telecommunications industry can be short-lived, unless accompanied by farsighted commitments to industry needs that go beyond the most advanced product available. Consistent quality, assured availability, technical services, including problem-solving capabilities, and customer cost-effectiveness have always been important concerns of the Trilogy founders.

TRILOGY LEADS IN TECHNOLOGY

Trilogy
COMMUNICATIONS INC.

Call or write for a free sample and brochure:
TRILOGY COMMUNICATIONS INC., 2910 Highway 80 East, Pearl, Mississippi 39208
800-874-5649
601-932-4461

Reader Service Number 2

CED

June 1987 Volume 13, Number 6

OFFICE
Denver 600 Grant Street, Suite 600, Denver, CO 80203 -or- P.O. Box 5208 T.A., Denver, CO 80217, (303) 860-0111.

ITCI
INTERNATIONAL THOMSON COMMUNICATIONS INC.

CED. (USPS 300-510) (ISSN 0191-5428)is published monthly by International Thomson Communications Inc., 600 Grant St., Denver, CO 80203. ©June 1987, Volume 13, Number 6. Subscriptions free to qualified industry readers. All other one-year subscriptions are $26, 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 P.O. Box 5208 T.A., Denver, Colorado 80217. MEMBERS OF THE BPA.

SPOTLIGHT
The guru of leakage **6**
Experience as a ham radio operator in South Africa gave Roy Ehman his start in cable, but only after moving halfway around the world to Calgary and then to the U.S.

MY TURN
No matter how you say it. . . **8**
Whether it's people talking to people or computers talking to computers, communication is one of the most important elements in the industry, so says Archer Taylor.

Dealing with lightning, Part I **26**
The first installment of a three-part series on lightning protection by Roy Carpenter explains the potential hazards presented by electrical storms on power lines and how to minimize their effects.

BTSC waveform tutorial **36**
Lu Rovira of Scientific-Atlanta gives an interesting tutorial on the different BTSC waveforms in this special two-page pictorial in this month's *CED*.

NCTA exclusive: Part IV **39**
This is the final part of the *CED* exclusive printing of the NCTA article on consumer interconnection guidelines. Part IV includes an Oak Communications piece on multiple home terminal units.

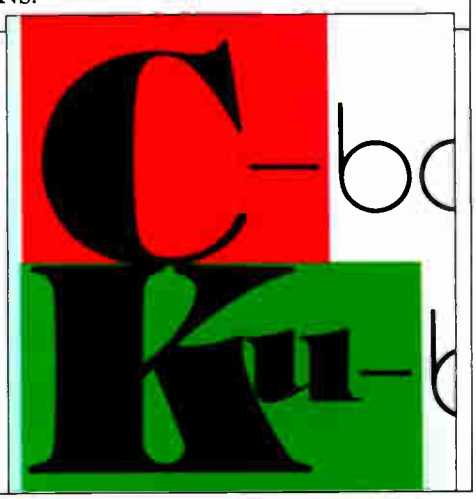
The makings of a lead acid cell **50**
Until the ideal battery for every situation is developed, it is up to the user to understand the ins and outs of the different lead acid cell batteries available on the market today.

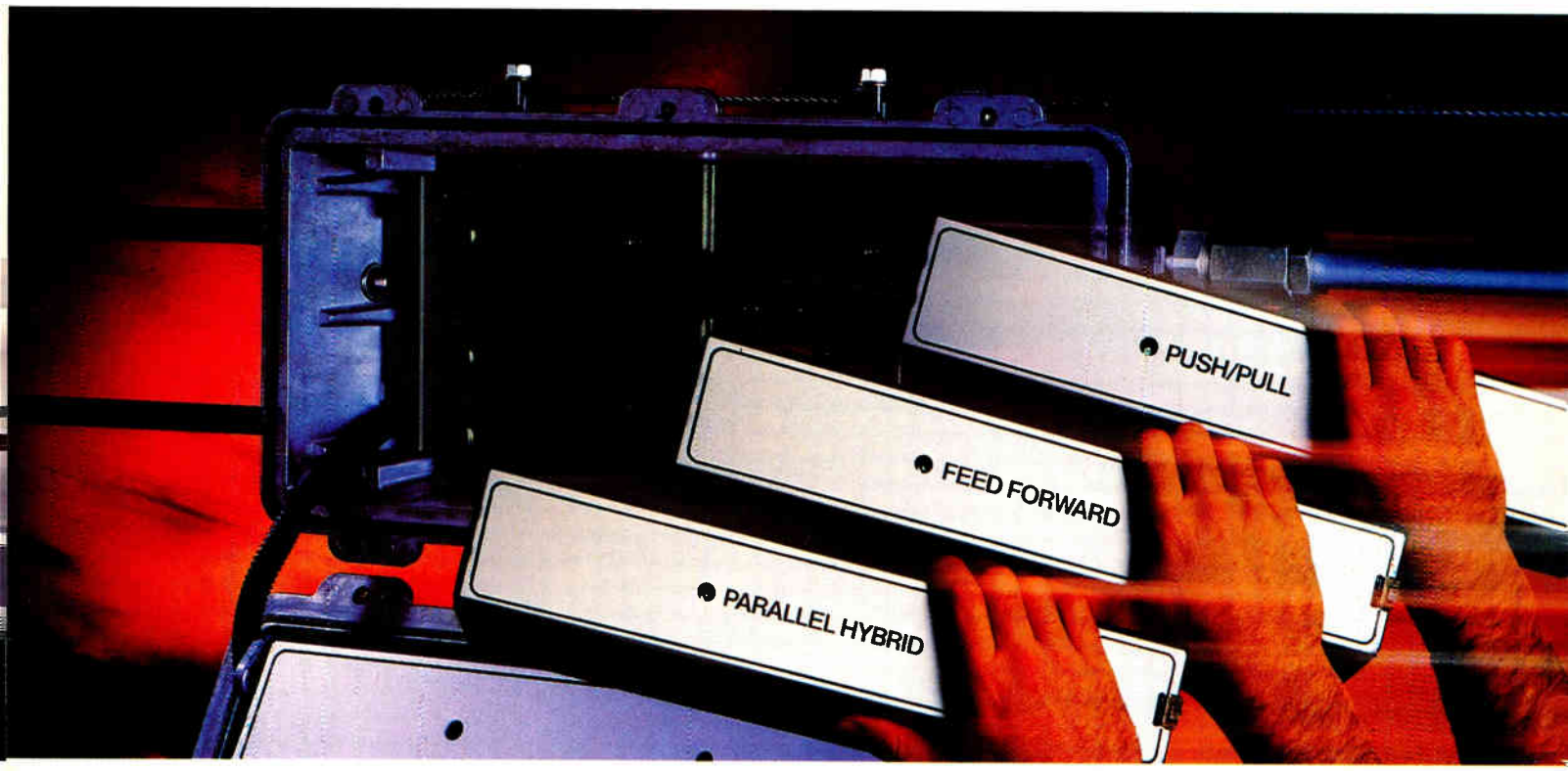
A new step for *CED* **63**
This issue signals an added dimension to *CED*. We're starting a "magazine within a magazine" to give broadband LAN people just what they're looking for: up-to-date information on the latest in LANs. Kicking off the section is a Who's Who in LANs.

PRODUCT PROFILE
Standby power suppliers **130**

DEPARTMENTS
Spotlight **6**
Frontline **10**
Looking Ahead **12**
In the News **79**
Classifieds **82**
Ad Index **83**

About the cover
C-band vs. Ku-band is the hot topic of this month's cover. Viacom and HBO, respectively, take a stand on the issue and provide arguments for each side. CED *invites its readers to state their position for the record as well in coming issues.*





GROWING WITHOUT THE PAINS.

SCIENTIFIC-ATLANTA MAKES UPGRADES AND REBUILDS A SNAP.
Expanding your system's bandwidth with Scientific-Atlanta is as simple as snapping new modules into existing Scientific-Atlanta housings. Or dropping us in when the job calls for amp replacement or total rebuild.

Our upgrade/rebuild program includes system analysis of cascade performance, project engineering consultation, system evaluation and feasibility studies.

MODULAR COMPONENTS, MAXIMUM CHOICE.
Our modular distribution concept gives you flexibility others can't. Our full line of push/pull, parallel hybrid and feedforward amps are available immediately in the widest choice of bandwidths (300/400/450/550) and gains (22/26/30).

SINGLE-FUNCTION MODULES.
Modular components let you configure a system with exactly the right combination of performance and economy...right to the end of the cascade.

MINIMUM MAINTENANCE.
Our use of discrete slope and gain controls, ultra-stable AGC/ASC, surge-resistant power supplies and heat-dissipating amplifier housings assures a smooth-running, maintainable system under the most demanding conditions...yours.

PART OF A FULL-LINE PACKAGE.
In addition to our distribution amps, taps and passives, Scientific-Atlanta offers a complete line of compatible, upgradable CATV products. And they're all backed by a company with a reputation for quality, service and support.

So why not call us for more information about our painless upgrade/rebuild program? It sure can't hurt. Dial **1-800-722-2009** or write to: Scientific-Atlanta, Dept. AR, P.O. Box 105027, Atlanta, GA 30348.

Scientific Atlanta

Reader Service Number 3

Roy Ehman

Filling his shoes would be a difficult task

They say you can't really judge a man until you've walked a mile in his shoes. If you tried on Roy Ehman's shoes, you'd find two things: that they're probably too big and they're well-worn from travel. But regardless of how the shoes fit, you'd find that Ehman is one of the cable community's most pragmatic, analytical and respected engineers.

A native Canadian, the soft-spoken Ehman gets his British accent from the South African rearing and education he received, starting at the tender age of one and culminating some 40 years later when he, his wife and seven children returned to his homeland.

While in South Africa, Ehman received a BS degree in physics and chemistry. He went back to school while in his 30s and studied electronics "because my physics and chemistry wasn't satisfying me," he says. He credits his interest in conventional and ham radio operation, which led to a five-year stint as a broadcast engineer, to an experience he had with headphones while still a young boy. "It must have had the most profound effect on me, I was impressed out of my mind," he recalls.

An 11-year stint as manager of an ill-equipped sound department at the National Film Board refined Ehman's engineering skills. While there, he rebuilt a vast portion of the equipment he inherited, including some of the optics, cabinetry, mixing boards, etc.

Throughout those years, Roy often spoke with Canadian and American ham enthusiasts. After years of encouraging him to revisit his North American home, in 1967 Roy finally took a three-month leave of absence from his job (and his children) and toured several cities with his wife. He was hooked.

Although it took three years to get everything in order, the Ehmans later sold their possessions and, because the difference in school years resulted in a nine-month layoff for his brood, slowly wandered through most of Europe before arriving in Novia Scotia. After wandering about the Northeast and Great Lakes, Ehman correctly figured Calgary, with its wealth in oil, would eventually prosper, so he made his home there.

Upon his arrival in Calgary, Ehman went to the fledgling local cable company, Community Antenna TV, and offered his services. Seemingly uninterested, the company's management told him to come back later. He did, and they hired him as their chief technician. After Ehman was later named operations manager, Canadian Cable Systems bought the system and then, in 1978, invited him to build their system in Syracuse.

For Roy, the invitation gave him the break he was looking for—an opportunity to live in the States. But the experience helped in another way, too. Intimate knowledge of the 400-mile, active two-way, 500-carrier system taught him "some hard, hard lessons about leakage." So much so that he has become known as Storer's "leakage guru" since joining that MSO in 1981.

His experience in leakage has led to some radical ideas concerning how to eliminate the problems associated with shared frequencies.

"Frequency offsets are the best things that ever happened," he says. "In 1990, after cable begins its mandatory CLI reporting, the FCC will allow cable to go back to using the actual frequencies. I think that's a very retrograde move" because there will always be some violations of the leakage rules, willful or not, Ehman says.

Instead of eliminating offsets, Ehman suggests that cable adopt a 6.25 MHz ±2.25 KHz offset. "I immediately hear cries that we can't maintain that kind of accuracy," says Ehman. "But I speak with the voice of authority because I have, on record, all these offset frequencies, hundreds of them, and over six months they are only varying by tenths of a kilohertz."

Furthermore, he unabashedly suggests that cable be granted use of 35 offset channel frequencies within the aeronautical band in perpetuity. "What I'm asking for is less than 1 percent of the more than 4,600 channels available to them," he says. And because the FAA would be aware that cable shared those channels and there would always be a danger of some interference, they would be encouraged not to use those frequencies in navigational and emergency situations.

"Offsets are so very easy to control and monitor, both for the FCC and operator," says Ehman. "Offset frequency readings can be made at any convenient location at any convenient time with extreme and unequivocal accuracy."

Never one to mince words, Ehman admits he's not a fan of ground-based CLI measurement, because of the amount of time and personnel it would take to do it properly. "You would need an army of technicians full-time" to do what is asked, he says. However, he just as readily admits that leakage programs must be carried out, but suggests that aerial detection and measurement is the way to go.

Besides leakage, Ehman counts among the most daunting engineering challenges the consumer interface and the F-connector. But it is clear that leakage issues take most of his time. "I've been known to stop work on my computer at 6 p.m., write it to a floppy disk, go home, put the floppy in my machine and carry on all through the weekend."

With dedication like that, filling those well-traveled shoes would indeed be a difficult task.

—Roger Brown

HOW TO TAKE THE RECALL OUT OF THE INSTALL

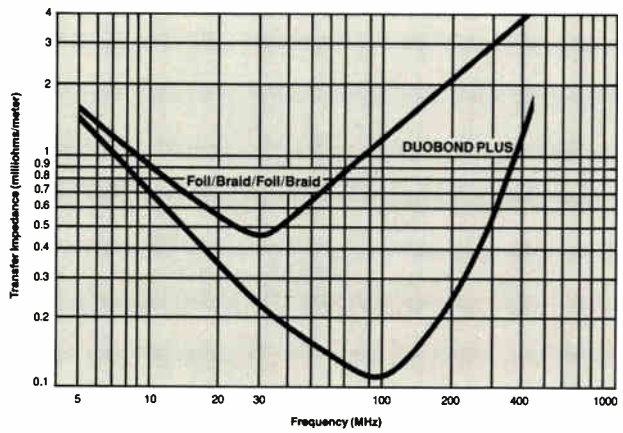
Belden's drop cable with DUOBOND PLUS™ shield helps you prevent costly call-backs. It's also the most shield-effective drop cable in the CATV industry.

Easier termination for maximum shielding integrity.

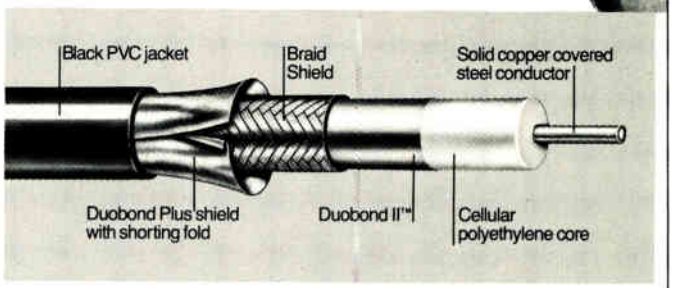
The DUOBOND PLUS shield features a foil/braid/foil construction with a shorting fold in the outermost foil which provides superior shielding effectiveness to typical 4-layer shield constructions. The transfer impedance graph demonstrates this effectiveness.

The added benefit is easier termination. This means less chance for error, resulting in greater shielding integrity and reliability. It also means fewer call-backs, lower operating expenses and more satisfied subscribers.

Cables with the DUOBOND PLUS shield require only half the steps for termination than 4-shield cables. Because it's less bulky, more flexible and its outer foil is bonded to the jacket, stripping and connectorizing are much simpler tasks. You can minimize your connector inventory to one size connector and one crimp tool.



Belden's unique shield protection.



The inner foil of the DUOBOND PLUS shield is bonded *directly* to the core. Foil pushback and signal leakage problems are eliminated. Protection from shielding degradation is eliminated during installation–where most shielding problems occur.

The unique shorting fold in the outer foil of the DUOBOND PLUS shield provides metal-to-metal contact for improved isolation. Traditional overlapping foils fail to reduce slot radiation as effectively.

Belden's exclusive shorting fold

Drop cables with the DUOBOND PLUS shield are available in RG59, RG6 and RG11 constructions—messengered, non-messengered, dual and flooded versions. All cables are 100% sweep tested from 5 to 450 MHz with a minimum return loss of 23db for RG59 and 26db for RG6.

When it comes to shielding effectiveness and ease of termination, *There is no equal* to Belden in the CATV industry. Take the recall out of your install. Call Belden today for more information and a free CATV catalog. Belden Wire and Cable, P.O. Box 1980, Richmond, IN 47375.

1-800-BELDEN-4

There is no equal.™

COOPER INDUSTRIES **BELDEN**

Communication without words: a scary thought

Our business is communication. Mostly, we communicate with words, written or spoken. An old Chinese proverb says: "A picture is worth ten-thousand words." However, most TV pictures are worthless without words; and the schematic or block diagrams, and orthogonal or isometric drawings used by engineers to communicate technological information are of limited value without explanatory words. In a world with hundreds of languages and thousands of dialects, prudence has dictated the growing use of pictograms to convey safety information to automobile drivers, and to segregate restrooms by sex. Nevertheless, communication without words is formidable.

Computers talk to each other with words of many languages not spoken by humans. Computers are absolutely intolerant of the misuse of words. They never execute the commands you meant to give them, but did not. We are different. Most of us, even lawyers, writers and politicians sometimes (maybe frequently) used words incorrectly. We expect people to understand what it is we are trying to communicate even if we use the wrong words. There would be much less grief and misunderstanding in the world if we could only learn to use words with the precision of meaning required by computers.

Take the word "redundancy," for example. We all know (or think we do) that it refers to back-up facilities. We have redundant power supplies to maintain continuity of service if the main supply fails. Redundant computers saved several space missions from failure.

In England, however, it means something else. Workers laid off from their jobs must depend on their redundancy compensation payments until they find new jobs. The dictionary defines redundant as, among other things: "superfluous; in excess of requirements." So, the British can properly claim to be technically correct. However, the idea that a worker, who has been laid off, is somehow superfluous, no longer required, must be far more depressing to the spirit than mere unemployment. Moreover, while back-up power supplies and computers may not really be required, so long as the primary units are working properly, they are certainly not superfluous. They are required for both safety and peace of mind. Yet we call them redundant.

Some 1,800 years ago, Claudius Galen, a Greek physician wrote:

> "The chief merit of language is clearness, and we know that nothing detracts so much from this as do unfamiliar terms."

Such specialist writers as doctors, lawyers, engineers and economists have always had a disturbing tendancy to use unfamiliar words; or even worse, unfamiliar capitalized initials representing words that might otherwise be familiar.

Successful communication of facts, or concepts, demands the use of terms familiar to those with whom we would communicate. The use of special technical terms, or unexplained initials or acronyms, often assures failure to communicate. Some believe that the use of unfamiliar terms or acronyms is a sign of superior knowledge, possibly even intelligence. On the contrary, it is at best elitist, and could even be considered boorish when indulged excessively.

Like any living organism, language must grow and adapt to meet the changing needs of communication. New technology required new words like geostationary, lift-off, byte and pixel. Even throughput better describes a useful quantity in computer technology than clumsy alternative expressions. However, there is no other excuse than ignorance for adultering the language with such abominations as "fragmentalize" or "initialize" so long as the perfectly good and totally adequate verbs to fragment and to initiate are available.

It is hard enough to read a sentence with "and gate" instead of "AND gate"; but converting the coined noun representing an important logic element into the strained past participle, "EXCLUSIVE ORed," clearly signifies a complete lack of respect for the English language. (Why not say: "Connected to an EXCLUSIVE OR gate?") Violation of the traditional rules of grammar is like running a red traffic light. Many get away with it, without arrest or collision (but not everyone). However, it is widely recognized as the sign of a scofflaw.

Perhaps even worse are the euphemisms used in military and other government-type documents. An "aluminum transfer case," for example, is a temporary coffin. A "manually powered fastener-driving impact device" is a hammer (worth, at typical Pentagon exchange rates, about U.S. $435). A "hexiform rotatable surface compression unit" is a machine nut. Perhaps, instead of calling a spade a spade, we might call it a "manually operated, small capacity earth mover."

Whatever happened to the word we once used to describe a lively picnic on the beach, or the merry sounds of children at play? Radio station WGAY began broadcasting its present format of happy, smooth music in the Washington, D.C., area long before the word gay took on its present connotation. Futhermore, what are we to expect of an adult community, once we learn what adult bookstores are like? Debasing the language with such euphemisms is irresponsible.

New words and the evolving meaning of old words can enrich the language and improve our ability to communicate new facts and ideas. However, effective communication also depends on a high degree of respect for traditional language. We need to take care that new words, or new usage do not actually conceal true meaning, or create new ambiguity.

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

MOST FOLLOW STANDARDS...

...A VERY FEW SET THEM.

In every industry there are leaders who are innovative and dedicated to producing the highest quality product. The vision of these leaders fuels progress; they forge ahead and bring new solutions to the marketplace. Most of all, these leaders listen to their customers and translate their needs into products and services of the highest standard.

In CATV, Alpha has set the standard in Standby Power technology. This leadership is based on a long list of 'firsts' in powering concepts and product capabilities. Implementation of Alpha's single ferro-resonant power supply design revolutionized the industry and gave new meaning to cable system reliability and customer satisfaction.

Direct cost reductions through improved battery performance and

simplified system maintenance were brought about by Alpha's temperature compensating and performance monitoring circuit designs. In addition to these technological contributions, Alpha has

established the highest quality and safety standards. To date Alpha remains the only Standby Power manufacturer offering UL, CSA and SEV listed products to the CATV industry.

The unique *Lifeline* status monitoring system provides diagnostic information and remote control facilities on *one-way* and two-way cable systems. This pioneering development now enables operators to optimize service strategies and reduce overall system maintenance costs. *Lifeline* is Alpha's latest in a series of historic status monitoring milestones: the first and only stand-alone power-supply monitoring system, hardware interfaces

for the major amplifier monitoring systems, and complete monitoring software have all preceded the *Lifeline* introduction.

Alpha Technologies set the standards in Standby Power for one reason: Alpha's customers won't settle for second best.

ALPHA TECHNOLOGIES

We're Here to Back You Up.

3767 Alpha Way
Bellingham, WA 98225
TELEPHONE:
206-647-2360

7033 Antrim Ave.
Burnaby, B.C. V5J 4M5
TELEPHONE:
604-430-1476
TELEX: 04-356760

Reader Service Number 5

Preventive maintenance isn't money down the drain

Boat owners and people who like to participate in water sports revolving around either sailboats or power boats are quite used to an old joke about their hobby. The joke goes like this:

"What is a boat?"

"A hole in the water surrounded by wood or fiberglass into which one pours money."

I'm sure a lot of boat owners get a good laugh out of this, but I'm also sure they realize that there is a certain amount of truth in the joke. Or, how about this: Have you ever been with the pilot of a small airplane, or for that matter, a reasonably large airplane, and watched as he walks around the plane before getting in and starting the engine? He checks a lot of seemingly insignificant things and, if you're with a truly professional pilot, you'll find that sometimes things that don't look particularly bad to you will cause a pilot to taxi the plane to the nearest mechanic's hangar and ask that whatever the pilot has discovered be fixed or looked after.

In the case of the boat owner pouring money into that hole and the case of the pilot doing a pre-flight walk-around and subsequent repair or checking of any abnormalities discovered, no matter how trivial, we see examples of preventive maintenance in operation. In both cases these people are not willing to trust their lives to poorly maintained equipment and, in fact, will spend both time and money on things that still work rather than experience a problem at a time or in a place that may be unpleasant. While one could argue that the protection of their lives is more important to them than the protection of their livelihood, I think the point to be made is that preventive maintenance, while it appears to be money disappearing down a hole, in fact serves a useful and valuable function.

In the normal course of an article on CATV, an entire range of options for the initial design and subsequent building of a system would be discussed. I will state flatly that for the health of our industry in the future, there is really only one way to provide quality, reliable service in any industry and in particular, I am talking about the type of industry that delivers services via some transmission medium:

- Build the system correctly to start with, and
- Maintain it consistently and promptly thereafter.

One way to get a leg up on this consistent and prompt maintenance is to do preventive maintenance when it's needed.

Unfortunately, while it's very easy for accountants and managers to see that spending funds to fix something that is broken is acceptable, it seems to be hard for anyone to see why a technician would spend time, money and perform activities potentially disruptive of the system to fix something that isn't broken. Indeed, that is a good question. There is a school of thought supporting what is called "crisis management" and asks the question, "Is it cheaper to spend money on preventive maintenance rather than responding quickly and aggressively only to something that fails?" The argument goes that, in the long run, fewer funds are expended and problems with things that eventually break anyway are fixed promptly in every case.

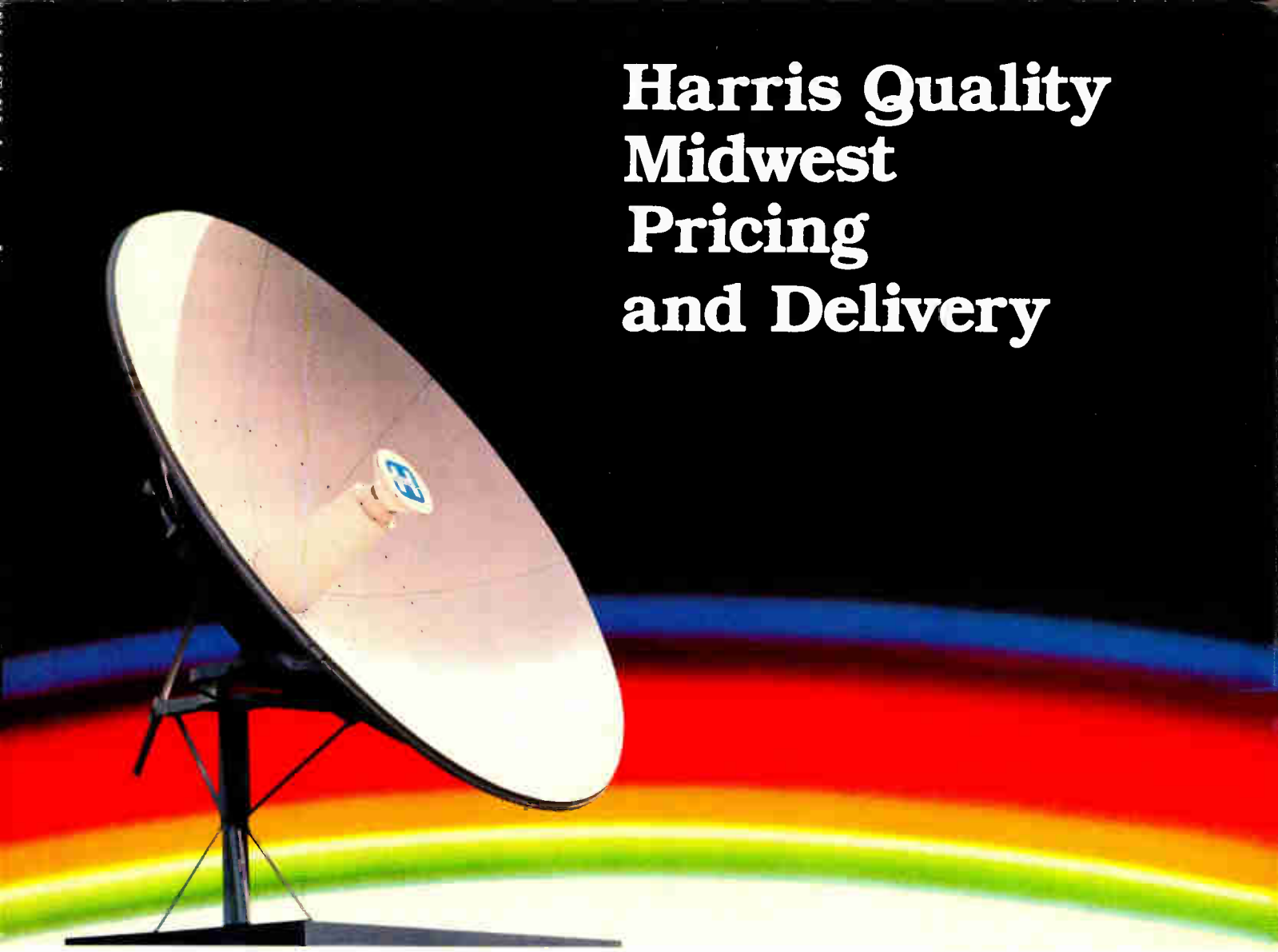
It's hard to find economic models of what the end result in terms of cost will be over a period of time in this maintenance management style, but my gut reaction is that while you may be able to show good economic results thereby, I'd be willing to bet you would have more actual maintenance to perform by fixing only those components that are broken than if you had performed preventive maintenance all along. With this type of reasoning you inevitably come to the intangible part of the equation, "What is customer dissatisfaction and churn worth to our bottom line?" If in fact we do preventive maintenance and prevent certain catastrophic failures or constantly keep the picture quality at the upper end of the range of acceptable standards, there is one less element which would potentially dissatisfy a customer. To the extent there is one less element for subscribers to be dissatisfied about, our jobs would be safer. I believe we could show that there would be less churn and fewer calls for service from our customer base.

While I know it's tough to make a case to add people and test equipment to the assets and personnel resources of a company, it's probably even tougher to add it on the basis of preventive maintenance—performing maintenance to fix things that haven't actually broken yet. But I believe that a strong case can and should be made to management that while this appears to be money down the hole with no direct return, in fact the return is as substantial and significant as any other budgeted project, even if it doesn't appear in the form of checks and new customers.

Beginning next month, Mr. Bailey will present Part I of a multi-part piece on "How to Minimize Customer Frustration." It will focus on procedures and attitudes that can be adopted to lower the risk of raising your customers' ire over routine operational tasks.

By Wendell H. Bailey, NCTA, vice president, Science and Technology

Harris Quality Midwest Pricing and Delivery



$1,295.00

Model 5115-AZ includes AZ/EL mount and dual polarity feed.

The Harris 3-meter C-Band Delta Gain™ Antenna gives you more than an impressive 41 dB gain. It's also rugged enough to withstand 120 MPH winds. Plus, it's easy to install and available with either an Az-El Mount or a Polar Mount with optional motorization.

The Harris 6529-2 Frequency Agile Receiver is the updated version of the popular 6529. It is a 4 GHz input receiver, so if you have an older system you can get the excellent picture quality of the 6529-2 without the added cost of installing an external down converter or new plumbing. Plus you get one of the best warranties in the industry – two years on parts, labor and workmanship.

As one of the world's largest stocking distributors of Harris equipment, Midwest has these, and other Harris products, on hand and ready to ship – instantly. Midwest provides complete systems or individual components for either C or Ku-Band, fixed or mobile, Up-link or TVRO.

For the best prices and fastest delivery in the industry, contact Midwest at 800-543-1584.

$695.00

Model 6529-2

MIDWEST
Communications Corp.
One Sperti Drive
Edgewood, KY 41017

800-543-1584
(In KY 606-331-8990)

Reader Service Number 6

The next challenge

At last! We can finally see the light at the end of the tunnel. As an industry, most of our suburban construction is pretty well completed, and the big urban builds are at least underway. While work remains, we can begin to sit back, take a breath, and work on fine-tuning our technical operations. Right?

Well, not exactly. Just when we thought we could see the beginning of the end of huge investments in plant construction, we've begun to discover that 30 to 35 channels may not be enough. Many systems are facing refranchising over the next five years or so, and while the implications of the Cable Act with regard to demands for increased capacity are not entirely clear, the issue is important to many franchising authorities. Also, the 30-, 35- or even 40-channel systems that we thought would satisfy our programming needs forever are falling short of marketplace demands. The last round of sports, shopping and PPV services have made that abundantly clear. While the must-carry ruling brings some relief, we cannot use it as an excuse to ignore what our markets want: down that path lies disaster.

The next five years may bring a whole new opportunity in the form of High Definition Television (HDTV). If the cable industry is complacent and fails to act, we could find ourselves totally outside the distribution loop for this potentially explosive entertainment medium. If we pursue it aggressively, it could prove to be an enormous asset to us. That pursuit will require chunks of channel capacity. The transmission format for HDTV is not yet resolved, but it is clear that it will be bandwidth hungry, gobbling up 1½ to 2 normal channels at a time.

At some point in the next few years, the amount being invested in new plant will be overtaken by money going for system rebuilds and upgrades and this trend will bring with it a whole new set of engineering challenges. We really know a lot about new plant construction; much of that knowledge was gained the hard way. But new construction begins with a fairly clean slate; system rebuilds and upgrades have the maddening additional complexities of working around existing plant and doing work without disturbing service to our subscribers.

From the standpoint of the economic health of our companies, it is critical that we make effective use of as much of the existing investment as possible in upgrading our systems. Sixty percent or more of that investment is in coaxial cable and support hardware and the labor required to put them in place.

To some extent, technology has come to our rescue. We have been doing upgrades for some years with electronic changeouts and "mod-kits" and the tools at our command are becoming more powerful. New high-performance hybrid amplifiers, power-doubling chips and feedforward amplifiers are all part of our arsenal. It remains for us to understand these tools and adapt them to specific situations.

In considering system upgrade as an alternative to rebuilding, the economics speak loudly. A recent situation where there was a need to increase capacity from 30 to 40 channels provided some dramatic contrasts. In terms of capital investment, a complete rebuild would have cost $12,000 per mile, while an upgrade of electronics and some passives cost less than $3,000 per mile. Also, there was a wide difference in the operating cost impact for the year in which the work would be done. With a rebuild, the undepreciated value of the wrecked-out plant would have been taken as a one-time write-off, essentially as an operating expense. In our example, this would have been $2,000 per mile. But in the upgrade, only the undepreciated portion of the amplifiers and discarded passives had to be written off; approximately $270 per mile.

It is difficult to generalize about the extent to which a system can be upgraded, but assuming that the majority of cable is relatively flat up to the highest frequency required, and that truly heroic amplifier spacings were avoided in the original design, 12-channel systems (220 MHz) can often be upgraded to 40 channels (330 MHz) and 30-channel systems (270 MHz) to 52-channel systems (400 MHz).

There is a natural desire, when looking at the need for additional channels, to want to discard all those old problems, scrap the plant and put up new strand, cable and electronics. While that approach may be satisfying, it ignores today's economic realities. The plant we build or upgrade today may take us through cable's first major competitive crisis. That may turn out to be DBS, multi-channel MDS, telco systems, or even an overbuild. But whatever form it takes, it is critical that we spend capital as intelligently as possible. In many cases this means keeping existing strand and as much cable as we can, keeping passives when they will handle the additional bandwidth and focusing on electronics as the most cost-effective way to improve system performance.

There are millions of dollars at stake. At one extreme, we can build brand-new plant. There is little technical risk there; it should work superbly, but at substantial cost. At the other extreme are poorly thought-out upgrades, full of compromise. Such projects make poor use of the money they require and leave our subscribers with perhaps a few more channels in a system with mediocre performance. If the engineering challenge is successfully met, however, we can produce upgraded systems with significantly better performance than those with which we began.

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

POWER KING™

Standby and Inverter Power Supplies

Model shown: PS-SB30/60
Standby Power Supply (2 Battery).

Other models available:
PS-SB30/60 (4 Batteries) with optional
Auxiliary Battery Pack (Model PS-ABP).

Model PS-INV-60/30
Inverter Power Supply.

RMS ELECTRONICS, INC.
50 ANTIN PLACE, BRONX, N.Y., 10462
CALL COLLECT: (212) 892-1000 (New York State Only)
TOLL FREE: (800) 223-8312 (Continental U.S.A., Puerto Rico, U.S. Virgin Islands)

Reader Service Number 7

C-band or Ku-band: which is better for cable?

Editor's note: *Technical standards in CATV rarely are adopted quickly or unanimously, so it's not surprising that opinion is divided regarding the course the CATV industry ought to take in protecting its satellite program distribution network. Galaxy I, Satcom III and Satcom IV, the industry's C-band workhorses, are nearing the end of their rated operational lives. All are expected to go dark in the next three to five years. So replacements definitely are needed. And replacements are available—both at Ku- and C-band frequencies. So the issue that has been quietly discussed over the past half year or so throughout the industry is whether to stay with C-band satellite technology or move to Ku-band. And, without question, the industry faces a crucial and possibly expensive decision.*

It isn't just the cost of retrofitting.

Proponents of C- and Ku-band offer arguments for each side of the issue.

Choosing one technology over the other could have major business repercussions. Do Ku-band receive dishes enhance or harm CATV's competitive position with respect to DBS operations? Does Ku-band technology open the door to direct program delivery to end-users by programmers? Does it matter? Is Ku- more reliable than C-band? What about rain fade? What protection is there from transponder or catastrophic satellite failure?

The following two papers, written by Viacom and HBO, respectively, present contrasting viewpoints on the problems, trade-offs and advantages of staying with C-band or going to Ku-band.

They're a start, but they're not the final word on the subject. What do you think? What considerations are most important to you? Which way should the industry go, and why? We'd like to hear from you.

CED is reserving space in the next three issues for your comments, reactions and questions. The choices are fundamental. Which way should the industry go? Let us know what you think. Address your comments to the editor, CED, 600 Grant St., Suite 600, Denver, CO 80203. Or, if you like, call us at (303) 860-0111. We'll be glad to transcribe your remarks.

Satellite communications: The new reality

Today, significant marketplace trends and other forces are impacting satellite technology and these developments can ultimately affect the long-term viability of the cable industry.

Consider that:

- Over one-half of the U.S. satellite fleet will reach the end of its design life within the next five years.
- Due to launch vehicle failures, no satellites are being launched today and extremely limited launch capacity will be available for at least the next five years.
- The cost of satellite launches has risen from $12 million to more than $60 million.
- Recent losses by the satellite communications industry have caused launch premiums to quadruple.

During the next five years, moreover, it's clear that satellites with Ku-band payloads will move to a position of worldwide predominance as C-band satellite capacity diminishes. Fifty-two out of the 59 international satellites proposed for launch prior to 1992 will have Ku-band payloads. Domestically, six out of seven satellites with launch contracts will have Ku-band payloads. Currently, no C-band satellites are under construction in the U.S. Only two U.S. companies are constructing any communications satellites: RCA (K-3 and K-4 for the HBO/RCA joint venture) and Hughes (two Ku spacecraft on behalf of its parent, General Motors).

The key issues for the cable industry are:

- The availability of capacity today, in three years, and beyond.
- The near- and long-term cost of capacity. Obviously, acquiring satellite capacity and renewal rights before a

Questions and answers about satellite planning

1. Q. Why is the Viacom Networks Group (Showtime/The Movie Channel, MTV Networks) pursuing its extended arrangements on C-band?

A. Performance, protection and price.

Performance

The performance of C-band satellites has been established by years of experience. The cable television industry has been well served by this technology for over a decade. Any one of several currently orbiting satellites is capable of delivering high quality video signals to the entire continental U.S., Puerto Rico, Alaska and Hawaii. Typical EIRP's exceed 36 dBW. Rain fades and atmospheric conditions are insignificant issues for C-band transmission.

Protection

All modern C-band satellites are built with redundant components to permit rapid restoration of service in the event of a transponder failure or failure of numerous other key components. Furthermore, other orbiting C-band satellites provide installed back-up capacity in the event of a catastrophic failure affecting an entire satellite.

The use of C-band satellites assures continued delivery of our programming to our CATV customers with no investment required at our affiliates' headends.

Pricing

Present C-band satellites were constructed and launched

Agile Omni, the industry's most advanced receiver designed by the most relied upon name in the business...Standard.

With the new Agile Omni, you need no other receiver.

Standard designed it for cable TV operators, broadcasters, CATV, SMATV, and business and special teleconferencing networks—now and in the future.

An onboard microprocessor permits selection of any band available from domestic satellites, including the 32-channel ANIK C2. Channel tuning provides direct reading of the transponder-assigned channel number and a format control permits selection of six frequency band formats—24-channel C-band, SBS/USAT and Spacenet already installed. Select channel and format, and the microprocessor controls frequency, channel spacing, transponder bandwidth, audio frequency and bandwidth, and antenna and video polarity—automatically.

Omni's flexible design can handle up to three separate subcarriers including stereo programming or data. Omni also will accept descrambling modules—eliminating the need for expensive add-on descramblers.

For CATV and SMATV applications, severe microwave terrestrial interference is minimized by optional internal SAW notch filters, automatically programmed to switch in. A 30 MHz low DG/DP LC bandwidth filter is standard, and a second internally installed optional filter of 18, 22, 26, or 36 MHz bandwidth can be controlled by the microprocessor, or manually switched.

Standard's proven RF loop-thru circuitry and blockdown conversion technology combine, with better image rejection and lower differential gain and phase, to provide excellent video performance. C/N threshold is an impressive 6.5 dB at the wide 30 MHz bandwidth.

Agile Omni is an affordable, flexible receiver designed to keep you in business, a commitment Standard backs with its unique 5-year warranty program. Contact us for further information.

Standard Communications

P.O. Box 92151
Los Angeles, CA 90009-2151
Toll free 800/243-1357
(In Calif. 800/824-7766, ext. 275)

Reader Service Number 8

Engineered to a new Standard

Operating functions including MGC, AGC, AFC, level sets, normal/invert video, clamp/unclamp video, skew, subcarrier frequency selection, video and IF test points are conveniently located on the front panel. Meter reads C/N ratio, signal strength or center-tune

Format control enables selections of desired satellite system. Direct-reading channel selector displays transponder-assigned channel. Second selectable, subcarrier and space for optional third subcarrier or descrambler modules.

Delay actually increases the risk that a launch will even be available.

base of antennas is in place is much less expensive than doing so when 100,000 or so fixed terminals are in place. The satellite user possesses greater leverage in determining long-term costs before the proliferation of antennas.

- The features and capabilities of the new spacecraft, including power, protection and market suitability.
- The overall communications environment. Market forces both within and outside the cable and programming industries are at work to support or change the cost structure and growth of a given technology.

Occasionally, postponing a decision with important long-term implications can buy something—a clearer perspective, less risk and short-term savings. But such is not the case here. Any delay in addressing the challenges that the satellite communications industry faces today will result in greater expense, less flexibility and higher risk in the future.

A short-term relocation to a satellite with only a year or two of additional life is not an effective solution. In fact, it puts the industry at a competitive disadvantage because it remains out-of-step with the currently evolving technology. What's more, satellite launch economics will not change significantly between 1990 and 1992, nor is there any reason to expect the risk of launch to improve for several years after launch activity resumes. Insurance losses of the past will take years and a string of successful launches to recover. Delay actually increases the risk that a launch will even be available. Ariane, the only available vehicle for commercial launches, is fully committed through 1990, and future availabilities are rapidly diminishing.

In the meantime, the successfully launched satellites of the future will be state-of-the-art Ku-band. They will be capable of affecting both cable before the current launch crisis environment, and their transponder rentals reflect the "old" satellite economics. We believe that the current crisis will eventually be resolved, and that launch and insurance costs will return to reasonable levels long before planning C-band replacements is required.

The cost and risk of undertaking satellite construction and launch in the next three to five years makes us uncomfortable. We are confident that existing C-band capacity will carry us past this temporary squeeze. By using proven technology requiring no significant new investment, we will be able to distribute our programming in the most cost-effective manner, both for ourselves and for our affiliates.

2. Q. But isn't Ku-band the newest and the best technology available?

A. The newest, yes. The best, not necessarily. The most cost-effective? Certainly not.

The current CATV distribution system, based on reliable C-band satellite delivery to the CATV headend and cable distribution to residences, works extremely well.

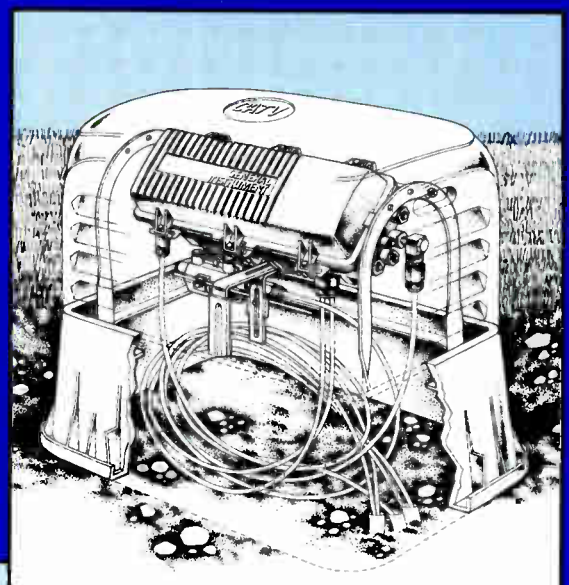
Because of fundamental physics, rain causes significant attenuation at Ku-band, reducing downlink carrier-to-noise performance in two distinct ways. First, it reduces received carrier power directly by the amount of rain attenuation; second, it increases received noise power by increasing the effective noise temperature of the sky. Neither of these effects is significant at C-band.

Exact determination and definition of fade margins can be a highly controversial subject which will not be dealt with in detail here; however, good engineering practice for most of the United States calls for a fade margin of at least 10 dB. Unfortunately, rain fades during heavy thunderstorms can exceed 15 or 20 dB. The cable industry's experience with CARS band confirms that there is no economical way to protect a link under such severe conditions.

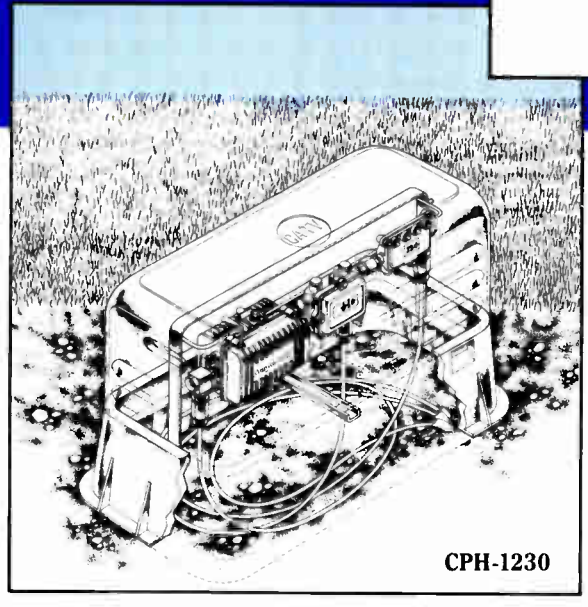
The impact of rain fades depends strongly on dish size and application. A small dish (e.g., 1.8m or smaller), such as might be used for short-cascade systems (DBS, business communications, SMATV, or CATV line extension), will suffer intermittent total

LIMITED OFFER!
April 15 thru July 31, 1987.
Reduced price and free freight!

Channell's low profile enclosures for active equipment... The best money can buy!



CPH-1730



CPH-1230

Channell has developed the best low profile enclosures for active equipment that money can buy...and we're ready to prove it to you! To let you see the benefits of these low profile enclosures for yourself, Channell is offering the CPH-1230 and CPH-1730 enclosures at special reduced prices—and **we'll pay the freight** on pallet quantities.

These high quality HDPE plastic enclosures have been designed specifically for active equipment. They provide ventilation that is far superior to other enclosures and—unlike metal enclosures—**come with brackets, locks and stakes installed.** There's no need to worry about missing accessories.

CPH-1230 Extending just 13-inches above grade, the new CPH-1230 enclosure is designed to house line extender and tap/splitter combinations. It is a low profile alternative to Channell's CPH-1016 and CPH-1022, and to high profile 10" x 10" and 10" x 16" metal pedestals. The CPH-1230 cover has louvers on both the sides and the ends to assure maximum ventilation and minimize internal ambient temperature rise.

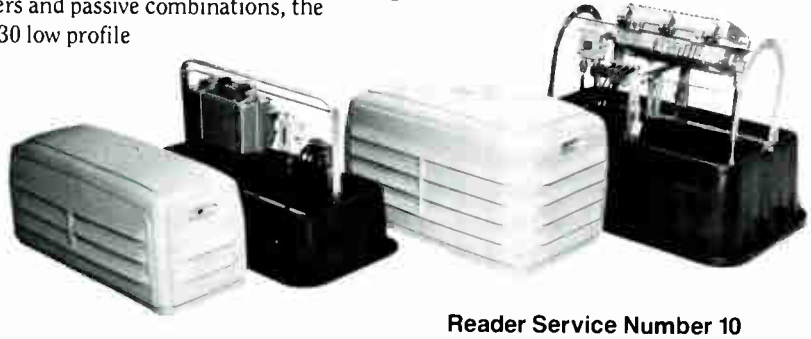
CPH-1730 Designed to house trunk amplifiers and passive combinations, the CPH-1730 low profile pedestal is built to handle the increased heat associated with today's higher operating frequencies. The standard 400 Series cover provides ventilation for active equipment that is comparable to any other enclosure in the CATV industry. The 500 Series cover provides ventilation that exceeds any other fully equipped amplifier enclosure. This superior ventilation could result in less wear on your active equipment and reduce long-term maintenance.

CPH-1230 (15 per pallet).	Regularly—$96.20 each **Special price—$76.95 each**
CPH-1730 (6 per pallet).	*With 400 Series covers:* Regularly—$167.55 each **Special Price—$134.00 each**
	With 500 Series covers: Regularly—$190.00 each **Special Price—$162.00 each**

Blanket orders must be completed by August 31, 1987.

The CPH-1230 and CPH-1730 low profile enclosures have aesthetically pleasing designs that will assist in gaining acceptance by community leaders. Both come with ground skirts that act as foundation support systems for active equipment and allow for storage of excess cable. Also, active re-splice capabilities are maximized without having to re-plow, re-pull, or re-trench coax cables. Additional high quality features found only in Channell's complete line of enclosures include: 360° working access area; Inner-Tite security locks (standard); and hot dipped galvanized bracketry which permits mounting of equipment without modification. Unaffected by extreme temperatures they are available in light green or beige and never need painting.

Take advantage of this limited time offer, and order a pallet of Channell's low profile enclosures now—at reduced prices and with freight paid. Call Channell toll free today for immediate response.



Channell
COMMERCIAL
CORPORATION
Technology you can trust!

620 W. Foothill Blvd., Glendora, CA 91740
Telex: 670-368 • (818) 963-1694
(800) 423-1863 except CA
(800) 345-3624 in CA

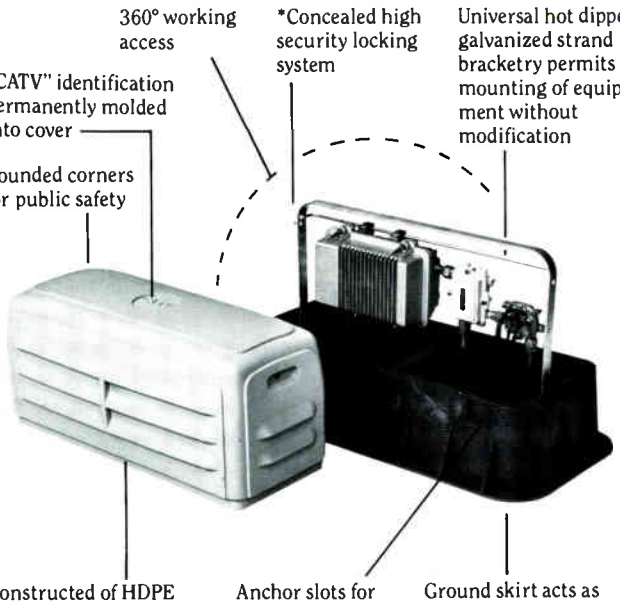
Reader Service Number 10

SINGLE PLANT ABOVE GRADE ENCLOSURES

(Also available — A complete line of dual plant above grade enclosures)

CPH-1230 Low Profile Enclosure

Houses line extender and tap/splitter combinations

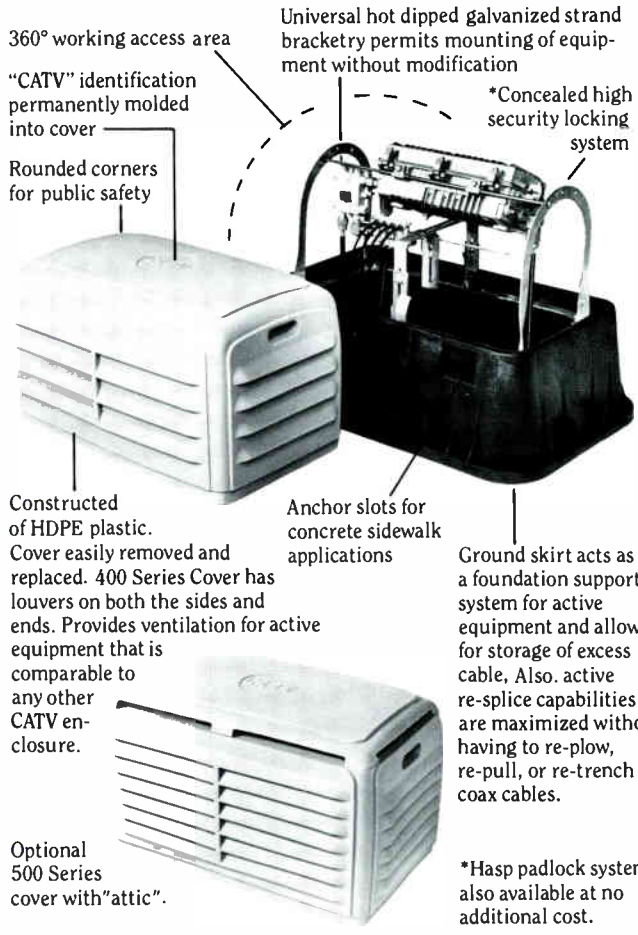


*Hasp padlock system also available at no additional cost.

(Trunk amplifier application not shown)

CPH-1730 Low Profile Enclosure

Houses trunk amplifiers and passive combinations



*Hasp padlock system also available at no additional cost.

CPH-508

Designed to house small diameter taps and for above ground service wire applications.

Dimensions: 5" diameter, 11"-15" above grade.

Shipping: 12 per carton.

CPH-658

Houses all taps currently available in the CATV industry.

Dimensions: 6.5" diameter, 11" - 15" above grade.

Shipping: 8 per carton.

CPH-816

Houses tap and splitter combinations.

Dimensions: 8" diameter, 20" - 24" above grade.

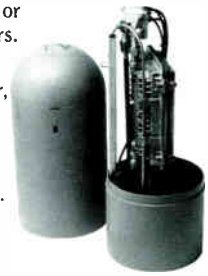
Shipping: 2 per carton.

CPH-1016

Houses tap, splitter and line extender combinations, or small amplifiers.

Dimensions: 10" diameter, 21" - 25" above grade.

Shipping: 2 per carton.



(CPH-6512, CPH-1006, CPH-1022 not shown.)

Channell Commercial Corporation designs and manufactures the broadest selection of free-breathing above grade pedestals, and airtight and watertight below grade enclosures available anywhere. In addition, Channell is the exclusive representative for Integral Corporation's Cablecon® Cable-in-Conduit and Carson Industries grade level boxes and vaults.

For complete information on Channell's total packaging concept, call or write today.

CHANNELL COMMERCIAL CORPORATION
620 W. Foothill Boulevard
Glendora, CA 91740 • Telex: 670-368
(800) 423-1863 except CA
(800) 345-3624 in CA

Channell COMMERCIAL CORPORATION

Technology you can trust!

A CATV headend requires substantially better performance than a short-cascade system.

operators' and programmers' businesses and may be operated by companies with little or no investment in our business such as GM, AT&T, GE or GTE. The cable industry cannot afford to restrict itself to yesterday's technology. Today, with Ku-band technology, we have the opportunity to maintain a competitive technological edge—an opportunity that has come at a time that is a natural juncture for satellite capacity planning.

What's up there today

There are currently 37 satellites in orbit serving continental North America. Twenty operate at C-band and 17 are pure Ku- or hybrid C- and Ku-band. The majority of the C-band satellites were launched in the late 1970s and early 1980s and were designed to operate from seven to 10 years. Without new launches, total in-orbit capacity diminishes dramatically.

Once a satellite-based business becomes established, it must plan for the eventuality of a satellite's demise when it reaches the end of its design life. And, based on design life data, less than half the existing U.S. satellite capacity will be available for active business purposes by the end of 1992.

The majority of cable programmers use Hughes' Galaxy I, RCA's Satcom 3R and Satcom 4 to distribute their signals. These satellites will reach the end of their design or warranty lives as follows: Satcom 3R by 1990; Galaxy I by 1992; and Satcom 4 by 1991.

Therefore, from the cable industry's perspective, 1987 is the year to focus on the transition to the next generation of satellites.

Prognosis for the future

The outlook for replacement of the exisiting satellites is not bright. Only two U.S. companies are constructing new communications satellites: RCA (K-3 and K-4) and Hughes. In the early 1980s, three C-band spares were built utilizing 1970s technology, and are in warehouses at RCA, Hughes and Western Union. Even if these are to be launched in the early 1990s, they will be nearly 10 years old, and at a 13- to 15-year technological disadvantage com-

Downlink carrier-to-noise calculation—CONUS footprint

		K-1—Ku-band	
	Typical C-band	Clear sky	Rainfaded
1) Satellite EIRP (dBW)	36	46	46
2) Path loss (dB)	196	205.6	205.6
3) Rain attenuation (dB)	---	---	10
4) Noise temperature increase (dB) (rain increases sky noise at Ku-band)	---	---	3
5) CATV G/T (dB/K) (C-band—3.2m dish, 90° LNA) (Ku-band—3.2m dish, 225° LNB)	19.5	25.3	25.3
6) Boltzmann's constant (dBW/K-Hz)	228.6	228.6	228.6
7) Noise bandwidth (C-band—32 MHz) (Ku-band—24 MHz)	75.1	73.8	73.8
8) Downlink thermal C/N (dB) (1-2-3-4 + 5 + 6-7)	13	20.5	7.5

Video signal-to-noise calculation

1) Downlink C/N (dB)	13	20.5	7.5
2) FM improvement (dB) (C-band—peak deviation = 11.8 MHz) (Ku-band—peak deviation = 7.8 MHz)	25.6	20.7	20.7
3) Pre-emphasis and weighting (dB)	12.8	12.8	12.8
4) Video S/N (dB) (peak-to-peak picture to RMS weighted noise)	51.4	54	41*

* With exceptional threshold extension, total outage otherwise.

These calculations show that the C-band satellite will always deliver high quality pictures to a 3.2m dish located anywhere in the satellite's CONUS beam. On the other hand, the same size Ku dish, served by a significantly more powerful (and more expensive) satellite will suffer serious unpredictable weather-related outages. In the end, today's Ku system presents no real advantage.

outages of varying duration when rain fades exceed the link margin and drive the downlink carrier-to-noise ratio below the FM threshold.

A CATV headend requires substantially better performance than a short-cascade system for two reasons:

1. The signal is degraded by passage through the amplifier cascade to the subscriber drop.

2. Signal degradation at the headend affects thousands of subscribers at the same time.

Item 1 determines the clear-air S/N performance which must be 7 to 10 dB better for a CATV system than for a short-cascade system. Item 2 determines the rain fade margin. The S/N requirements alone dictate the use of a large dish (e.g., 3.2m or larger). For

Between now and 1992, 59 proposed communications satellites are authorized for launch worldwide.

pared to a satellite designed for the 1990s.

Given the new reality of increased risks and costs, it is highly unlikely that any satellites, regardless of frequency, will be constructed unless a significant portion of the cost and risk is covered by upfront commitments by users, either internal or external (i.e., RCA-Crimson Satellite Associates).

The availability of launch vehicles may improve, but certainly not until the mid-1990s, and underwriters will need to see a series of successful launches on proven vehicles before the pool of available insurance expands.

Furthermore, satellite hardware costs are likely to remain at the current level of $75 million to $90 million.

Finally today's transponder glut, and its accompanying bargain pricing, will end with the expiration of the current generation of satellites. Increasingly, fiber optic terrestrial networks are favored by telephone and data carriers, and those are the very same interests who launched most of the exisiting 25 satellites.

The emergence of Ku-band

Between now and 1992, 59 proposed communications satellites are authorized for launch worldwide. Of these, 52 will be Ku-band or Ku hybrids, six will be C-band and one (Italy's) will operate at another frequency.

Considering that Ariane is the only organization launching communications satellites in the next four years, the direction of the technology that will be employed is quite clear. Between 1987 and 1990, Ariane has reservations or contracts to launch 32 communications satellites on 24 rockets. Of these 32 satellites, only one does not have a Ku-band payload. This inescapable fact merits emphasis: every communications satellite launched between now and 1990 will be Ku-band, save one.

Ku-band has become the clear choice for future capacity by satellite operators and users worldwide for four important reasons:

1. **Operational benefits.** C-band satellites are secondary users of a shared-frequency assignment and consequently must not interfere with the terrestrial microwave links also using the spectrum. They operate at low power levels to minimize any interference. C-band TVROs need to be frequency coordinated with local microwave paths.

The Ku-band satellite service, on the other hand, is a primary user and does not need to protect any other radio service. Consequently, Ku satellites can be more powerful than those using C-band, permitting the use of smaller, less expensive equipment to receive the signal.

2. **Superior protection against failure.** Secondly, Ku-band is the technology of choice because it offers the opportunity to create a superior level of protection at lower costs.

Ku-band satellite protection has a significant cost advantage over C-band because of the way protection is provided. For the number of protected satellite transponders in orbit, a certain amount of back-up equipment and such a system, some rain fades will be graceful and gradual, causing picture degradation for all subscribers but not causing total outage. However, total outages will still occur even for prudently designed systems.

The nominal 10 dB fade margin provides 99.99 percent statistical availability—corresponding to 53 minutes per year of problems—for most of the U.S. However, for much of the Southeast, a 20 dB margin is required.

The bottom line is this: small Ku-band dishes are simply inappropriate for CATV distribution. It is absolutely true that Ku-band satellites have a 10 dB advantage in EIRP compared to C-band. But that advantage gets consumed pretty quickly as the link calculations illustrate (See Table 1).

There are two areas where Ku-band offers advantages compared to C-band, but neither one is of any great benefit to cable operators:

1. Direct Broadcast from Satellites (DBS)

The higher power of Ku-band permits reception in dishes as small as three to four feet. Although outages will occur due to rain fade, such outages will affect individual customers, not entire communities, and may be tolerable from the broadcaster's perspective.

2. Business Communications

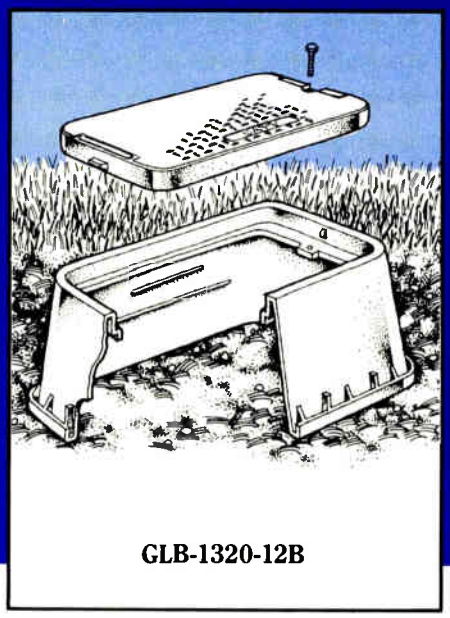
Ku-band is not employed as extensively as C-band for terrestrial telecommunications. Thus, Ku-band can work in business districts where terrestrial microwave congestion causes interference at C-band.

We don't think these two benefits can outweigh the costs of expensive satellites, reduced reliability, and extensive replacement of existing ground equipment.

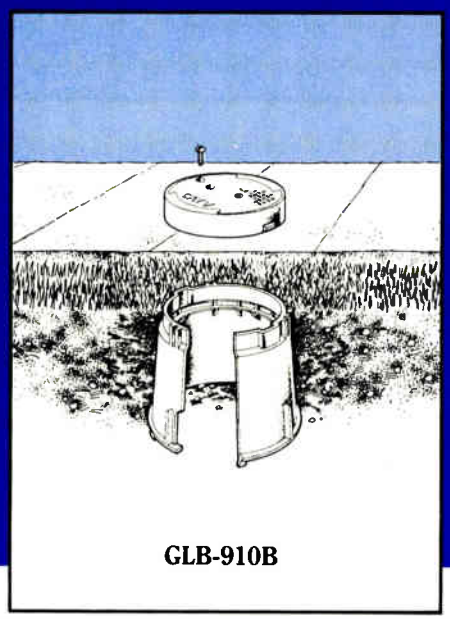
3. Q. What about C-band successor satellites?

A. Numerous companies, including American Satellite, AT&T, GTE, Hughes, RCA, Western Union and others, are licensed for future C-band transponder operations. The FCC has

Carson Grade Level Boxes...



GLB-1320-12B



GLB-910B

GLB-1324-15B

A great cover up for underground CATV installations!

Carson Industries, Inc., a leading manufacturer of structural foam plastic utility products has developed a full line of Grade Level Boxes (GLB) that are a great cover up for underground CATV plant.

Ideal for housing drops, passives and active splice applications, there's a Carson "GLB" designed to meet your requirements:

- GLB-608 — For housing single RG drop underground cable.
- GLB-610 — Houses multi-drop underground cables.
- GLB-1419 — Designed for use in special passive and drop applications.
- GLB-1320 — For underground drop and passive electronics applications. Also used for coax feeder and trunk cable splices.
- GLB-1324 — Available in 12" and 15" depths for housing underground single or dual passive applications, and for coax feeder and trunk cable splices.
- GLB-1730 — This box comes in either 12", 15", or 18" depths. It will house single and dual plant tap/splitter combinations, and coax trunk splices. Optional racking is also available for special below grade active equipment applications.

Carson GLB features include HDPE structural foam plastic; 100% stainless steel hex bolts, or optional penta and captive security bolts; available in grey or green with ultra-violet stabilizers added; box bodies tapered to eliminate ground upheaval and provide stability; CATV identification molded into covers; optional anti-skid covers available; and hot-dipped galvanized steel bracketry available for below grade active device applications.

Carson GLBs are marketed exclusively by Channell as part of the Channell total packaging concept for underground CATV installations. They're also readily available from authorized distributors throughout North America:

Anixter
Cable TV Supply
Signal Vision

Looking for a great cover up for your underground CATV installations? Take a good look at Carson's complete line of Grade Level Boxes. For complete information, call Channell toll-free, or contact your nearest authorized Carson distributor.

Marketed exclusively by
Channell Commercial Corporation
(818) 963-1694
(800) 423-1863 (except CA)
(800) 345-3624 (in CA)

CARSON INDUSTRIES INC.

1925 "A" Street La Verne, CA 91750

Reader Service Number 11

Satellite communications has become a highly competitive arena, and suppliers are responsive to the needs of the market.

pre-emptible transponder are also maintained. The cost of this back-up capacity is shared by all users of protected capacity on a given satellite system. Because the number of future C-band systems will significantly decrease, the cost of protection will be shared by a smaller base, and thus, higher costs.

The growing base of Ku satellites, on the other hand, means that the cost of equivalent protection will be comparatively lower and will likely continue to decrease.

3. Technical evolution. The early problems of degraded performance due to rain attenuation exhibited in the first generation Ku satellites have been overcome through the development of more powerful satellites capable of providing increased signal margin. Using the antenna sizes our industry employs, rain no longer degrades service for any significant time.

4. Channel capacity. Because only 24 channels of video programming can be transmitted from each C-band orbital location, cable headends are now "antenna farms" with an ever-increasing number of dishes looking at a variety of C-band satellites. By creatively constructing a Ku-band frequency plan as HBO has done with K-3, each dish can now receive 32 program channels.

With K-3 and K-4 co-located at one orbital location (pending FCC approval) current cable programming networks as well as new services could be received by one dish, with room for expansion without increasing the number of satellite antennas.

Crimson Satellite Associates

Today, major networks with established distribution must focus on long range planning for satellite capacity. Networks in business for the long-term face two areas of vulnerability: continuity of service and successor capacity in its availability, cost and competitive capability.

Accordingly, in planning for satellite capacity through the next decade, HBO has joined with satellite operator RCA in forming a joint venture known as Crimson Satellite Associates. The joint venture has three primary objectives:

- Acquire hardware at a reasonable cost;
- Develop a satellite protection plan suitable for the current business environment;
- Ensure the opportunity to be joined by compatible programmers.

The essential fact about the HBO/RCA venture is that it is a hardware relationship—not one in which HBO has an annuity interest as do carriers in the satellite communications business. The hardware's characteristics have been optimized to meet the unique requirements of video-program delivery rather than the "common denominator" flexibility of a carrier.

Satellite-protection requirements already granted construction and launch permits for eight equivalent C-band satellites.

Satellite communications has become a highly competitive arena, and suppliers are responsive to the needs of the market. When the CATV industry enters the market for C-band successor satellites the satellite operators will compete to provide them.

4. Q. Isn't much of the rest of the world going to Ku-band?

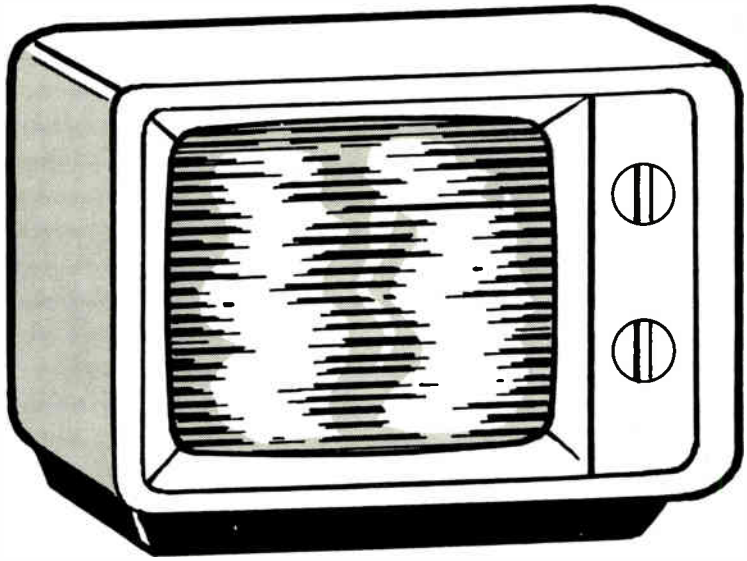
A. There are a number of foreign countries developing Ku-band communications technology. None of them have an extensive installed base of CATV systems. Many of them have nationalized, regulated TV networks which will be distributed by DBS.

There is no other nation in the world which has the extensive CATV distribution infrastructure, the large geographic area and the competitive marketplace of the United States. he current distribution technology is optimal for our nation's unique video distribution requirements.

There is a well-worn but time-honored engineering maxim which applies here: "If it ain't broke, don't fix it." ■

Guaranteed...

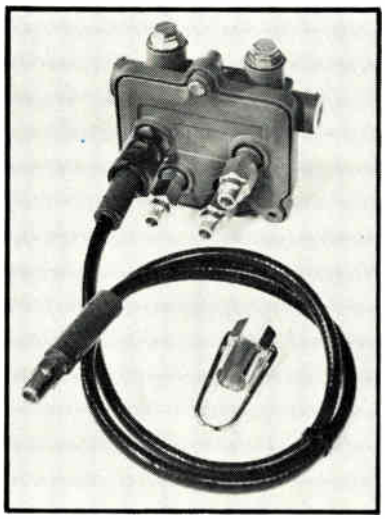
An Unwatchable Picture!



But more revenue for you with the Security Trap from VITEK.

Traps are the least expensive way to turn non-pay pirates into revenue producers for your system. Traps effectively eliminate video signal.

The Vitek Security Shield and strain relief are standard with the Security Trap. Both are manufactured of high impact, U.V. resistant plastic. The units are available in seven colors for coding your traps. The security shield and strain relief combination are available at no additional cost when you purchase high-performance Vitek Electronics traps.



Security Traps can be made to fit any channel line-up, or customized to remove the audio or video carrier. Also available without Security Shield and strain relief. To get complete information on Vitek Security Traps for your system, call or write today.

AUGAT · VITEK

Quality and Innovation

VITEK Electronics, Inc.
901 South Avenue
Box 111, Horseheads, NY 14845
(607) 796-2611

THERE'S MAGIC TO DO

for your subscribers, your community, your company and yourself...

Brush up on your magic.

- Outstanding line-up of technical and engineering sessions presented by the Society of Cable Television Engineers
- SCTE's BCT/E Testing available in all seven categories
- Largest display of latest cable products East of the Mississippi
- Low-cost registration rates available
- 40-75% Discounts on Airfare to Show
- Headline Entertainment and Southern Hospitality

1987 EASTERN CABLE SHOW

AUGUST 30–31 ☆ SEPTEMBER 1

ATLANTA ☆ GEORGIA

GO FOR THE MAGIC

SCTA

Sponsored by **THE SOUTHERN CABLE TELEVISION ASSOCIATION, INC.**

for information call **404-252-2454**

Alabama Arkansas Florida Georgia Kentucky Louisiana Mississippi North Carolina South Carolina Tennessee Virginia West Virginia

Reader Service Number 14

The new reality of satellite communications involves complex issues, yet the conclusions are straightforward.

have grown along with our industry's revenue stream. Several networks started out on pre-emptible transponders until their business was recognized as a significant resource to their parent companies, at which time they sought protection. Early on, protection involved relocating programming to other satellites in the event of failure. Later generations enhanced reliability to incorporate on-board spare parts.

Today, our industry uses dishes at more than 25,000 commercial locations to receive satellite programming. The protection scheme for the 1990s must provide programmers with the ability to stay in business in case of catastrophic failure without repointing thousands of dishes overnight.

A cost-effective plan will necessarily spread the costs over a broad-based satellite system. Such a comprehensive level of satellite protection was achieved by joining with RCA in our equity venture. Once K-3 is operational, the K-1 satellite HBO is now on will serve as an in-orbit spare, which can be rapidly relocated to the K-3 position in the event of a total failure.

Furthermore, K-3 and K-4 will be co-located, operating 32 tranponders from the same orbital location, achieving an even higher level of protection.

In order to co-locate the K-3 and K-4, the satellites need to be clones, and in fact, they are designed to be flown together at the same location in space. Each spacecraft has the highest ratio of redundant spare- to active-parts of any satellite placed in orbit.

Conclusions

The new reality of satellite communications today involves complex issues, yet the conclusions are straightforward.

The satellite, the linchpin of program distribution for the cable television industry, needs replacement in the next three to five years. Satellite successors will be more expensive and launches uncertain, yet commitments must be made today.

C-band distribution will continue to be used on a market-specific basis, but the undeniable fact is that the majority of future international and domestic satellites will be Ku-band. Ku-band's unique capabilities offer many more opportunities to continue to grow our business. Some may consider the Ku technology a potential threat to the status quo. Yet, the greatest threat to the future viability of the cable business is to delay a commitment to this state-of-the-art technology and forfeit our capability to compete with those companies with no vested interests in our industry who will take advantage of the technology.

HBO's assessment of the facts has led us to conclude that decisive action is required and our business should not be risked by delaying. ■

Dealing with lightning...

... Part I—on the power lines

By Roy B. Carpenter,
Lightning Eliminators & Consultants

The progress in electronic systems design has brought with it an increased sensitivity to the operating environment and to the interface connections. These interfaces bring with them both the desirable and the undesirable. The interface of concern in this article is power lines.

The power lines bring in the motivating power for the cable system. They also bring destructive and disruptive electrical transients, herein termed anomalous events.

Destructive anomalies are electrical events superimposed on the normal line voltage that cause it to be elevated above the safe level or operating range of the equipment it feeds, regardless of the character. This is normally taken at 120 percent of the normal peak voltage. As an example, it would be between 200 and 250 volts for a 120-volt RMS line.

Disruptive anomalies are electrical events superimposed on the normal line voltage that create a situation within the unit fed that causes it to momentarily malfunction. This momentary malfunction causes erroneous commands, creates faulty data or "locks up" a system. This can be an annoyance and sometimes costly in lost time, but does not cause damage.

This article is an attempt to eliminate some confusion on lightning protection by defining known hazards and comparing the performance of contemporary protectors with the hazards, thus providing a reliable decision tool. The data used to define the hazards has been taken from a wide variety of publications on the subject.

One of the problems related to lightning protection is the jargon used and the way it is used. To eliminate misunderstanding, it is necessary to define basic terms encountered in discussing lightning.

An **over voltage** occurs when line voltage is elevated to well above the normal RMS voltage and sustained above that level for a period in excess of one cycle (over plus 15 percent).

An **under voltage** occurs when the RMS line voltage drops to what is termed the "brownout" level and remains at that level for a period in excess of one cycle (over minus 20 percent).

An **energy surge** is a rapid increase in the flow of total energy (joules or Watt-seconds) to the service entrance that is sustained for periods of less than one-half cycle.

Single phasing occurs when one phase is dropped prior to the service entrance.

Transients are usually considered as random voltage pulses of relatively high magnitude, but short duration, usually less than about 100 microseconds.

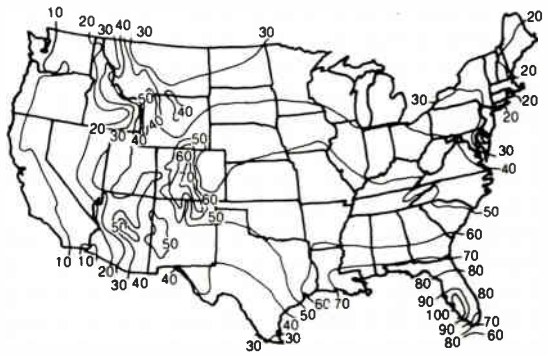
Electromagnetic pulse (EMP) is a single pulse of energy created by a collapsing magnetic field such as that created by lightning or a nuclear burst. The magnitude can vary from insignificant to devastating.

Switching transients are created by the public utility during load switching or power source switching actions. They are also the result of other nearby customers, usually on the same feeder, switching on and off high-current devices.

A **joule** is a measure of energy, the product of volts, amperes and time. It

Figure 1

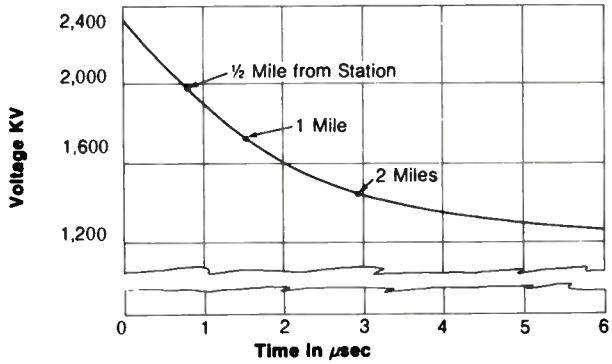
Number of Lightning Days per Year



The probability of lightning for each day is: Iso number ÷ 365
The maximum for the USA is 0.27 or a probability of lightning on one day out of four.

Figure 2

Sample Surge Voltage as a Function of Distance from Stroke to Line



The shape of typical lightning stroke current flow rises rapidly to its peak and then tapers off relatively slowly.

is the only true measure of protector performance. A Watt is the product of volts and amperes only.

Destructive voltage anomalies that permanently damage connected components may be categorized as naturally caused or man-made. Table 1 lists potentially destructive anomalies by cause.

Natural hazards

Most naturally caused line voltage anomalies are related to atmospheric activity of one sort or another. Lightning-related anomalies can be the result of either cloud-to-cloud or cloud-to-earth events. These, in turn, are related to such factors as the geographical location of the site, the isokeraunic number related to that location and the time of year.

Figure 1 is an isokeraunic map of the United States. The number defines the potential number of lightning days that can be expected in a year at a given location. The number can be used to estimate the probability of lightning for a given day (if seasons are disregarded) and the number of strikes that may be expected to terminate in any given area for that year. In applying these data, two factors must be considered: It is an estimator only and can vary considerably from year to year, and it takes only one strike to cause irreparable damage.

Lightning in general can cause three specific forms of hazards: Direct strikes producing power surges, induced transients from nearby strikes and the EMP from the strike's magnetic field.

Power surges result from a direct strike to any or all phase conductors near or at some distance from the facility. The character of these surges is, therefore, directly related to the character of the lightning stroke, the line it strikes and the distance to the point of concern. To define their specific character, an engineer must look at specific cases or parameterize the rise time, stroke-peak current, distance between strokes and facility or the resulting line impedence, and the grounding resistances at significant points in between.

One signifiant factor is shown by Figure 2 where the surge voltage is estimated for an average lightning strike for various distance from the station of concern. These numbers must be greatly increased for higher energy strokes. Other measurements indicate that these voltages could achieve levels in excess of 100 Kv if the wire insulation would support that potential without arcing and if the measurement point were near the stroke. The higher voltages seem to be the norm, rather than the exception, for FM and TV transmitter sites.

The shape of typical lightning stroke current flow is such that it rises rapidly to its peak and then tapers off relatively slowly, following a log-normal shaped curve. There are two classes of lightning strokes: The impulsive stroke and the non-impulsive or hot stroke. This characteristic determines the damage caused.

The impulsive stroke causes most of the damage to electronic systems. Since they embody a large percentage of high frequency energy, the rate of rise exceeds 10,000 amperes per microsecond and can achieve rates of over 100,000 amperes per microsecond. They last for no more than 100 microseconds.

The non-impulsive or hot stroke rises much slower than the impulsive stroke, as low as 500 amperes per microsecond. However, it usually lasts much longer, extending out to as long as 10 milliseconds to the 50 percentile. These strokes are responsible for many fires and explosions.

Induced transients are the second order effects of lightning activity in or near the area of concern. Their character is related to the lightning discharge and the system character into which the transient is induced. In general, they are high voltage, low energy disturbances. Estimates of the potential for this disturbance phenomenon range up to 100 Kv. This value is more dependent upon the system circuit parameters than lightning itself; installa-

Earth-current induced transients are created by lightning strikes to earth, to or near the facility of concern.

tion breakdown levels usually limit the peak voltages to much lower levels, except on primary feeders. Public utilities have found that this phenomenon accounts for most of the lightning faults on lines with a potential of 20 Kv and lower. Lines as short as 50 feet can pick up a significant transient, depending on their proximity to the stroke. These induced transients tend to take a shape related to the differential of the stroke itself—short negative and positive pulses of less than 10 joules.

Induced transients are created by one of three related phenomena. They are the result of the invisible but highly potent electrostatic field found between the charged clouds and the earth. This field moves and varies in strength with the charged cloud activity.

Atmospherically induced transients are created by sudden variations in the electrostatic potential of the atmosphere. Where the clear air field may be 150 volts per meter elevation above earth, during an electrical storm this field can achieve levels of up to 30,000 volts per meter of elevation. Nearby cloud-to-cloud and cloud-to-earth discharges can cause significant field variations continuously throughout the storm period, on a random basis, in both time and magnitude domains.

A field can be shown where both the suspended power lines and the interplant data lines experience induced transients when a charged cloud in the area of concern charges everything on the surface of the earth beneath it, to an equal but opposite potential by induction. The field between the cloud and earth can achieve 30,000 volts per meter. A wire elevated above the earth by 10 meters in this field would be charged to a potential equal to its surroundings, which could theoretically equal as much as 300,000 volts with respect to earth. A sudden lightning discharge to earth or another cloud will cause this field to collapse, leaving the elevated wire with a bound charge, which seeks ground through any available path, even jumping large insulators in the way. This creates a voltage pulse that can exceed 100,000 volts at times. Transients resulting from electrostatic field changes can be propagated over long distances, depending on the circuit parameters.

As an example, a nearby cloud-to-cloud discharge or a strike one mile away will induce as much as 70 volts per meter of exposed wire into a thus connected system.

Earth-current induced transients are created by lightning strikes to earth, to or near the facility of concern. With the termination of a stroke to earth all the charge induced into the earth by that cloud must move from the point where it was induced to the point of impact of the stroke, and thereby neutralize the charge. As a result of this motion of the induced charge, earth currents are set up within the earth's crust on or near the surface. Any good conductors buried in the earth within the charged area will provide a preferred path for these earth currents and thus be the recipient of these severe earth currents. The results are transients within the conductor, either directly or indirectly related to the earth current character. Current along the sheath of wires will induce transients into the inner conductors through mutual induction, or these currents will be superimposed on the conductors without sheaths.

Electromagnetic-field induced transients are also created by lightning discharges. For this phenomenon the lightning flash channel acts as a vertical radiator or antenna. The large flow of current in a short time down the ionized lightning flash channel sets up a rapidly changing electromagnetic field propagating out from the stroke channel in much the same fashion as a broadcasting station using a single tower/antenna. These waves propagate for many miles and are the cause of static in a radio receiver, reflected waves in the transmitters and transients in nearby conductors. Generally, cloud-to-cloud strokes produce predominately horizontally polarized waves,

Man-made disturbances may be subdivided into those caused by electromagnetic or electrostatic fields and those caused by some form of accident.

while the cloud-to-earth strokes produce vertically polarized waves. The di/dt's can exceed 100,000 amperes per millisecond.

Tornadoes create a cyclic phenomenon of a shape similar to a poor sawtooth generator. This phenomenon is the result of a charge separation within the eye of the twister and its rotary motion. As the twister does its thing, the induced voltage rises and falls with and at the frequency of rotation of the twister. The induced potentials can be damaging if the twister passes near an area of concern.

To protect against all of these induced transients, the protective systems must be designed to satisfy the worst case situation. The requirements would be the following:

Transient energy	500 joules
transient peak current	20,000 amps
transient peak voltage	4,500 volts
transient rise-time	50 nanoseconds

Man-made hazards

Man-made disturbances come from the electrical systems environment man has created. These disturbances can be the result of a directly injected phenomenon or an externally induced phenomenon. It is futile to attempt to define all the potential causes, but the following identifies and deals with some of the more significant. Man-made disturbances may be subdivided into those caused by electromagnetic or electrostatic fields and those caused by some form of accident.

Man-made electromagnetic field transients usually are created by poor installation practices or inflexibility in the plant layout. For example, the power lines for large motors and power lines for sensitive electronics are layed side-by-side in the same cable tray.

During the planning stages for a plant, it should be understood that power lines carrying any large loads that are switched will create transients on the lines. Electric motors with poor commutators will radiate transients into nearby lines and cause malfunctions in any electronic equipment sharing it as a common source of power.

The possibilities of directly injected hazards are as diverse as the industry itself. Some common examples are: High voltage wires dropping into the data/control lines or arcing over them; or failure of insulation or isolation devices which inject a high voltage onto the data lines. This happened three times in one year at three similar facilities separated by thousands of miles. In all three cases, the related computer was destroyed.

The electromagnetic pulse (EMP) resulting from a large atmospheric explosion, usually nuclear, will also create this phenomenon. The characteristic of the EMP is usually considered similar to lightning, buth with much faster rise-times (nanoseconds) and much shorter duration (only a few microseconds). The energy content can be very high near the center of the explosion.

Table 1

Potentially Destructive Power Mains Anomalies

	Natural Causes			Man-Made Causes			
Potential Anomaly	Cloud-to-Ground Lightning	Cloud-to-Cloud Lightning	Tornados	Public Utility	Other Customers	Own Plant	Accidents and Explosions
Overvoltages				X			X
Undervoltages				X			X
Surges	X				X		X
Transients	X	X	X		X	X	X
EMP	X	X					X
Single Phasing	X			X			X

The designer must select the risk considered acceptable and design the protective system to satisfy those parameters.

Protection requirement

The protection requirement, if limited to destructive anomalies, must be derived from a composite of all the potentially destructive causes.

A summary of the resulting design requirements by key design parameters follows:

Peak voltages	45,000 volts
peak-surge current	200,000 amperes
rise-time response	50 nanoseconds
peak-surge energy	100,000 joules
loss of phase	10 cycles or less
overvoltage	line +20 percent
undervoltage	line -30 percent

It should be understood that it is possible to encounter situations well beyond these parameters. As an example, studies have shown that FM radio and television stations, because of their location in remote or elevated areas, are subjected to the higher energy level, fast rise-time surges.

The designer must, therefore, select the risk considered acceptable to his client and design the protective system to satisfy or exceed those parameters. The foregoing list defines the safe basis for design. All systems must exceed that capability by a safe margin and then fail-safe for 100 percent protection.

Protection concepts

Line protectors fall into three classifications: Filters, surge or transient protectors and voltage regulators or isolation transformers. The conventional line filters are primarily limited to the removal of radio frequency interference (RFI). Power surges and other disturbances are attenuated very little. Line transformers are available in one or a combination of two types: Regulators or isolation transformers. Regulators usually maintain a given output voltage over a range of input voltage variations of up to ±30 percent. The isolation or super isolation transformer is a low-pass filter with up to 120 dB of attenuation across a limited RFI band. They do not protect against lightning-related power surges of significant magnitude or all modes of noise.

Devices sold as "surge protectors" often have similar, and thus, confusing claims. They are seldom related to a well-defined hazard. Any candidate must be evaluated against the total spectrum of performance requirements as previously defined.

First, however, the applications concept should be considered. There are two ways of implementing surge protection into the system to be protected. The protector may be installed in parallel with the device to be protected or it may be installed in series, prior to the unit to be protected.

Most conventional protectors, except the LC filters, are designed to be wired in parallel with the load they protect.

The series hybrid protector concept is the only concept that can be made 100 percent effective.

The parallel protector's effectiveness is compromised by two factors:
1. Because it forms a parallel circuit with the load to be protected, the load must share the disturbance it is to be protected against. As a result, the protector reaction time is very significant, as is the clamping ratio (ratio of peak line voltage to voltage at the peak-surge current). In actual cases, measurements have proven to be very high, in excess of 10 times the normal line voltage at the peak of the surge.
2. The wiring that connects the parallel protector into the circuit becomes a series impedence to the rapidly clamping, high surge current, thereby adding the voltage developed across these series impedences to the high clamp voltage.

By way of contrast, a series hybrid protector is in series with the power feeding the protected unit, thereby acting as an interceptor to any incoming disturbances. The negative effects of connecting leads, reaction time and even clamping ratio are overcome through use of series elements and by separating the paths for the surge current from the clamping control elements. An examination of the foregoing factors alone is sufficient to demonstrate that the series hybrid protector concept is the only concept that can be made 100 percent effective.

Surge eliminators

The LEA Dynatech surge eliminator (SE)© designs are all based on the same concept, with the same objectives. In addition to the previously defined requirements, the SEs must react within 5 nanoseconds; eliminate at least 99 percent of the possible disturbances for the particular application without loss of the protector or protected function; fail-safe above the 99 percentile by opening the circuit of the protected function; and eliminate even the high frequency, high voltage impulse spike.

To illustrate surge eliminator performance, consider the situation depicted in Figure 3. Part A presents a badly distorted sine wave for a 120-volt RMS hot-to-neutral situation where several forms of voltage anomalies are illustrated. The equipment destruct level is assumed to be above about 250 volts peak (to protect reliability). The surge protector must, therefore, prevent the voltage from rising significantly above that level.

To accomplish this, the SE functions are as follows. First, the voltage controller assembly constantly monitors the output voltage. When it rises above the clamp voltage, which is usually set at 1.2 times the normal peak voltage, it acts as a constant voltage device holding the voltage at the selected clamp level. If the anomaly is more than a small transient it turns on the high energy dissipation assembly. Some of the energy is dissipated within the unit

All SEs are designed with a special surge fuse that will open if the capability of the SE is exceeded.

to compensate for the influence of the grounding system surge impedence. The remainder is dissipated in the grounding system and its connections.

During the SE operation, the voltage to the protected system is maintained within the operating limits of the system, neither being crowbarred to or near ground potential, nor allowed to rise significantly above the clamp level. As soon as the surge or transient has passed, the SE returns to its passive mode.

The SE series elements contain a low-pass filter to accomplish the energy conservation control functions and minimize noise and impulse transients. Negative going spikes on the positive half-cycles and positive going spikes on the negative half-cycles are attenuated to some degree, about 10 dB.

LEA surge eliminators are designed to provide complete protection. SEs will handle at least 99 percent of the potential surges or transients they would experience in a particular application. Beyond that, all SEs are designed with a special surge fuse that will open if the capability of the SE is exceeded. Note that the fuse-blow characteristic is a decaying exponential that asymptotically approaches the circuit operating current. The SE will dissipate any energy below the curve and above the operating current level and the fuse will protect against any unusual event that would introduce energy in excess of the SE capability. The probability for this event is less than one chance in 10 years for the average location within the continental United States.

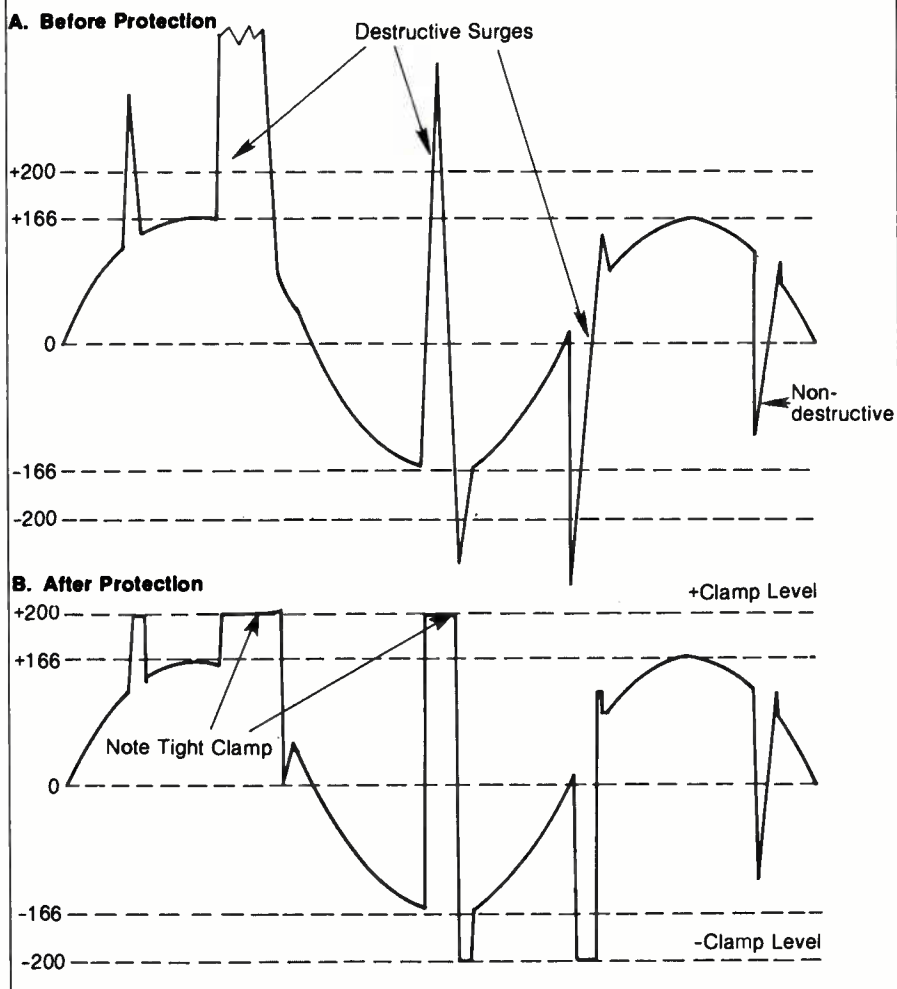
The rating of SEs in terms of power handling capabilities is not a simple matter. Although SEs can dissipate energies in excess of 100,000 joules per phase and handle surge current flows in excess of 200,000 amperes, this does not completely describe the protection provided. The LEA SE design is such that it makes use of the grounding resistance and power system surge impedence to increase the overall protection capability significantly. The principle can be illustrated in which a worst case lightning strike of 200,000 amperes is assumed to have terminated at a hilltop utility pole. The pole is assumed to be within 35 meters of the user's terminal wherein a LEA SE is used for surge protection. The parameters selected are typical for a mountaintop facility, or perhaps a bit on the optimistic side. Referring now to the related equipment schematic diagram, it may be seen that both the surge impedence of the connecting wiring and the grounding resistance are used to dissipate a major portion of the stroke released energy, most of which is in the grounding resistance. That is, the excess energy heats up the earth around the grounding components. From these data it is evident that the SE could provide protection against lightning induced energy levels in excess of a total of 100,000 joules.

The clamping ratio (CR) is also a factor of importance in considering a surge protector. The CR is defined as the ratio of line voltage under the worst case lightning surge current vs. the initial clamping level. For all surge protectors the terminal voltage permitted at the protected equipment rises with a rise in surge current. Obviously, the lower the CR value the safer the protected unit is for any given set of conditions.

This article will appear in three sections, ending with August. Part 2 next month: How to cope with direct strikes.

FIGURE 3

Surge Eliminator Protective Action



Stereo Hotline:

Just call the Hotline. The technical assistance you need to implement the latest stereo technology is at Wegener Communications.

At Wegener, we've done our homework *again*—researching and testing every possible combination of cable headend products with our Model 1791 Broadcast Stereo Encoder.

Scrambling systems, microwave, supertrunk—our technical experts want to share the results of the tests with you. Because at Wegener, the sale is not complete until you're satisfied with the performance of the equipment.

Let Wegener help analyze your system and determine exactly what *you* need to add true broadcast stereo sound.

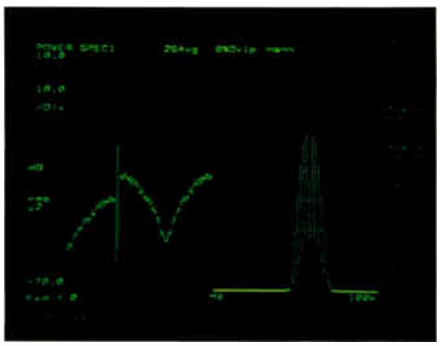
1-800-445-BTSC

Call the Wegener Stereo Hotline and receive your copy of our latest Stereo Applications Report.

WEGENER COMMUNICATIONS
TECHNOLOGY PARK/JOHNS CREEK
11350 TECHNOLOGY CIRCLE
DULUTH, GEORGIA 30136
(404) 623-0096 TELEX 54-3634 FAX (404) 623-0698

Reader Service Number 21

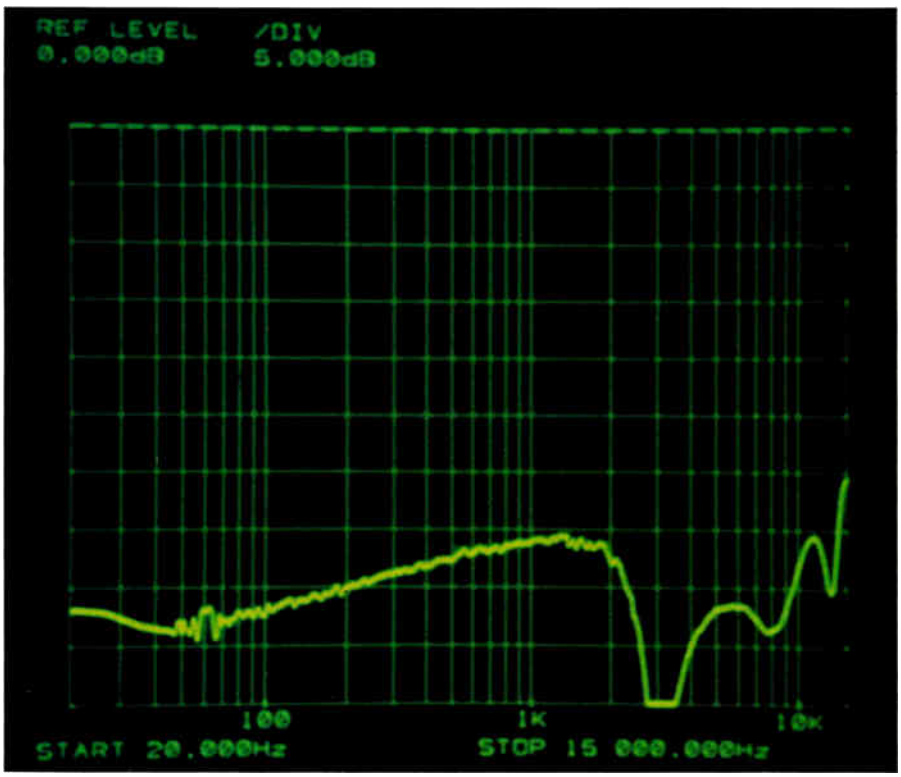
A tutorial on BTSC waveforms



BTSC spectrum

This plot was made using an HP 3562 Dynamic Signal Analyzer. Random noise from the analyzer was connected to the left audio input of the stereo encoder. A 1 kHz tone was connected to the SAP input. The composite BTSC output spectrum is shown including the sum channel (20 Hz to 15 kHz), pilot (15.734 kHz), different channel (16 to 46 kHz), and SAP (centered about 78.7 kHz). The slope of the noise shows the re-emphasis and dbx noise reduction used in the sum and difference channels.

Photos by Lu Rovira, Scientific-Atlanta

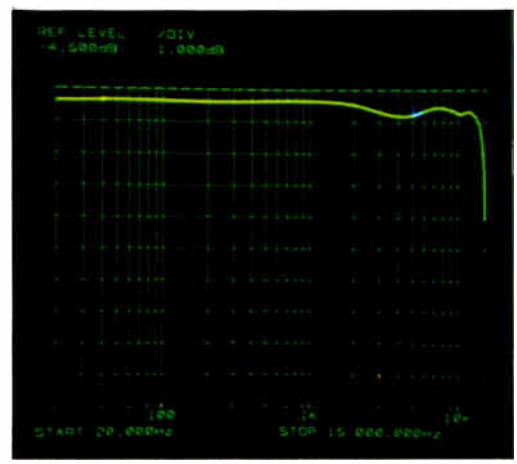


Stereo separation

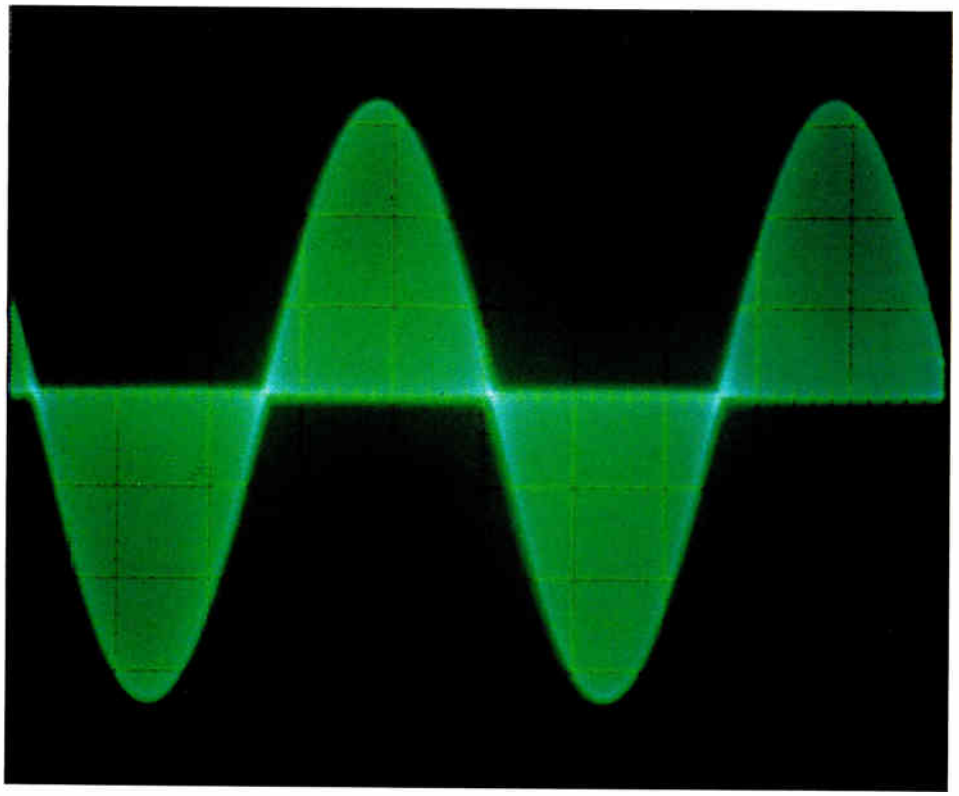
An HP 3577 Network Analyzer was used to sweep the left input of the stereo encoder. The output of the encoder was connected to a Modulation Sciences Stereo Reference Decoder. The left output of the decoder was connected to the reference channel input of the network analyzer. The plot shows the level at the right output (undriven channel) of the precision decoder relative to the left (driven channel). This represents the stereo separation of the encoder and decoder.

Frequency response

The network analyzer was again used to sweep the left input of the stereo encoder from 20 Hz to 15 kHz. The left output of the precision decoder was fed back into the analyzer. The photo shows the combined frequency response of the encoder and decoder on a 1 dB per division scale.

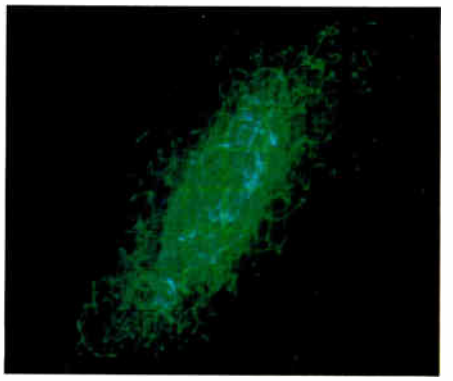


The Lissajous pattern is used by FM broadcasters to continuously monitor their system.



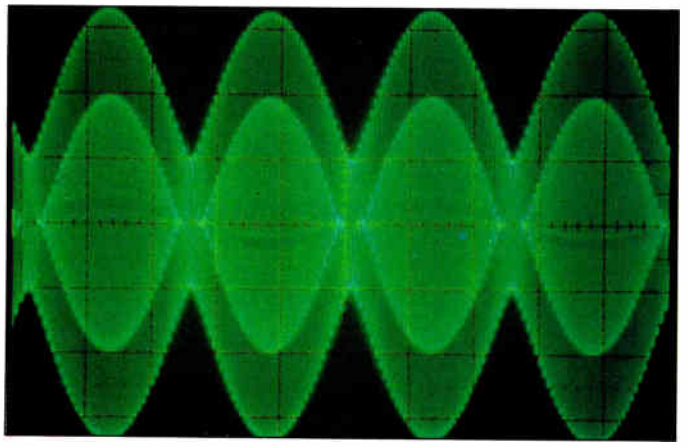
Butterfly pattern

A 1 kHz tone was connected to the left input of the encoder. The pilot tone and SAP were internally defeated. dbx noise reduction was replaced with pre-emphasis equivalent to that of the sum channel. The difference channel was attenuated by one half. The remaining composite output of the encoder (sum and difference channels) was viewed on an oscilloscope. This pattern is commonly used by FM broadcasters to evaluate separation. The baseline of the pattern should be flat for good separation.



Lissajous pattern

This simple pattern is commonly used by FM broadcasters to continuously monitor their system using normal program material. All that is required is a receiver and an oscilloscope capable of displaying vertical vs. horizontal voltage inputs (X-Y input). One output channel of the receiver is connected to the X input, and the other channel is connected to the Y input. If the program source is in mono, or if the system significantly degrades stereo separation, a thin diagonal line is seen. If the source is in stereo and the system passes stereo, the line widens into a diagonal "scribble" as seen in the photo. The pattern should always tend toward a diagonal from bottom left to top right. If the diagonal goes from bottom right to top left, the phase of one of the channels has been reversed somewhere in the system. If this happens, stereo receivers will sound as if the phase to one of the speakers were reversed.



Eye pattern

A 1 kHz tone was connected to the left input of the decoder. The sum channel and SAP were internally defeated. dbx noise reduction was replaced with pre-emphasis equivalent to that of the sum channel. The difference channel was attenuated by one half. The remaining composite output of the encoder (pilot and difference channel) was viewed on an oscilloscope. Pilot and difference carrier phase are properly adjusted when the zero crossings of the inner and outer patterns line up horizontally.

Micro-Beam™ The Cable Expansion Problem Solver

Innovation in Cost-Effective CARS-Band Microwave Technology

Turn your cable expansion goals into a working reality with MICRO-BEAM™, the Channel Master® CARS-band microwave relay system designed for cost-efficiency and flexibility...two important bottom line considerations in any cable expansion plan.

Both of our 1 and 5 watt systems offer you more for your investment. With MICRO-BEAM™ there are no "hidden costs" for the equipment or services you need to make your system operational. Our standard system package includes feasibility studies, equipment installation, on-site service, warranties and much more, all at no extra charge. And because MICRO-BEAM™ is basically option free, the system you order is in stock, giving you the fastest lead time of any microwave product on the market.

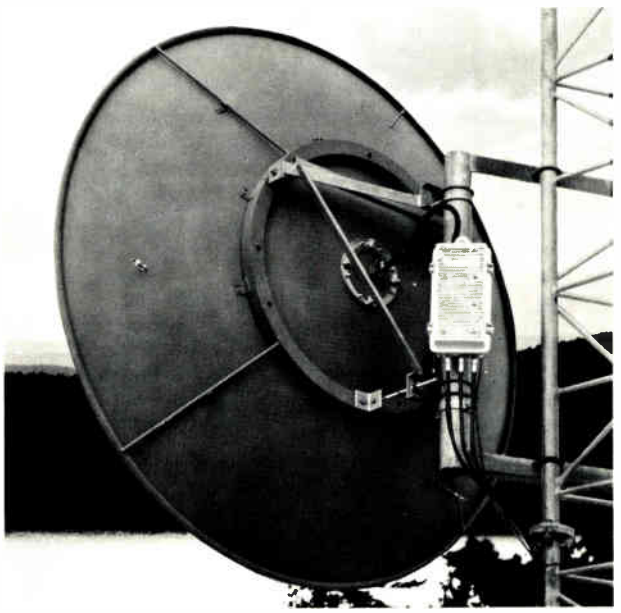
In addition, our new microwave repeater and microwave multiplier offer extra versatility and cost-savings to your MICRO-BEAM™ system by consolidating transmitter and receiver equipment, as well as allowing you to add microwave paths as needed without utilizing expensive and often excessive, tube type equipment.

Standard Equipment & Services

- **450 MHz Transmitter**
- **300-450 MHz Microwave Receiver**
- **LNA/Image Rejection Filter/AGC**
- **Mounts, Waveguides, Connectors**
- **Feasibility Study**
- **Installation of MICRO-BEAM™ Electronics**
- **F.C.C. Application Assistance**
- **Alignment of Microwave Paths**
- **1-Year Warranty on Parts & On-Site Service**
- **24 Hour, 7-days a week, Technical and Warranty Service**

(In Continental U.S. Only)

That's why small cable operators, as well as some of the top MSO's like United Cable, Centel Cable, Cable Entertainment, Sonic Communications and Telescripts, use MICRO-BEAM™ as an alternative to the more expensive systems on the market today. They know that a MICRO-BEAM™ CARS-band system will put their money to work profitably.



Eliminates Additional Headends

MICRO-BEAM™ reaches isolated subscriber pockets and spans natural barriers without additional remote headends, adapting to your entire service including audio, video, data and addressability signals and commercial insertion capabilities. MICRO-BEAM™ also saves you that $500 per-channel descrambling cost by allowing you to descramble each channel at the main headend. In fact, MICRO-BEAM™ is so compact, it allows you to transmit from a weatherproof unit that mounts behind the antenna. It can even be mounted on water towers, and can be placed anywhere in your system, not just at the headend!

Two New Microwave Products

Channel Master® has added a new microwave repeater and microwave multiplier to its line of CATV equipment products for even greater CARS—band system expansion.

The new **Repeater**, available in 1 and 5 watts, is a low noise amplifier designed to consolidate transmitter and receiver functions, allowing microwave links to be cascaded or hopped without down-converting and then up-converting the signal.

The new **Multiplier** allows the systematic addition of microwave paths to a single transmitter location without utilizing tube type equipment. Also available in 1 or 5 watts, the new multiplier is designed with adequate gain to allow full output power over a wide range of input power, allowing microwave paths to be added as needed.

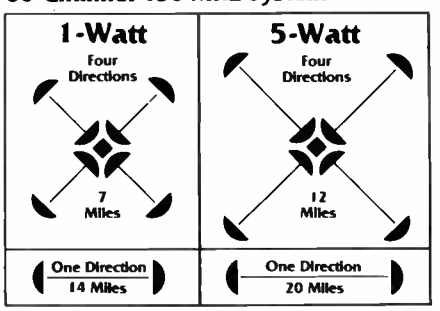
Versatility In Signal Delivery

36-Channel 300 MHz System

1-Watt: Transmits a fully loaded signal up to 9 miles in four directions.
5-Watt: Transmits a fully loaded signal up to 15 miles in four directions.

Sample Applications:

60-Channel 450 MHz System



Contact us today and let our staff of qualified specialists show you how flexible and cost-efficient your cable system expansion can be, now and in the future with MICRO-BEAM™.

Contact: Jim Crownover

Channel Master®
Division of Avnet, Inc.
Industrial Park Drive, Smithfield, N.C. 27577
(919) 934-9711

Connecting Cable Systems To Subscribers' TVs and VCRs—Guidelines For The Cable Television Industry

Part IV

TABLE OF CONTENTS

SECTION I—DISCUSSION OF ISSUES AND HISTORICAL SOLUTIONS

Chapter One—Overview and Tutorial **I-4**
Introduction I-4
Scope of Subcommittee's Work I-4
Review of FCC Technical Standards I-5
Technical Requirements for a Solution I-5
Switching Isolation I-5
Losses and Amplification I-6
Shielding Requirements I-6
Security Factors I-6

Chapter Two—A/B Switch Solutions **I-6**
Discussion I-6
How To Use This Guide I-7
Selection Guide I-8
Diagrams I-9

Chapter Three—Ingress/Egress Discussion **I-24**
Analysis of Ingress/Egress Issues in the Home I-24
Technical Guidelines for Direct Connection to Customer Owned Equipment I-25

Appendix A—Summary of Scope and Progress of Other Industry Groups **I-29**
RF Cable Interface and Decoder Interface I-29
Working Group I-29
Consumer Electronics Bus Committee I-32

SECTION II—SOLUTIONS FOR TODAY AND TOMORROW

Chapter One—Integrated Switching Systems **I-35**
Discussion I-35
Configuration Options I-35
Model Specification I-36
Description I-36
Electrical Specifications I-39

Chapter Two—Accessories to Aid Compatibility **I-40**
Discussion I-40
Timers I-40
Multifunction Remote Controls I-40

Chapter Three—Hardware Modifications **I-40**
Discussion I-40
Proposal I: Wideband Cable Feed Including Premium Services I-40
Proposal II: Dual Channel Premium Decoder I-42
Proposal III: Master-Slave Descramblers I-44

Appendix A: Subcommittee Chairman's Cover Letter **I-52**
Appendix B: NCTA and the NCTA Engineering Committee **I-53**

Put the box office a phone call away.

The Panasonic PC-200 Addressable Converter.

Offer more than just the basics...

The Panasonic PC-200 Addressable Converter lets you provide more than just basic cable services to your subscribers. It gives you the tools necessary to deliver a new and profitable service to your consumers — pay-per-view television. Naturally, the more services you offer — the more subscribers you'll maintain. Not to mention the additional revenue you'll be generating for your own business.

The PC-200 Converter offers you the convenience of instantaneous control of every channel in your system. Plus, an independent Panasonic scrambling system which helps increase system security. What's more, the PC-200 is compatible with gated 6 and 10 dB sync suppression scrambling which means you can hook it up to your present Jerrold system. And, it allows purchase of converters from more than one source.

In addition, you also get a host of downloadable parameters. Like channel map, barker channel number, IR enable/disable, and force tune of the converter just to mention a few.

Put the Panasonic PC-200 Addressable Converter to work in your system — we're ready to help you deliver entertainment that's a phone call away. And, address your bottom line, of course.

For more information call:
East Coast: (201) 392-4109 West Coast: (415) 672-2592

Panasonic
Industrial Company

Reader Service Number 23

Appendix A

Dr. Walter Ciciora
Vice President, Research and Development
American Television and Communications Corp.
160 Inverness Drive West
Englewood, CO 80112

Dear Walt:

Enclosed is the first official submission of the Consumer Interconnect Subcommittee to the Engineering Committee. I am sending it to you as committee chairman and requesting approval of the full NCTA Engineering Committee. Given that there is a heightened awareness in the industry of consumer interconnect problems and a range of new equipment coming on the market to neet that need, I would suggest that this information be disseminated as soon as possible. Perhaps a direct mailing to manufacturers known to make equipment for that market and member system's engineering departments combined with publication in an industry technical journal would be appropriate. I would like to publicly thank those committee members who contributed to the final product for their efforts, most especially my co-authors: yourself, Joe Van Loan, Al Kernes, Judson Hofmann, James Cherry and Tony Chen-tung Li.
We have not yet determined the best future direction for our efforts and would welcome the Committee's inputs as to whether to disband or, if not, the most productive area to investigate.

Sincerely,
David J. Large
Engineering

on the system it will deauthorize following reception of the first deauthorize message (see timing diagram in Figure 4).

Multiple dwelling applications

The control channel interrupt method can readily be extended to multiple dwelling situations where a large number of slave HTUs are required on the master HTU (see Figure 5). This can offer an interesting alternative to off-premises equipment in situations where unauthorized migration and use of home terminals are the principal concern.

There is no restriction on the number of slaves in one building. Each building would be treated as a separate group with its own group address. Thus, slave HTUs from one building would be useless in any other building. However, it should be pointed out that level differences in the cable spectrum between the trap on/off states of the switched control channel filter may create disturbances visible in the TV picture. Also, it does not prevent transfer of slave HTUs within the designated building.

Message security

Central to the above approaches is a technique of informing the master units of an impending slave disable command. In any system employing the described approach, the ability of a pirate to covertly mimic the master's message interruption process must be examined. The Oak approach to this danger, as well as other dangers of control channel manipulation (or tampering), is to encrypt all control channel messages using a time-varying process. Thus, a pirate will be unable to detect the slave disable warning message going to the master units. Patents are currently being filed for these approaches as well as the master/slave concept.

Summary

The problem of secondary HTU theft for addressable cable systems is a major concern for system operators that offer lower rates for secondary HTUs. The master/slave solution will eliminate that risk.

The control channel method requires transmission of the control signal at 10.7 MHz instead of a switching DC pulse used by other approaches. The advantages of this method are that there is no requirement for external hookups between the master and slave HTUs and that only RF signals are present on the cable.

The master HTU for the control line approach can also send a switching (DC-coupled) pulse via the RF cable instead of the external connection to each slave HTU. Several commonly used splitters tested were found to pass DC without significant degradation. During the pulse duration, a data channel message is transmitted to command the slaves to deauthorize. Thus, HTUs that are not linked to a master HTU sending such a pulse will be deauthorized for viewing. However, if the switching pulse is carried by the RF cable to each slave HTU, DC blocking devices must be used to avoid DC shorts in the cable throughout the subscriber's home. This can happen if the customer decides to hook up a VCR to the RF cable.

For both the control channel and the control line methods, the deauthorize command can be sent as frequently as desired by the system operator. While in the control channel interrupt method, the deauthorize command frequency should be limited to a minimum since the switched control channel filter may cause picture interference during switching.

For all three approaches described, the master and slave HTUs can be manufactured and shipped identically. At installation the HTUs can be reprogrammed from the central control computer to function as master or slave HTUs. The control message will utilize a time-varying encryption process to ensure maximum security. These techniques are currently under development at Oak Communications in San Diego.

Slave HTU. The slave HTU is designed to respond to the control line inhibit signal. When this signal is present, the standard control channel receiver is deactivated and no control messages can be received by the slave HTU.

Periodically, the headend sends deauthorize messages to all slave HTUs as a group, preceded by a group inhibit command sent to all master HTUs. If the slave HTU is connected to the control line from the master HTU it will be protected from the deauthorize command and will continue to function normally. If the slave is not connected to the control line it becomes deauthorized following reception of the first deauthorize message.

Both slave and master HTUs can be manufactured the same and shipped as master units. At installation a message from the headend can be sent via the standard control channel that will configure designated HTUs as slaves.

3) Control channel interruption

Figure 3 shows a functional block diagram of the control channel interrupt configuration.

Master HTU. The master HTU has been designed to transmit a switching pulse on the input cable. This switching pulse is transmitted by the master HTU immediately following reception of an inhibit command from the headend via the standard control channel. The inhibit command is sent to all master HTUs in the system as a group. The duration of the switching pulse is sufficient to prevent the reception of the following message which is directed to all slave HTUs. The switching pulse operation is executed as long as the master HTU is powered.

Switched control channel filter. The switched control channel filter is designed such that the signal from the cable drop normally passes directly through to a splitter, except when a switching pulse from a master HTU is imposed on the output port of the device, a control channel filter is switched into the line to interrupt the control channel. When the switching pulse is removed the device returns to normal operation, passing all signals on the cable. Another possible approach to designing this filter is to block all the RF signals on the cable for the entire pulse duration.

Slave HTU. In the control channel interrupt configuration, any addressable HTU that is system compatible can be used. At installation, a message from the headend will be sent to the slave HTU to make it associate with the slave group. Periodically, a deauthorize message is sent to all system slave HTUs as a group. If a slave is operated downstream from a master HTU-controlled switched control channel filter it will be protected from receiving the deauthorize command. If the slave HTU operates directly

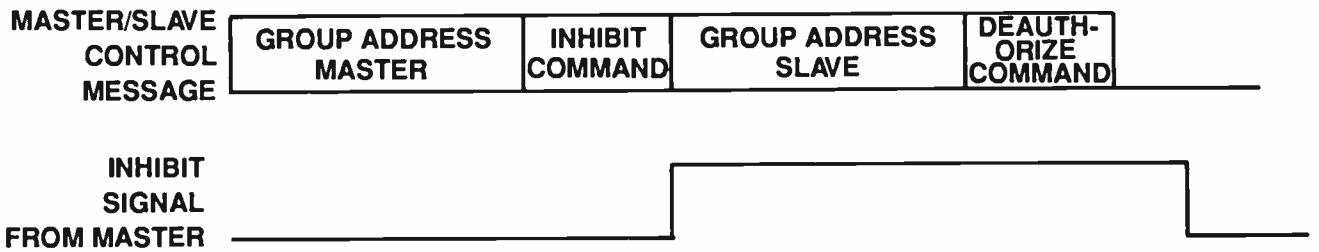


Figure 4. Timing diagram

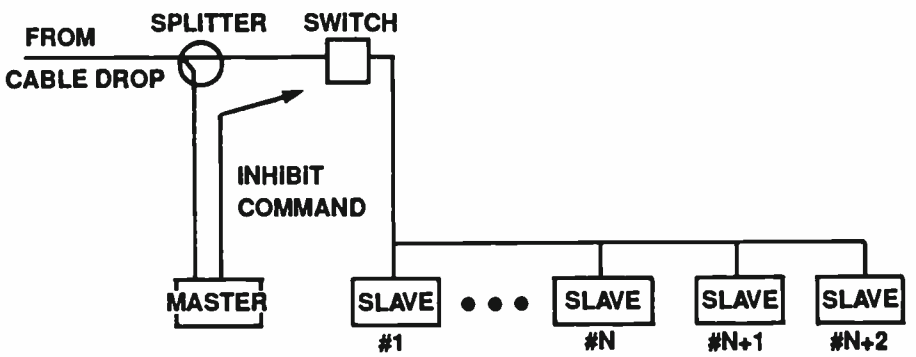


Figure 5. Extension to multiple dwellings

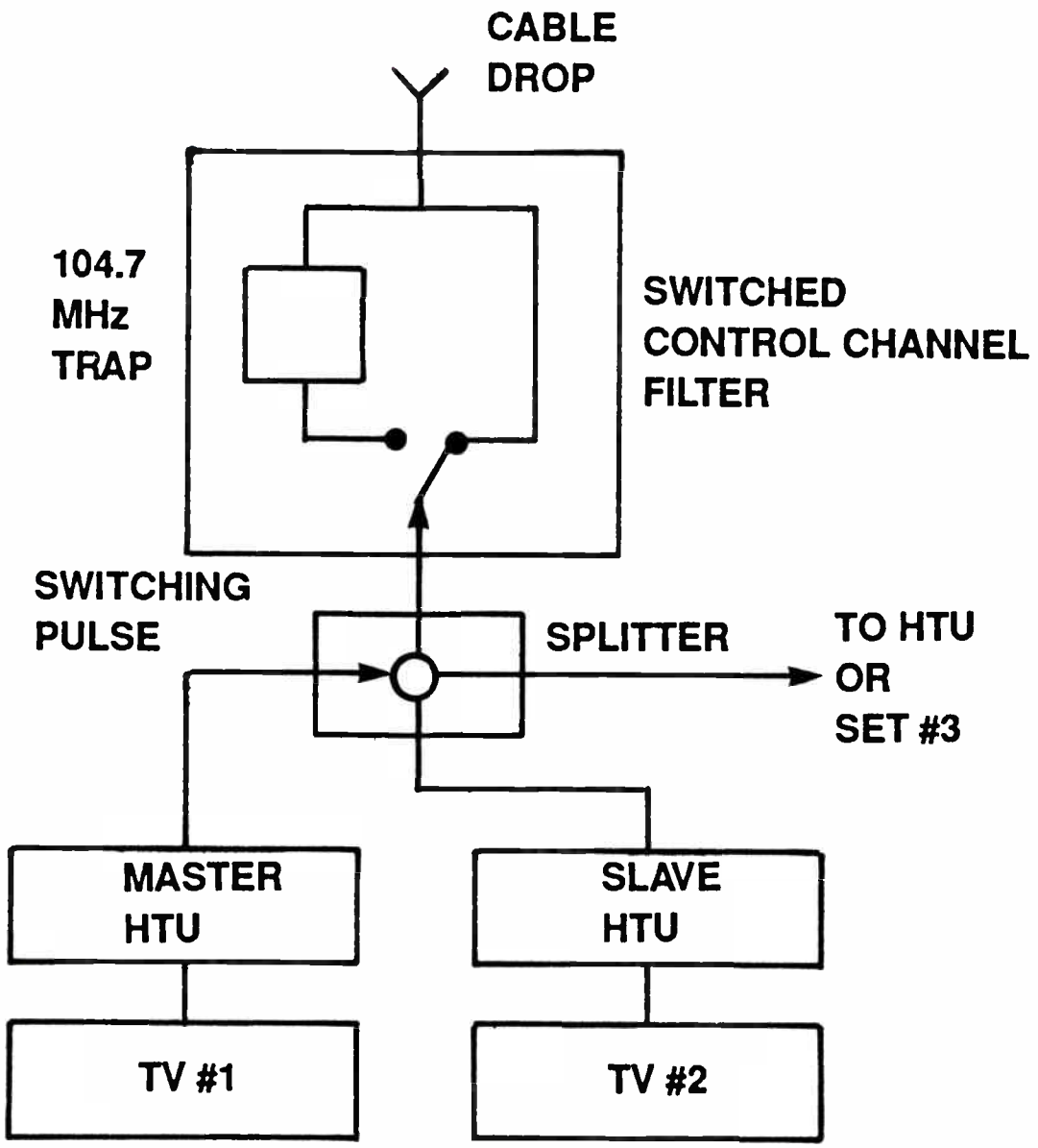
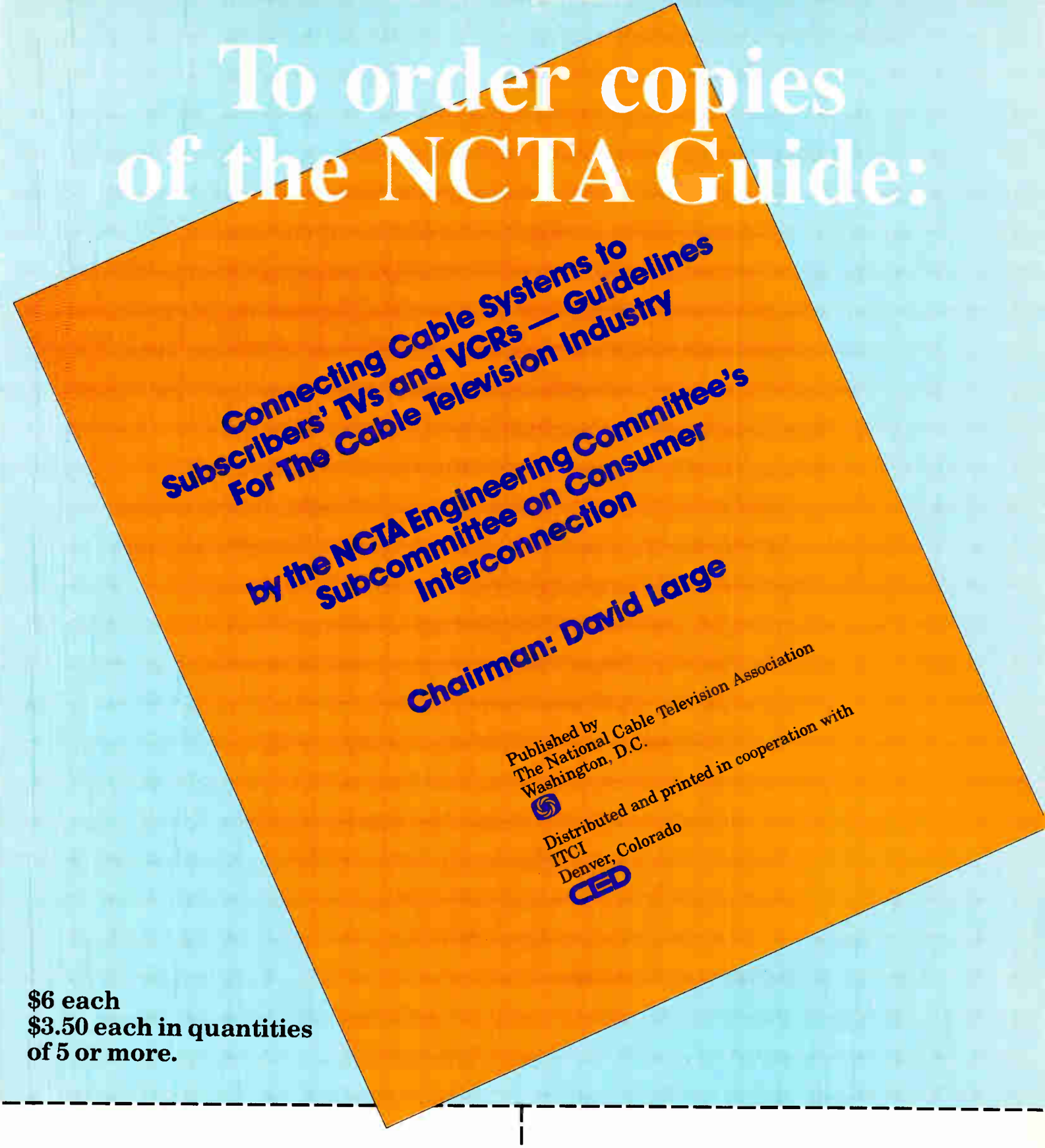


Figure 3. Control channel interrupt

To order copies of the NCTA Guide:



$6 each
$3.50 each in quantities of 5 or more.

NCTA Guide
P.O. Box 5208 T.A.
Denver, CO 80217

Available NOW

Pre-paid orders only, please. Send check or money order made out to *CED*.

Ship to:

Name _____

Address _____

City _____ State _____ Zip _____

I've enclosed $ _____ for _____ copies.

Inside the lead acid cell

With ever increasing use of standby power and consequently lead acid storage cells, the need for a clearer understanding of this device and its components is necessary. No one battery is universal. Therefore, a basic knowledge of cell constructions and their corresponding performances is required.

With this, one can then appreciate the manner in which batteries respond when exposed to various charge and discharge parameters. This paper will deal with the design and application characteristics one should be aware of when called upon to make a choice of today's available products.

A brief look back shows that in response to research conducted during the years 1859 to 1879 by Gaston Plante, considered to be the father of the lead acid cell, a wealth of ingenuity and imagination was illustrated by a rapid growth of design and application variations of early products through the turn of the century. Since that time, the improvements have been essentially refinements of these basic designs using more modern materials and techniques.

However, even yet there is no ideal

Figure 1: Capacity/power loss during storage at 25°C

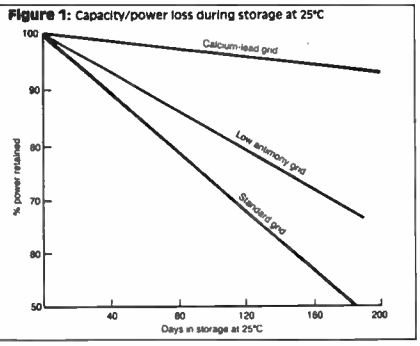
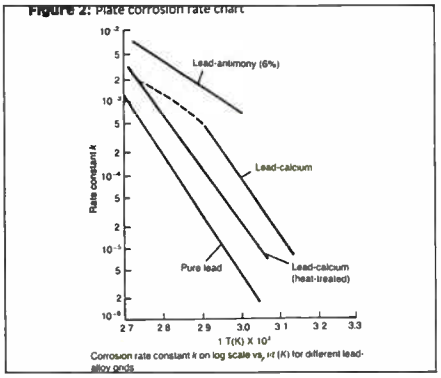


Figure 2: Plate corrosion rate chart



Corrosion rate constant k on log scale vs. $1/T$ (K) for different lead-alloy grids

Wise application of the proper battery is a must.

battery. The ideal battery, were it available, would exhibit infinite energy, handle all power levels, operate over a full range of temperatures, have an infinite shelf life and be consumer proof. Since this is not the case, we must approach this device with its many factors in mind.

In the design of a lead acid cell, the function of the various components must be considered in relation to the actual requirements of each application. It is worth noting that any design is a compromise. Each function has been considered in terms of its importance in the particular application. Thus, there will be different optimized designs depending on the use into which the cell will ultimately be placed. Cells that are designed, for example, for optimum capacity at relatively low or moderate discharge loads contain maximum quantities of active material. On the other extreme, cells capable of high-rate, large current delivery performance are designed with reaction surfaces and other features to minimize internal resistance. The latter is done often at the expense of total capacity. It will be found that cells designed for high-rate service will exhibit a more constant performance, i.e. current output, to those of the greater capacity category.

The typical lead acid battery is comprised of three basic elements. The positive plate, the negative plate and the electrolyte. There are, of course, other nonreactive components such as the separators, connecting straps and case. We will only consider the active components and their interrelated effects.

Plates and grids

The plates should be considered as a compound element in that they are a combination of two items. First, a grid is formed by one of several methods, the most popular, for a vertical plate design, being a casting process where the lead is poured into a mold to form the basic structural component. The second most popular process employed today is a wrought technique where a solid lead sheet is drawn through an expander which places slots in the sheet and then stretches these slots into openings much like the common expanded mesh sheets available from most hardware suppliers.

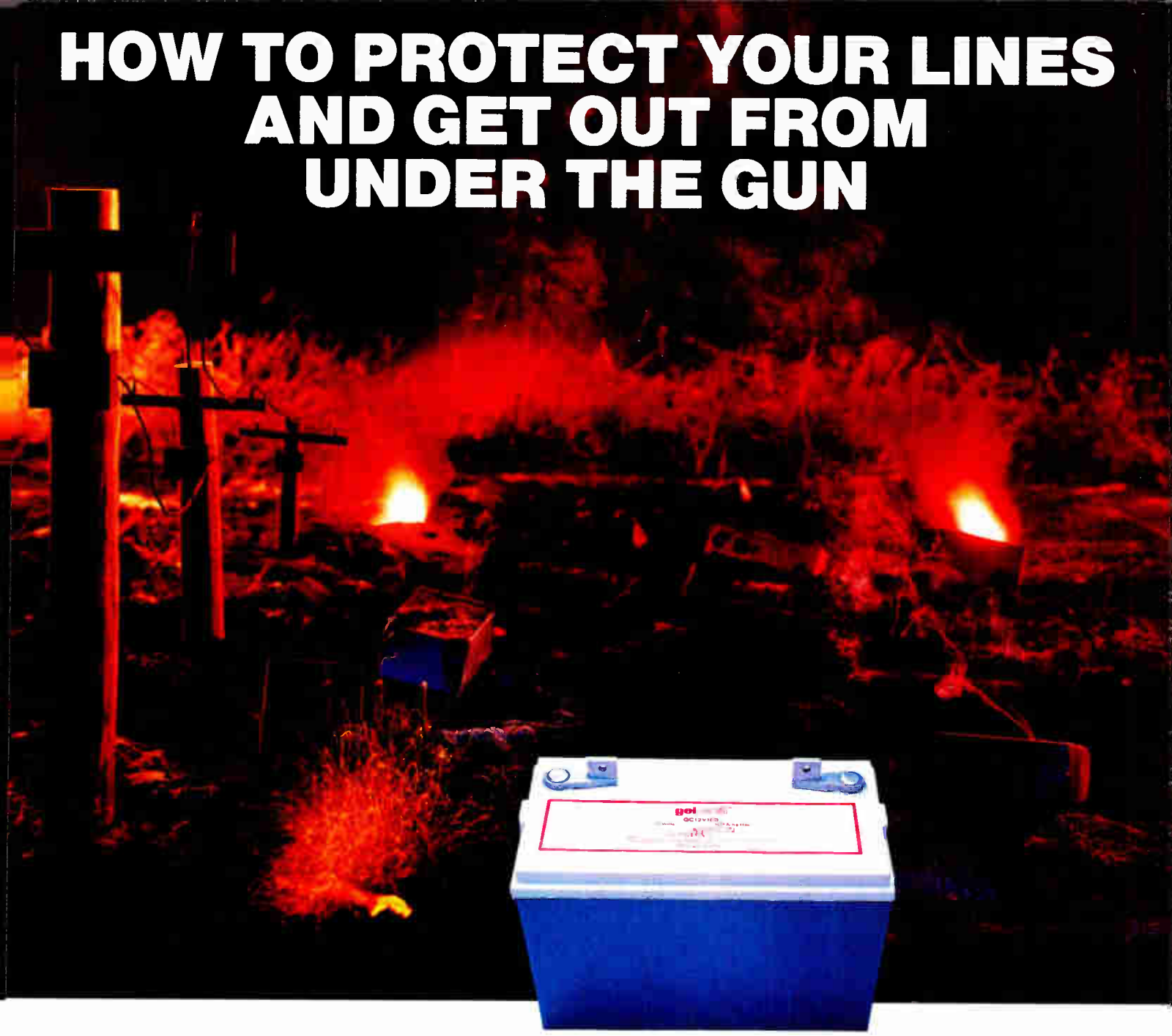
This system reduces the cost of manufacture as there is less energy required to process a continuous sheet of lead as opposed to maintaining supplies of molten lead for the casting operations. The advantage of individual casting is that in-process changes can be made in the lead mixture at any time where as in the wrought process the entire lead supply must be reworked.

The claimed advantage of lower gassing rates in the wrought process, due to a more consistent and finer grain structure in the lead, will most likely not be a factor of concern in CATV applications as this reduced gassing is such a low value of change that other factors in the electrochemistry and particularly the application will serve to overshadow these gains.

After the grid is prepared, a mixture of highly reactive sponge lead for the negative electrode (anode), or lead dioxide for the positive electrode (cathode), is mixed with sulphuric acid to form a paste. Included in this mixture are sufficient expander materials to achieve and maintain a high level of porousity. This is necessary so as to achieve an optimum ion conductivity in and out of the plate active material. The paste is then spread onto a grid which will provide the necessary support structure and electrical conductivity.

There are, however, several points regarding the lead which should be addressed here. If pure lead were attempted to be used for the grid structure, which by far is the most desirable, it would not exhibit enough rigidity to withstand handling during manufacture, not to mention the actual in-service requirements. This then dictates that an alloy be introduced into the pure lead to add strength. Historically, an antimonial alloy was used as this strength-adding agent. The presence of this compound, though,

HOW TO PROTECT YOUR LINES AND GET OUT FROM UNDER THE GUN



Wipe out maintenance assaults

Arm yourself with the original CATV sealed lead acid battery that eliminates watering and other service problems. Here's wall-to-wall computer designed grids surrounded by gelled electrolyte. You don't buy empty space. And you don't buy stratification that attacks reliability. What you do buy is the one standby battery that defends your lines 24 hours a day. Non-stop.

JOHNSON CONTROLS

Industrial Products Unit
900 E. Keefe Avenue
Milwaukee, WI 53212
(414) 961-6500

Put maintenance costs on the run

The real killer isn't what you pay for standby batteries. It's what they cost you in unnecessary work. The cost of electronics corroded by fumes and acid. The cost of replacing batteries that surrender to freezing cold and boiling heat. The cost of trying to mount batteries you can position only one way. That's why we give you a fighting chance by making sure you pay for your standby batteries just once. When you buy them.

The "Original" gel/cell
GC-12-800 80 AMP

The "Second Generation" gel/cell
GC-12-100 100 AMP

Come out a winner with the 5-year CATV original

Get the outage defense that's more than a label change. Ask for the standby batteries with 5 years of field testing in CATV service. With sure-fire cycling up to 500 times regardless of float service time. With standby capacity no one else can touch. With the fighting durability it takes to protect your lines in any attack. And with one more thing. The difference between you surviving the fight and becoming just another casualty.

Reader Service Number 25

The inclusion of calcium brought on its own set of problems mainly related to the manufacturing process.

exhibited two major down-side effects. The first to be discussed is that of excessive gas production.

The gassing is a direct result of electrolysis depletion of the water at the end of charge. This electrolysis produces hydrogen at the negative plate and oxygen at the positive plate. The main contributor to this activity is the presence of this antimony alloy. In the past, low-cost vertical plate design batteries were routinely maintained, therefore, frequent watering intervals were not of great concern. It is interesting to note that the production of oxygen starts as soon as the recharge cycle is commenced and continues through full charge. The evolution of hydrogen at the negative plate does not start until it has reached 90 percent to 95 percent recharge. An interesting point is that the negative plate accomplishes its recharge much faster than the positive. This is why the "end of charge rate" must be closely controlled to achieve total recharge of the positive plate without excessive overcharge of the negative, which would result in excessive hydrogen evolution.

In the mid 1970s, the maintenance-free lead acid battery became popular. This design featured a grid alloy that basically was a nonreactive component. The antimonial alloy, being a reactive component, and as stated before, elevated the gassing rate and contributed to plate corrosion which also results in increased water depletion as the cell ages. By using a nonreactive strengthening agent, a more nearly pure lead grid could be achieved. This resulted in a dramtically reduced end of charge gassing rate.

This marked the introduction of the lead-calcium battery. The inclusion of calcium resulted in a reduction of the antimony to generally no more than 2 percent. A maximum strength yield is achieved with about .11 percent calcium content.

The inclusion of calcium brought on its own set of problems mainly related to the manufacturing process. It seems that while maintaining the lead in the molten stage, rapid loss of calcium through oxidation would result. Many attempts to control this were tried.

Floating lids of various types were tried by placing them on the surface of the molten lead. One attempt of a floating layer of dross was even tried. None of these were successful. It was then found that by adding aluminum to the mixture that this condition could be controlled effectively. Along with the inclusion of AU, it has been found that by utilizing nucleating agents such as copper and selenium, a very uniform and fine grain structure results. This allows for a superior active material to grid adhesion, thereby reducing loss of the active material through shedding. This also reduces the ill effects of corrosion as the corrosion tends to be more uniform on the grid wires rather than forming pits and fractures as a result of inconsistency in the lead crystallization.

The second ill effect of using antimony for grid alloy is a high self discharge rate. The self discharge rate (loss of battery capacity on storage) is dependent on a number of factors, including the type of lead alloy used, the concentration of electrolyte, the age of the battery and storage temperature. The greatest contributor to this activity, however, is the antimony lead alloy.

Self discharge is caused by local reaction of the plate materials and occurs almost entirely in the positive electrode. The rate of self discharge is about 15 percent per month for antimonial-lead batteries at 25°C. Batteries using lead-calcium grids have substantially lower rates of self discharge. A reduction in this activity by 50 percent or more is not unrealistic. For best practice, a battery on stand should be recharged every three to six months, since prolonged storage can cause irreversible damage and make recharging difficult, owing to sulfation of the plates. (See Figure 1.)

Stationary batteries utilize a thick plate design that reflects the lack of need for high energy and power as in the case of starting, lights and ignition (SLI) types. The typical overcharge operation of stationary batteries requires a large electrolyte volume and non-antimonial grids, all to maximize intervals between waterings. This over or constant recharging, by any of the various on-off, dual-rate or closed loop methods used today, causes some positive grid corrosion. This is manifested in a "growth" or expansion of the grid structure and must be allowed for during the design of the cell so as to provide room for this normal expansion to take place during the useful life of the battery. Excessive overcharging can accelerate this activity to a point where, if allowed to continue over time, it may cause case rupture to occur. The normal tolerated growth is calculated to be about 10 percent over the life of the cell. (See Figure 2.)

Electrolyte and specific gravity

The selection of a specific gravity used for the electrolyte depends on the

Battery suppliers

Advance Telecom Inc.
14405 N. Scottsdale Rd.
Scottsdale, Ariz. 85254
(602) 998-4441
CONTACT: Susan Coady, marketing manager; Gay Montilla, Southwest sales manager; Suzan Smith, customer service manager.
PRODUCT LINE: Advance Telecom distributes the following Teledyne battery products: The XL, a 100-A.H. maintenance free, starved electrolyte, sealed unit; the 1280, a 80-A.H. dry charge unit; and the LANS, a 100-A.H. maintenance free, sealed battery with extended warranty.

Delco Remy
2401 Columbus Ave.
Anderson, Ind. 46012
(317) 646-2063
CONTACT: Brian Barclay

GNB Inc.
P.O. Box 64100
St. Paul, Minn. 55164-0100
(612) 681-5000
CONTACT: Jim Trenter
PRODUCT LINE: GNB offers the Watchman II in three sizes.

Johnson Controls Inc.
Industrial Products Unit
900 E. Keefe Ave.
Milwaukee, Wis. 53212
(414) 961-6500
CONTACT: Richard Scarvaci
PRODUCT LINE: Johnson Controls offers models GC12800 and GC12V100.

Hi-tech deserves Hi-tech.

Watchman® II. Superior stand-by power battery.

Watchman® II is the technological leader in stand-by battery power, designed especially for CATV and other stand-by power applications. Watchman II is made of Duratrex™. This same tough material is used in GNB heavy-duty batteries which virtually eliminates breakage in the field. The bottom line is, it's the top of the line.

No maintenance.

Watchman II's Absolyte® sealed lead acid technology means no maintenance, and no maintenance cost. Watchman II never needs watering, there's no acid spillage or corrosive fumes to damage expensive electronics. And because Watchman II is sealed, you can use it in any position, no matter how remote, even freezing will not damage it.

Premium performance.

Compatible with float service, and unlike most stand-by batteries, Watchman II can be cycled over 250 times. Give your Hi-tech equipment all the power it deserves. Watchman II stand-by power battery.

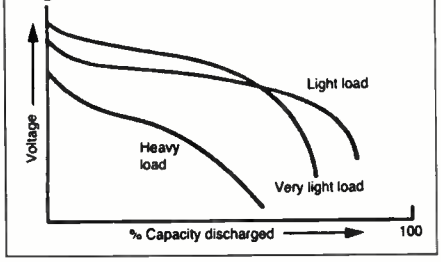
For more information, contact Jim Trenter, Technical Applications Manager, GNB Incorporated, P.O. Box 64140, St. Paul, MN. 55164-0100. (612) 681-5000.

GNB Incorporated

Reader Service Number 26

If the electrolyte is allowed to become contaminated an increase of the gassing rate will result.

Figure 3: Self-discharge



application and service requirements. The concentration must be high enough for good ionic conductivity and to fulfill electrochemical requirements, but not so high as to cause separator deterioration or corrosion of other parts of the cell which would shorten life and increase self discharge.

In some cases where a battery is required to operate in high ambient temperatures, the electrolyte concentration may be deliberately reduced to offset the effects of temperature elevated chemical activity, resulting in accelerated plate corrosion and lowered overvoltage gassing potential. The concentration for most lead acid batteries to be used in temperature climates is usually between 1.26 to 1.28 sp.gr. Higher concentrations tend to attack the separators and other components. Lower concentrations tend to be insufficiently conductive in a partially charged cell and freeze at low temperatures. In standby and/or stationary cells with larger proportional electrolyte volumes and no high rate demands, concentrations as low as 1.12 sp.gr. are used.

It is important to maintain not only the correct specific gravity at full charge per the manufacturer's specifications, but also, especially in the case of calcium alloyed grids, not to contaminate the acid solution. A preventive measure, from the manufacturer's standpoint for automobile batteries, has been to permanently attach the vent caps. This is done understanding that under normal conditions the electrolysis of the water will be at a rate far lower than the overall aging of the cell. Therefore, cell failure due to other factors will occur prior to damage caused by water loss.

If the electrolyte is allowed to become contaminated, as in the case of replenishment with other than distilled water, an increase of the gassing rate will result. This obviously will increase watering intervals and if at these times the same practice of using non-distilled water is employed, the gassing rate will again be increased. This practice, if allowed to continue, will most likely result in premature failure of the cell as it is highly unlikely that the watering schedules will be adjusted to compensate for this increased loss.

Voltage and specific gravity

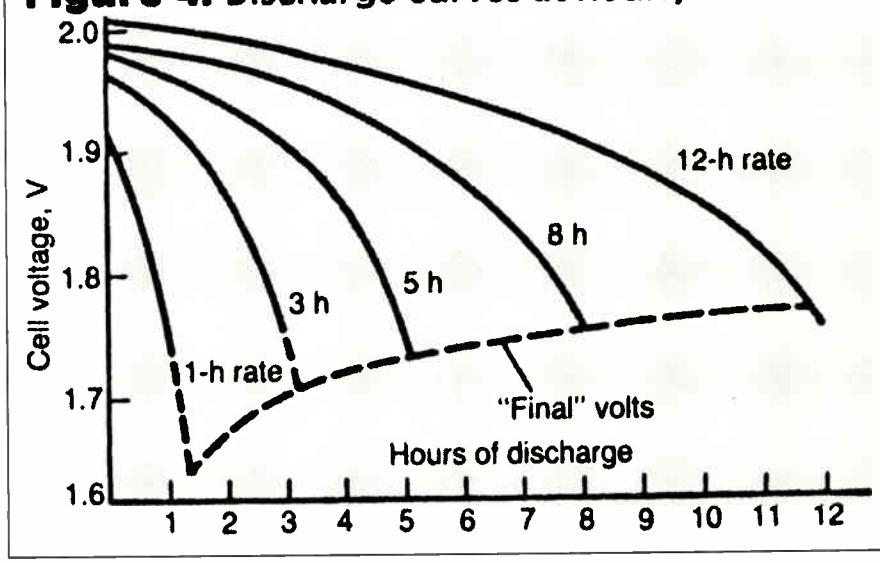
The nominal voltage of the lead acid cell is 2 V. The open circuit potential is a direct function of the specific gravity ranging from 2.12 V for a cell with a specific gravity of 1.28 to a potential of 2.05 V at 1.21 specific gravity. Figures C, D and E represent typical discharge curves for the lead acid cell. The end voltage is typically 1.75 V but can be as low as 1.0 V at extremely high rates such as in automotive starting service. The 1.75 V point is the standard cut-off voltage which manufacturers design, too. During discharge the specific gravity decreases about 0.125 to 0.150 points from a fully charged to a fully discharged condition. The change is proportional to the ampere-hours discharged. The specific gravity is thus an excellent means for checking the state of charge of the battery.

A short period should be allowed prior to measurement after completion of the discharge for equalization of the concentration throughout the cell. On charge, the change in specific gravity should similarly be proportional to the ampere-hours accepted by the cell. There will be a lag in the specific gravity change if the cell incorporates a high-concentration electrolyte as complete mixing of the concentration will not occur until overvoltage gassing occurs and is sustained at the end of the charge.

The variation of the performance of the lead acid cell at different temperatures and loads is given in Figures 6 and 7. Although the battery will operate over a wide range of temperatures, continuous operation at high temperatures may reduce cycle life as a result of the aforementioned increased rate of chemical activity and subsequent corrosion.

It should be understood that in applications where the battery will be housed outside, subject to very low temperatures for long periods of time (dissipating the internal heat needed for full capacity delivery), some form of warming provision should be considered. If long-term storage is going to take place, an area should be chosen that will provide a low mean temperature but will not fall below freezing as

Figure 4: Discharge curves at hourly intervals



A battery can be discharged under different modes depending on the equipment load.

this could damage a flooded free electrolyte battery which is only partially charged.

Phosphoric acid effects

The utilization of phosphoric acid as an electrolyte additive has been patented as far back as 1929 for the claimed purposes of strengthening of the positive active material and preventing harmful sulfation during long discharge stand conditions. In the case of cell designs using tubular positive plates, a reduction in active material shedding and in the rate of positive grid corrosion have been claimed.

It has been demonstrated that cycle life of lead acid batteries using plates with lead-calcium grids is increased when the electrolyte contains small amounts of phosphoric acid, at the cost of some reduction in the positive plate capacity, of the order of 5 percent to 10 percent.

The mechanism by which phosphoric acid increases cycle life is one of modification of the pattern of the lead sulfate as it forms on the plate active material surface. The result is a more conductive interface, with less of a sulfate barrier and less interference with the discharge process.

There also are chemical and/or electrochemical reactions which occur between the phosphoric acid and the positive plate active material, with phosphoric acid incorporation during charge and release during discharge. However, the formation of lead phosphate compounds in the positive plate during charge is the likely candidate for responsibility of the observed reduction in capacity in such cases. Other effects due to the presence of phosphoric acid in the electrolyte solution are lead "mossing" and dendrite formation, both of which are factors which tend to reduce capacity.

Discharge loads

A battery can be discharged under different modes depending on the equipment load. Three typical modes include constant resistance (the equipment resistance remains constant during discharge), constant current and constant power (the current load on the battery increases as the voltage drops to maintain a constant power, $I \times V$).

Assuming that the discharge current is the same at the start of the discharge, the current will be different during the discharge under different discharge modes, as shown in Figure G-a. The constant resistance curve reflects the drop in the battery voltage. Figure G-b shows the voltage vs. time discharge curves for three modes. Under the conditions shown, the service time is longest in the constant resistance mode.

Figure G-c and G-d show the same relationships assuming the same average current during the discharge. Under these conditions, the service time is about the same, but the voltage regulation for the constant resistance mode

Proper recharging is important to obtain optimum life from any lead acid battery under any condition of use.

is best. The constant power mode has the advantage, however, of providing the most uniform equipment performance throughout the life of the battery and, hence, makes most effective use of the battery's energy.

It is worth noting at this point that standby equipment and powering line equipment will regard this load as a more nearly constant power load. In the case of a pulsed discharge load, these conditions will exhibit the recovery effects that occur when the cell is left open circuit for a period of time after discharge. This sawtooth type of response will, in some cases, lead one to think that a battery has sufficient charge to operate when in fact it has reached cutoff under load but has had time to recover above the specified exhaustion voltage. (See Figure 8.)

Battery charging

Proper recharging is important to obtain optimum life from any lead acid battery under any condition of use. Some rules for proper charging are given here and apply to all types of lead acid batteries. The charge current at the start of the recharge can be of any value that does not produce an average cell voltage in the battery string greater than the gassing voltage which is typically 2.39 V/cell.

During the recharge and until 100 percent of the previous discharge has been returned, the current should be controlled to maintain a voltage lower than the gassing voltage. If one wishes to minimize charge time, this voltage should be just below the gassing point which is directly related to the specific gravity and cell electrolyte temperature. When 100 percent recharge is accomplished, the charge rate will have to decay to the "finish" rate. This rate is described as a constant current no higher than 5A per 100 ampere hour of the rated capacity at the five-hour rate. As a result of testing done at temperatures of 80 degrees on new cells, a finish rate for batteries available to the cable television industry of no more than 100ma float current will overcome the effects of self discharge and keeps the end-of-charge gassing to a tolerable limit.

Some of the more popular methods to achieve recharge are listed below:

1. Constant current
2. Constant potential, modified constant potential
3. Taper
4. Pulse
5. Trickle
6. Float

Figure 5: Discharge/charge characteristics

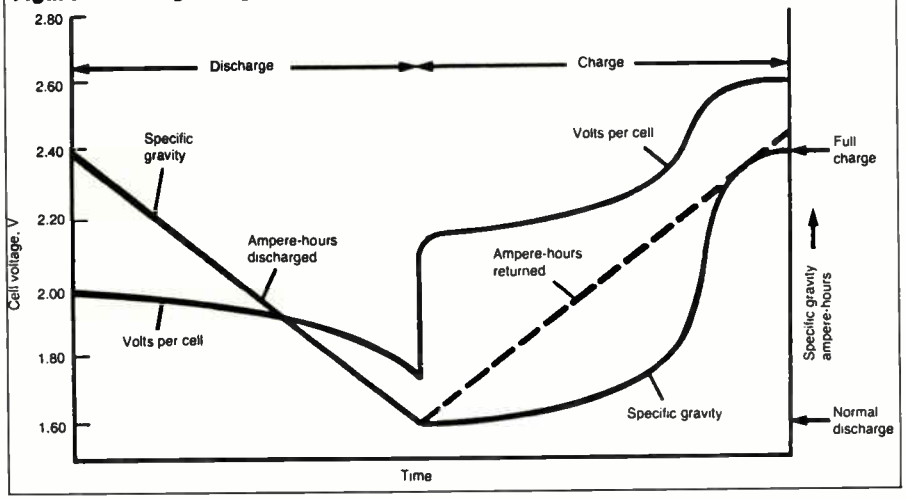
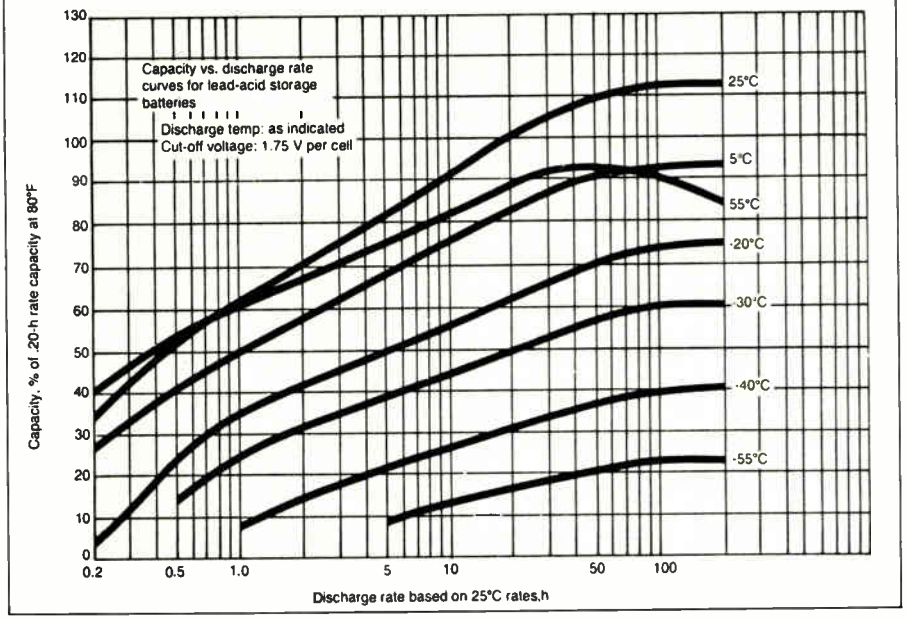


Figure 6: Temperature effects on electrolyte



Constant current

Constant current recharging at one or more rates is not widely used for lead acid batteries. This is because of the need for current adjustment unless the charging current is kept at a low level throughout the charge cycle. This would, however, result in an extremely long recharge time.

Constant potential, modified constant potential

In normal industrial applications, the modified constant potential is employed. In this case the charging circuit has a current limit, and this value is maintained constant until a predetermined voltage is reached. Then

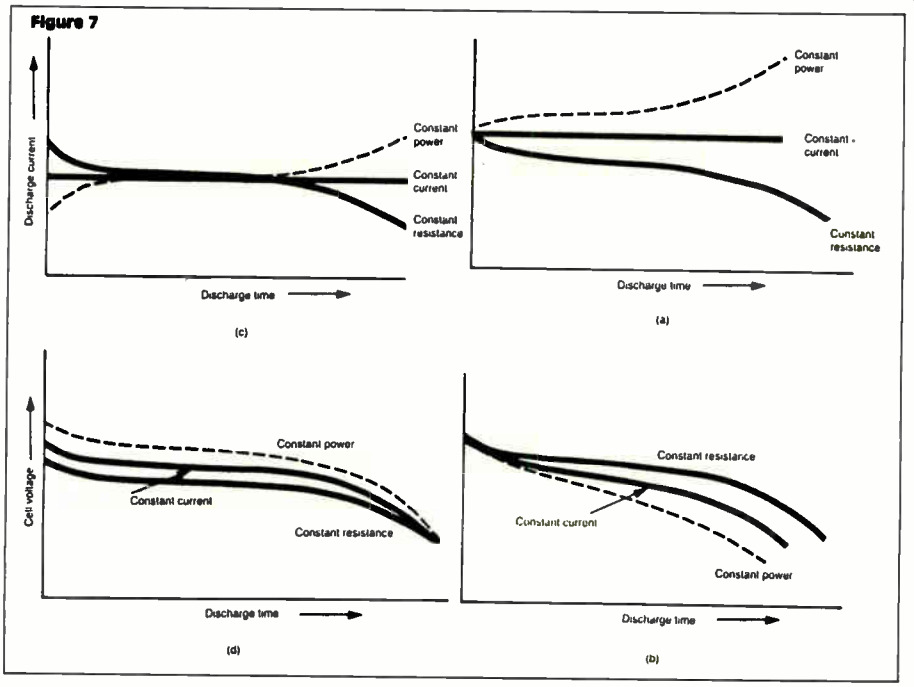
The degree of gassing is a variable depending upon the charger design.

the voltage is maintained constant until the battery is called upon to discharge. It has been found that more than 50mv positive negative over potential is necessary to prevent self discharge. So that .005a float current per 100 ampere hour of capacity is required for lead calcium batteries. Lead antimony cells require at least .06a per 100 ampere hour, but this increases to about .6a per 100 ampere hour as the battery ages. This higher current also increases the water electrolysis depletion rate. This can be attributed to plate grid corrosion and accelerated sulfation. Decisions must be made regarding the current limit and the constant voltage value in accordance with the manufacturer's specifications.

Taper

The taper charging is a variation of the modified constant potential method

Figure 7



A pulse system periodically disconnects the batteries from the charge circuit and performs a voltage check.

using less sophisticated controls to reduce equipment costs. The intial rate is limited, but the taper is such that, if special precautions are not taken, the 2.39 V/cell at 25C may be exceeded prior to the 100 percent return of charge. This method could result in gassing at the critical point of recharge. The degree of gassing is a variable depending upon the charger design. Battery life can be degraded from excessive gassing. The gassing voltage decreases with increasing electrolyte, not ambient, temperature. A correction factor for the actual temperature of the electrolyte should be employed. The end of charge is often controlled by a fixed voltage rather than a fixed current. Therefore, when a new battery, which has a high counter EMF, is used, this battery often does not receive sufficient charge. Conversely, an older battery whose CEMF is low will now receive a higher than normal finishing rate resulting in excessive gassing.

Pulse

A pulse system periodically disconnects the batteries from the charge circuit and performs a high-impedance, no-load voltage check. If the open circuit voltage is above the preset value, depending on the reference electrolyte temperature, the charger is not called upon. When the open circuit voltage decays below that limit, the charger delivers a DC pulse for a fixed period of time.

The duration of the open circuit and charge pulses are chosen so that when the battery is fully charged the time for the open circuit voltage to decay is exactly the same as the charge pulse duration. When the charger senses this condition, it is automatically switched over to the finish rate current and short charging pulses are delivered.

Trickle

This is a constant current simplistic system which delivers a very low current to the battery and is used mainly to overcome the effects of self discharge. There are no provisions for any compensation techniques.

Float

This is a system used to deliver a low rate, constant potential charge. In its purest form it will be found in applications where stationary batteries are used in constant temperature environments.

Conclusions

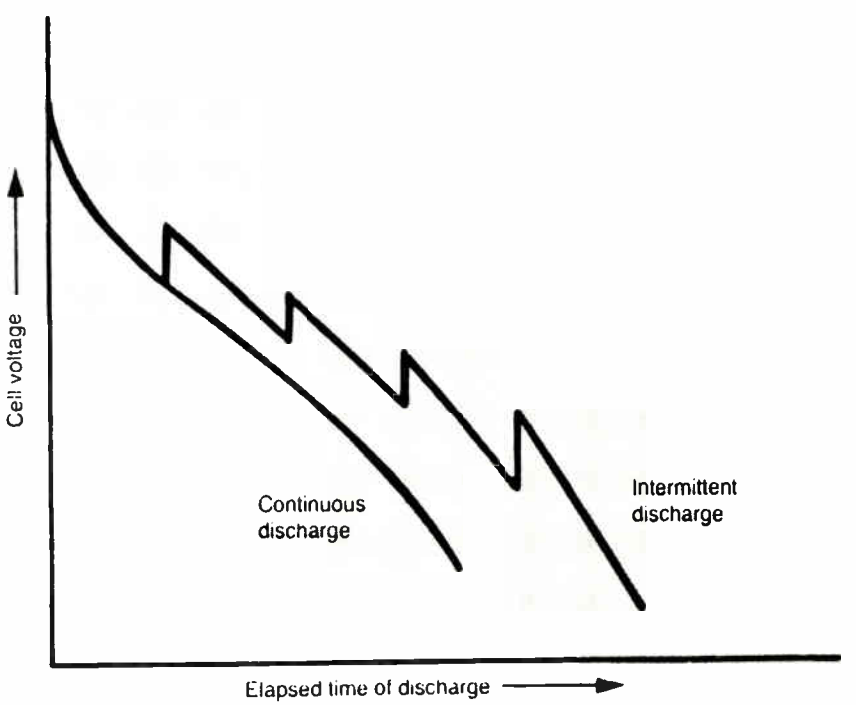
As can be seen from the information given here, wise application of the proper battery for a specific need is of most importance. The cable television industry has basically three cell configurations to choose from. The traditional flooded lead acid battery, the gelled flooded battery and now the SLA configuration. Of the three mentioned, list price comparisons will show that the traditional flooded type has the lowest cost, with the gelled and SLA being competitive with each other. The obvious disadvantage of the flooded type is the need for water replenishment and the overhead cost thereof.

The gelled types can be thought of as "can't maintenance" cells as replenishment of dissipated moisture is impossible. They do have, however, very low gassing rates so as to provide an improved life performance before replacement is required. The SLA technology, as applied to CATV uses, would seem to indicate the best of all available performance characteristics. It can be spoken of as the only true no-maintenance product. Its inability to vent the internal gases obviously will prevent it from dissipating the electrolyte moisture.

References include: *Handbook of Batteries and Fuel Cells*. McGraw-Hill Inc., 1983, ISBN 0-07-037874-6. For other references used in this article, contact Linda Johnson, 600 Grant St., Suite 600, Denver, CO 80203, (303) 860-0111.

By Martin H. de Alminana,
Burnup & Sims Cable
Products Group

Figure 8: Effects of intermittent discharge on battery capacity



CATV services marketplace

Lakeshore CABLE CONTRACTORS, INC.

Aerial & Underground Construction • Splicing
Balancing • Activation • Sweep • Installation • Audit

851 W. LAKETON AVE. MUSKEGON, MICHIGAN 49441

HARRY LAMBERT
President & CEO

TELEPHONE
(616) 759-4594

Reader Service Number 29

Electrodyn INC.

Rebuilding the World of
Converters, Amplifiers, Receivers
Actuators & Distribution Equipment

Mark Adams
President
812/334-1023

917 S. Rogers Street
Bloomington, IN 47401

Reader Service Number 30

STRAND MAPPING
AS-BUILTS
COMPUTER DESIGN
MDU ENGINEERING
MAKE READY SURVEY
DRAFTING SERVICES

L.A.N.-DESIGN
INSTALLATION
CERTIFICATION

Mike Snowdon
DESIGN AND DRAFTING SUPERVISOR

SWEEP BALANCE
HEAD END PROOF
SPLICING
LEAKAGE
TEST-REPAIR

CABLE ENGINEERING, INC.
P.O. Box 4086, Louisville, KY 40204
1-800-334-9684
502-589-5023

Reader Service Number 31

INTRASTELLAR ELECTRONICS
"Quality Converter Repair and Brokerage"

KATHLEEN CLARK
Accounts Director

(312) 658-0300
200 Berg St.
Algonquin, IL 60102

Reader Service Number 32

Cable/Telecommunications Equipment
Sales and Technical Services

FULL LINE CATV SUPPLIER
MID ATLANTIC FACTORY REPRESENTATIVE
AUTHORIZED WARRANTY SERVICE CENTER
EQUIPMENT REPAIR

NCS Industries Inc.
2255-E Wyandotte Rd., Willow Grove, Pa. 19090

800-523-2342
(In Pa. 800-492-2032)
215-657-4690

Reader Service Number 33

E.A. Design, Ltd.
Communications Engineering

Alan N. Katz
Executive Vice President

P.O. Box 483 • 2500 Office Center • Maryland Road • Willow Grove, PA 19090
(215) 657-8330

Reader Service Number 34

SIGNAL LEVEL METER REPAIR
Prompt, Professional Service at Reasonable Prices

JGL ELECTRONICS, INC.
4425 BLACKSTONE DRIVE
INDIANAPOLIS, INDIANA 46237
317/783-8130

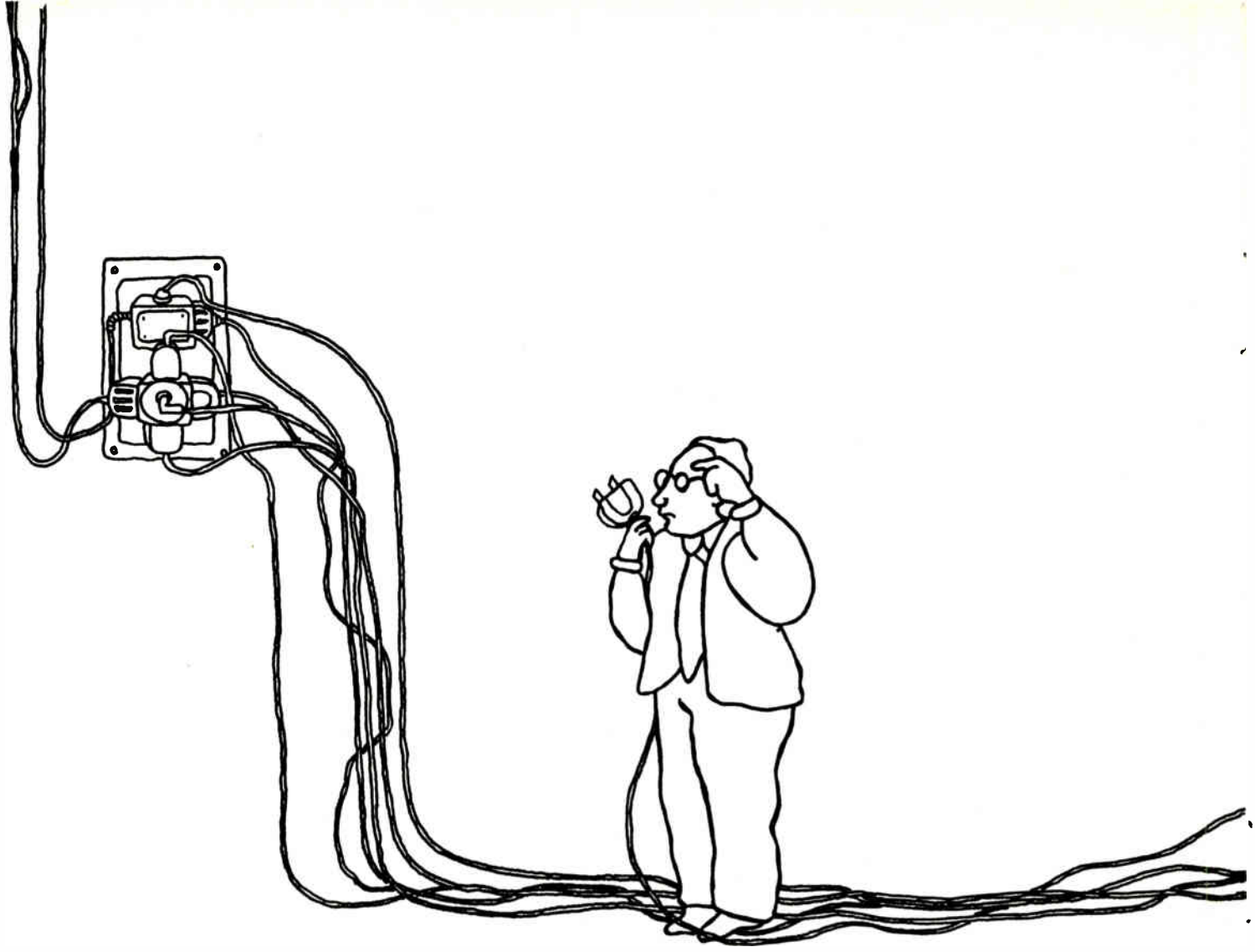
Reader Service Number 35

CED
The magazine of broadband technology

THIS SPACE COULD BE YOURS NEXT TIME. PLEASE CALL:

Judy J. Mouser
Sales Representative
FAX: (303) 837-8625

600 Grant Street, Suite 600
Denver, CO 80203
(303) 860-0111



You choose: frustration or flexibility

Ever try to plug 18 pieces of equipment into a single duplex outlet? Frustrating.

Your Local Area Network can be just as frustrating when it doesn't do the job you expected. And hinders your company's growth instead of speeding it along.

Here's where a simple phone call to TELE-WIRE can help you two ways:

We're experienced communications system integrators who can custom design and implement your LAN from the ground up — tailored to your exact requirements. With built in flexibility and performance that won't leave you frustrated.

Or we can provide all the equipment and cable on a bill of materials — top notch, state-of-the-art equipment — direct from stock in our own regional warehouses. Made by manufacturers like Jerrold, Belden and Microdyne to name just a few.

Either way, you can depend on our 40 years of telecommunications experience to provide you with a high powered communications network that will keep your company competitive in today's high tech corporate climate.

And when you're ready to tie into a satellite broadcast network, so are we. We'll provide the downlinks, uplinks, and all the electronics necessary for voice, video and data transmission.

Whether you're building a Local Area Network from scratch, or upgrading a system that's already in place, depend on TELE-WIRE.

Find out more about our flexibility options in Local Area Networking and corporate satellite communications systems.

Dial (516) 293-7788 today.

TELE-WIRE®
SUPPLY CORPORATION

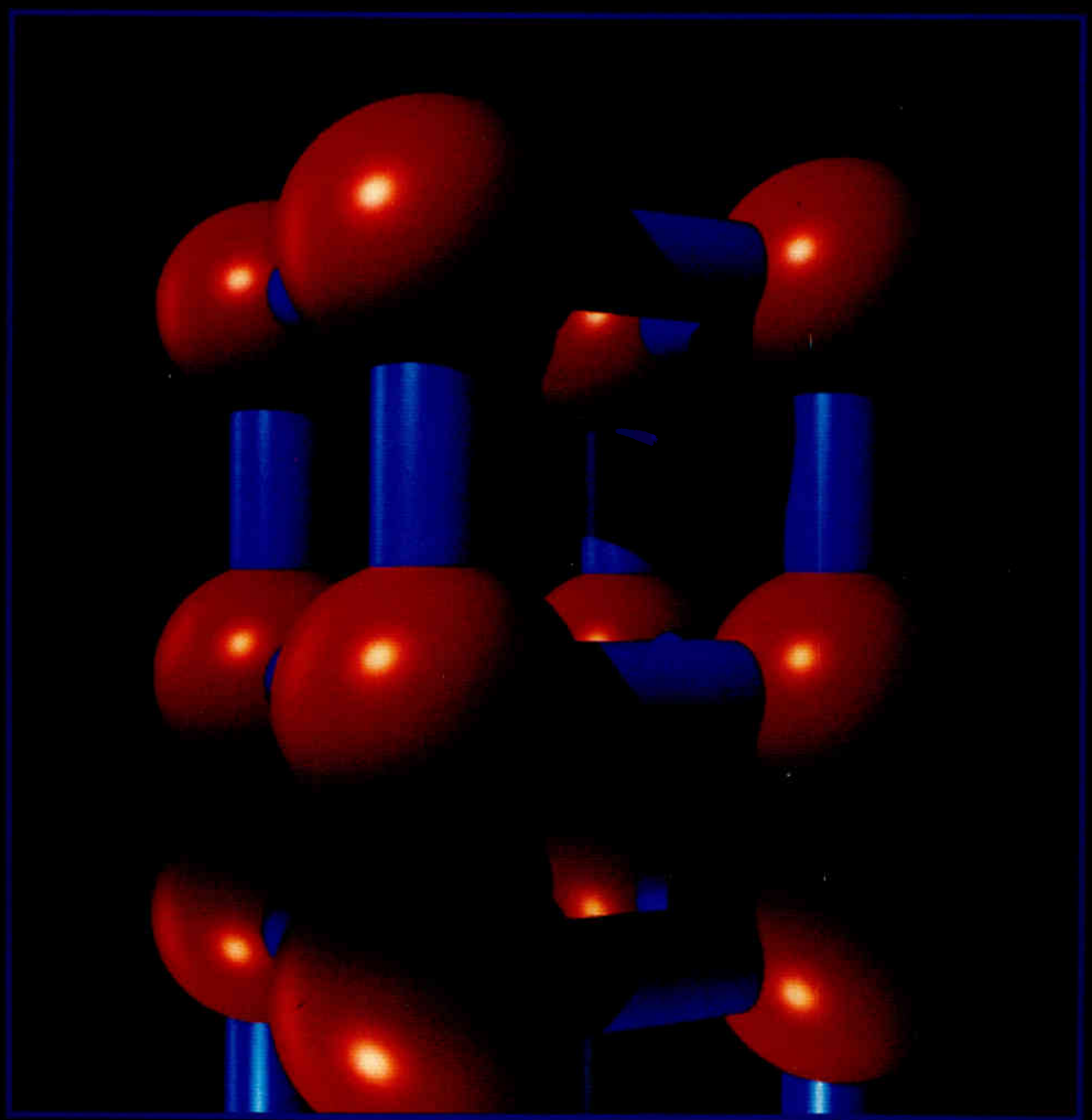
Corporate Headquarters: 7 Michael Avenue, C.S. #6025, E. Farmingdale, NY 11735

Reader Service Number 37

CED's magazine of
local network technology

BroadbandLAN

Who's Who in broadband



Broadband LANs: Who's Who?

Beginning with this issue, CED *launches a new "magazine within a magazine" focusing on broadband technology as applied to local area networks. We do so because campus, factory, military and facility networks based on CATV technology have grown dramatically over the past few years, creating a new information need for specifying engineers who build, maintain and operate LANs. Not by accident, many technical personnel now active in the LAN industry are former CATV engineers and techs. So this new magazine is simply a recognition that broadband no longer belongs exclusively to the CATV world. Over the next several months* CED *will be adding more network managers to its subscriber rolls and expanding editorial coverage of this increasingly important subject.*

Back in 1971, when General Motors first experimented with broadband local area networks to monitor and control energy use at its manufacturing plants, and later in 1973 and 1974 when Dow Chemical and the Mitre Corp. first got interested in 75-ohm technology, LANs probably seemed a somewhat odd, specialized business for the few CATV equipment vendors who were quietly supplying the distribution gear. Not anymore.

Today, the Manufacturing Automation Protocol, based on a 75-ohm CATV standard, is widely predicted to become the dominant communications standard for factory automation. And broadband LANs are finding growing application at universities, hospitals, military and government installations and Fortune 1000-size companies.

The players

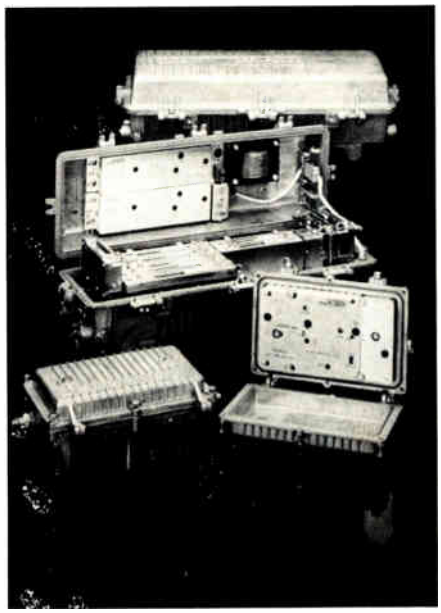
For most companies with roots in CATV, the LAN business means supplying components for, designing, installing, certifying and maintaining LANs. In short, working with the actual physical distribution system, as opposed to supplying software or devices that use the networks.

In general, companies active in the broadband LAN market fall into several categories. There are a relative handful of system integrators, largely

It isn't a sleeply little business anymore.

companies with roots in data communications rather than CATV, that can supply a complete network, including software, modems, remodulators, control consoles, possibly bridges or gateways and network management. In some cases these companies also can put together the specialized device communication capabilities clients may desire. These companies, Sytek, Ungermann-Bass, Concord Communications, TRW Information Networks, Applitek, Kee, Allen-Bradley, Contel Information Systems and Wang, for example, provide more than a turnkey distribution system. They supply a complete local area network.

Typically, system integrators subcontract for the actual installation of network cabling and amplifiers. In some cases, they'll also subcontract for network design and certification services. So there's an additional market for companies that specialize in the design, installation and certification of the physical distribution system. These firms can deliver a fully-installed, tested LAN ready to accept network interfaces and devices, although most stop short of supplying the actual software, modems or other devices that communicate over the network. Companies such as Dinsmore Communications, Tele-Engineering, Videophile, United Teleplex, AM Communications, RTK Communications Group and NaCom are in this category. Others, like RFI Electronics, Clover Electronics, Allied Data Communications and ISN, might more accurately be described as value-added resellers (VAR). They'll build the network as well as supply the modems and other data transmission gear.



Jerrold's distribution amplifier line

Network components

Like system integrators and installation contractors, equipment suppliers face a highly fragmented market, with widely scattered potential buying influences. So, reaching system integrators and installation contractors, particularly the specifying engineer, is important. But some sophisticated end-users are able to design and build their own networks, in which case the buyer could be the actual end-user of the LAN. Here again, it's important to reach the engineering authority who designates actual brands of components to be used in building the LAN.

In the supply area, certain companies, such as Times Fiber/Scientific Atlanta, General Instrument's Network Cable and Comm/Scope divisions, Trilogy, Capscan and Belden specialize in cabling. Others, such as Zeta Labs, EF Data, LanTel or ISC Datacomm, specialize in modems (often referred to as network interface units). Yet others, like General Instrument, C-Cor, Scientific-Atlanta, Magnavox, Broadband Engineering, Quality RF, Texscan, Blonder-Tongue and Lindsay Specialty Products, are known for distribution electronics. Power supplies are the province of Alpha Technologies, C-Cor Electronics, Lectro, Data Transmission Devices and others.

Passive components like taps, wallplates, connectors, couplers and splitters are produced by LRC Electronics, Gilbert Electronics, Broadband Networks, RMS, Regal, Pico Macom, Northern CATV, Eagle Comtronics, Viewsonics and Pyramid Industries, among others. Microwave Filter is a big supplier of a variety of filters used in

Let General Instrument Guide You Through The Maze Of Local Area Networking

Choosing the right technologies and vendors for your Local Area Network can be like trying to find the right path through a hedgerow maze in an old English garden. Should it be broadband, baseband, fiberoptics or twisted pair?...Our experience says your best choice is broadband...and with General Instrument you get the convenience and value offered by the leader in broadband LAN distribution products for over 35 years.

Broadband Turns Your Communications Maze Into A Smooth Flowing Network

Much like a system of highways and roads, broadband delivers two-way traffic, in the form of data, voice and video signals to and from remote user locations. A broadband network provides for hundreds of data, voice and video channels on a single coaxial cable. It readily supports a wide variety of services between multiple points over distances up to 40 miles.

We've Already Put Hundreds Of Users On The Right Path

You'll find our broadband network products working for a wide variety of customers...from America's largest auto makers to legislative centers in Washington and abroad...from the nation's leading hospitals to high-security government and military installations ...from space flight monitoring facilities to major Ivy League and State Universities.

For a detailed explanation of how General Instrument can turn your communications maze into a smooth flowing network, write for our broadband LAN brochure today. It's bound to put you on the right path!

GENERAL INSTRUMENT

Jerrold Division-LAN
2200 Byberry Road
Hatboro, PA 19040
(215) 674-4800

Reader Service Number 38

If an end-user really is serious about acquiring his or her own components, a full-line distributor is helpful.

Zenith's Z-LAN-500BRG bridge

broadband LAN equipment.

To certify, test and maintain broadband LANs, RF test instrumentation is needed. Suppliers of test gear include Wavetek Indiana, Vitek, Comsonics, Sadelco, Texscan Instruments, Applied Instruments, CaLan, Biddle Instruments and Wideband Engineering, for example.

Full-line distributors

Of course, if an end-user really is serious about acquiring his or her own components, a full-line distributor that can supply everything from cabling and passives through amplifiers and test equipment is helpful. Anixter Communications, Merit Communications (a division of Cable TV Supply), CWY Electronics or NCS Industries are some firms that can do so. Anixter, the industry's real powerhouse in this area, also offers inventory management services from its nationwide network of stocking locations. With long experience supplying both the CATV and telephone industries, Anixter can supply broadband, twisted pair, fiber optic, Ethernet, IBM cabling system—in short, just about everything at the physical layer—for just about any type of network.

Engineering support comes from some installation contractors, all system integrators, most distribution gear manufacturers and many consultants.

Certain products, like bridges and gateways, which allow different broadband networks to be linked, link broadband and other types of LANs, or connect broadband nets and the public telephone network, are produced by a few manufacturers, like Bridge Communications. All system integrators will offer gateway and bridge products.

Also, to the extent that particular LANs have satellite video reception needs (for teleconferencing, continuing education or internal company communications, for example), satellite system houses like Scientific-Atlanta, Standard Communications, General Instrument, Channel Master and others also are providing equipment for the LAN industry.

So what might have seemed like a sideline business back in the early

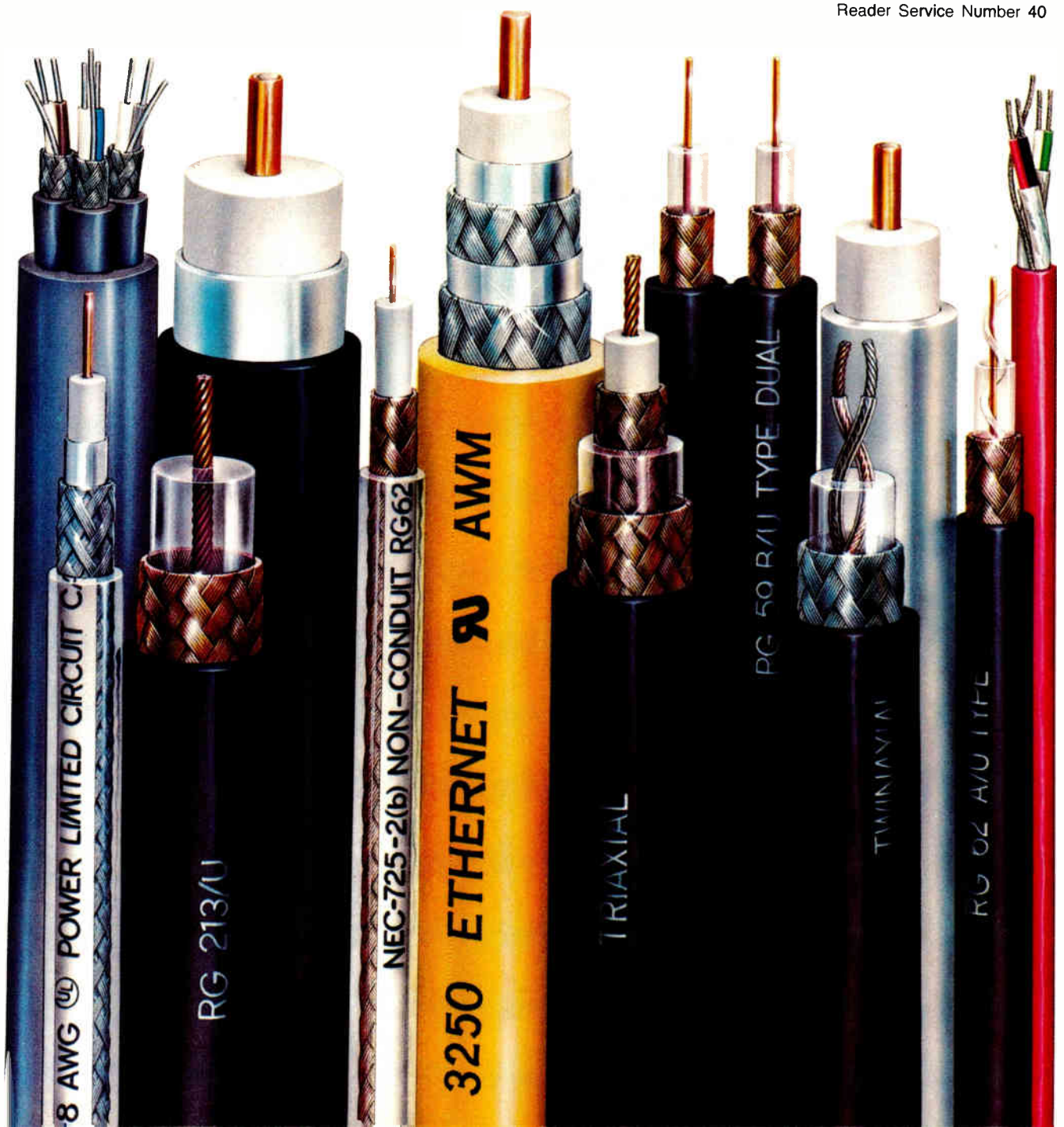
A BETTER LINE FOR EVERY LINE OF BUSINESS.

GENERAL INSTRUMENT advanced network cable lines are designed to meet the strict demands of today's network market. We manufacture a wide range of plenum products. And our lineup for data transmission, industrial, military and telecommunications applications is also impressive. Whether it's 50 ohm, 75 ohm, 93 ohm, 125 ohm balanced video cables in various sizes, or multi-conductor data cables — or if you require highly shielded coaxials, twin-axials or triaxials — GENERAL INSTRUMENT has it. And can deliver it fast! So for your next design specify our line. Call or send for our free catalog today!

NETWORK CABLE DIVISION
P.O. Box 1729 • Hickory, NC 28603
800-982-1708 • (704) 324-2200 • Telex 802-166

GENERAL INSTRUMENT

Reader Service Number 40



New LAN OTDR maps fiber optic cable routing

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

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

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

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

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

Reader Service Number 41

Most, but not all, installation contractors will design, install and certify a broadband LAN.

1970s now is a true business in its own right.

Complete networks

Some of the available broadband LANs are general purpose networks while others are optimized for factory automation, PC or IBM data processing environments. Of particular interest to the broadband community is the development of MAP, a set of standards codified as IEEE 802 committee standard 802.4, which specifies broadband as the backbone medium and token-passing as the network access protocol.

Zenith Electronics is one of the vendors with a general purpose LAN. It released the Z-LAN system in 1986. The modems it uses are frequency agile and transmit at 500 kbps, use BPSK modulation and operate at all frequency splits.

Sytek, based in Mountain View, Calif., was an early leader in broadband LANs, and has a family of general purpose LANs aimed at large computer-using organizations. In addition to the LocalNet general purpose LAN, Sytek has the System 2000, suitable for medium and large-scale networks. It also can be adapted for MAP applications. A PC network, the System 6000, and the terminal-to-host System 3000 and System 7000 systems (compatible with IBM's 3270 standards) also are available. Sytek features a secure, data encrypted transmission format.

Ungermann-Bass, based in Santa Clara, Calif., is a leading general purpose LAN vendor that got its start with Net/One, which runs the Ethernet protocol. It also has versions running on broadband, fiber optic and "thin" RG-58 cable. In conjunction with General Electric, U-B has a joint venture called Industrial Networking Inc. that specializes in MAP networks.

Marlboro, Mass.-based Concord Communications, in fact, is so confident of the future of MAP that it's staked its entire product line on the 802.4 standard. Concord can supply the modems, headend translators, bridges, host interfaces and network analyzers to support MAP networks.

TRW Information Networks Division, based in Torrance, Calif., is a supplier of the Concept 2000 general purpose LAN, whcih uses broadband backbones but also connects to Ethernet-protocol subnetworks, either remotely or locally.

Agile Systems, based in Carrollton, Texas, specializes in second-source supply of Sytek-compatible hardware.

Allen-Bradley, of Ann Arbor, Mich., can provide both a general purpose LAN, the VistaLAN, as well as a MAP-compatible network, the VistaMAP. With deep roots in the factory automation market, Allen-Bradley has particular expertise in industrial applications.

Applitek, of Wakefield, Mass., offers the UniLAN, operating on broadband, fiber optic or baseband cable at 10 Mbps.

Bethesda, Md.-based Contel Information Systems sells the ContelNet, with a 2 Mbps CSMA/CD network. The company specializes in Ethernet over broadband applications, using Bridge, DEC and 3Com gear.

Gould Inc.'s Programmable Control Division has a specialized industrial LAN called Modway that allows Gould's controller line to be run over MAP networks.

Kee Inc., of Beltsville, Md., specializes in networks running the defense department TCP/IP protocol, IBM SDLC and HDLC formats, terminal-to-host, PC-to-PC or host-to-host traffic.

M/A-Com Telecommunications, of Germantown, Md., specializes in running Ethernet over broadband. Its EtherPlus system transmits at 10 Mbps.

Wang Laboratories offers both the WangNet and FastLAN, capable of supporting both Wang and other broadband modems. The FastLAN is basically a pre-fabricated, easy-to-install version of the WangNet, designed for smaller networks.

Installation contractors

Most, but not all, installation contractors will design, install and certify a broadband LAN, stopping short of involvement with network software and modems. Most also will provide maintenance if geography permits. But a few of the contractors are more accurately described as "value-added resellers" since they will install the network as well as recommend and

Did you know that Broadband Engineering builds an amplifier for every LAN system requirement?

It might surprise you to learn that we are the most innovative supplier of LAN amplifiers. That comes from listening to our customers and designing amplifiers that meet their requirements.

To meet our customers needs, we build rack mounted amplifiers for single and dual cable networks, a mid-split amplifier with a weatherproof housing and a highly efficient switchmode power supply. We also have mid-and high-split indoor distribution amplifiers.

Our rack mounted amplifiers are AC or DC powered. DC powered units are built for use with communications battery powering systems.

Another unique LAN product is our network expander for expansion from a single port to four ports. The network expander allows more terminals on an existing network without adding taps.

To find out about our full line of LAN products or for LAN application assistance, give us a call.

Call toll free at 800-327-6690. In Florida, call 305-747-5000 or write us at 1311 Commerce Lane, Jupiter FL 33458.

AUGAT® BROADBAND
Quality and Innovation

A part of the growing Augat Communications Group

Reader Service Number 42

Many firms with deep roots in CATV now are active in the LAN market.

provide the modems, amplifiers and headend translators required to make the network work.

Clover Electronics, based in Novi, Mich., was founded in 1952 primarily to install microwave and TV systems for schools, hospitals, the Archdiocese of Detroit, General Motors and Ford. It established an early tie with General Instrument and continues to rely on GI for distribution electronics. Clover can provide the specialized communications requirements for MAP, Ethernet over broadband or general purpose networks. Its focus remains the Midwest, although it operates nationally and in Mexico and Canada, primarily in the factory, hospital and campus markets. About 70 percent of its business is industrial, about 10 percent government, about 20 percent hospital and university.

On the West Coast, RFI Electronics got its start in 1979, installing security systems. In 1981, however, it became very active in LAN installations, especially broadband, and also is a VAR. It'll typically use Sytek modems, General Instrument and C-Cor distribution actives, Times Fiber cabling and Anixter as the primary supplier.

Norcross, Ga.-based Allied Data Communications also is an active VAR/installer. The firm has installed more than 150 networks and provides design, installation, certification and maintenance services.

Clover, RFI and Allied never were active in CATV installation. But many firms with deep roots in CATV now are active in the LAN market. Dinsmore Communications, in Portland, Maine, got its start in 1979 doing CATV installations. But in 1982 it became a Wang-certified LAN installer, wiring Wang's Lowell, Mass. headquarters. It also installs for Digital Equipment Corp., doing Ethernet LANs, mostly.

Where to find them

Here are telephone numbers for companies mentioned in this story.

Agile Systems (214) 242-4307
Allen-Bradley (313) 668-2500
Allied Data Comm. (404) 923-4866
Alpha Technologies (206) 647-2360
AM Communications (215) 536-1354
Anixter (312) 677-2600
Applied Instruments (317) 782-4331
Applitek (617) 246-4500
AtLANta Technologies (404) 984-9095
Augat Communications (206) 223-1110
Belden (312) 232-8900
Biddle Instruments (215) 646-9200
Blonder-Tongue (201) 679-4000
Bridge Communications (415) 969-4400
Broadband Engineering (800) 327-6690
Broadband Networks (814) 237-4073
Cablemasters Corp. (814) 774-2616
C&S Construction (412) 935-1553
Cable Services Co. (800) 233-8452 or (800) 332-8545 (in Pa.)
Cable Power (206) 882-2304
Cable TV Supply (213) 202-2700
CaLan (717) 828-2356
Capscan (201) 462-8700
Cavision (513) 667-4416
C-Cor (814) 238-2461
Channel Master (919) 934-9711
Chipcom (617) 890-6844
Clover Electronics (313) 471-0200
Cable Communications Technology (303) 423-0050
Comsonics (703) 434-5965
Concord Communications (617) 460-4646
Contel (301) 654-9120
Control Technology (214) 272-5544
CWY Electronics (317) 448-1611
DLM Enterprises (404) 426-6852
Data Transmission Devices (617) 532-1884
Dinsmore Communications (603) 436-6344
Dovetail Systems (215) 691-0100
Eagle Comtronics (315) 622-3402
EF Data (602) 968-0447
English Enterprizes (305) 841-7210
Fairchild Data (602) 949-1155
General Instrument/Jerrold (215) 674-4800
General Instrument/Comm/Scope (704) 324-2200
Gould (617) 475-4700
Hewlett Packard (408) 257-7000
IFR Systems (316) 522-4981
ISC Datacom (408) 748-7616
ISN (301) 469-0400
Kee Inc. ((301) 937-4740
Kennedy Cable (912) 557-4751
LRC Electronics (607) 739-3844
Lanca Instruments (512) 388-1195
Lanetco (404) 263-8082
LanTel (404) 446-6000
Larson Electronics (817) 387-0002
Leader Instruments (516) 231-6900
Lectro (404) 353-1159
Lindsay Specialty Products (705) 324-2196
M/A-Com Telecommunications (301) 428-5820
Magnavox (315) 682-9105
Microwave Filter (315) 437-3953
Nacom Corp. (614) 895-1313
NATCOR (313) 544-7771
NCS Industries (215) 657-4690
Northern CATV (315) 463-8433
Pico Macom (818) 897-0028
Power Guard (404) 354-8129
Quality RF (305) 747-4998
Radyne Corp. (516) 567-8484
Regal (312) 677-2600
Riser-Bond (402) 694-5201
RFI Electronics (408) 298-5400
RMS Electronics (212) 892-1000
Scientific-Atlanta (404) 441-4100
Standard Communications (213) 532-5300
RTK Lanstall Div. (215) 696-1800
Sadelco (201) 569-3323
Sytek (415) 966-7330
Tektronix (503) 627-7111
Tele-Engineering Corp. (617) 875-3137
Tele-Wire Supply (516) 293-7788
Texscan (915) 594-3555
Texscan Instruments (317) 545-4196
Trilogy (601) 932-4461
Times Fiber (203) 265-8500
TRW Information Networks (213) 373-9161
U.S. Cable (414) 733-3321
Ungermann-Bass (408) 496-0111
United Teleplex (303) 429-2181
Videophile (303) 770-7000
Vitek (607) 796-2611
Wang Laboratories (617) 459-5000
Wavetek (800) 622-5515
Wideband Engineering (602) 254-1570
Zenith Electronics (312) 699-2100
Zeta Labs (408) 727-6001

The LAN division of Nacom Construction Corp. also is actively pursuing network cabling jobs.

But the firm also can handle twisted pair and fiber optic cabling systems. Dinsmore can operate nationally but concentrates on the Northeast, and already generates 50 percent of its revenue from LAN installations. Most of the company's 300 installs have been WangNet or DECconnect networks. "Word-of-mouth, repeat business and referrals" are a main source of new business, says Dave Walters, principal. The business really took off between 1984 and 1985, as interest in broadband really began to grow.

Lanetco Communications Group, based in Norcross, Ga., is an engineering services firm that can design, install and certify broadband, fiber optic, baseband and twisted pair networks.

And new firms, generally founded by personnel with CATV installation experience, still come into the market. Arvada, Colo.-based Cable Communications Technology was started last year by the principals of a company known as Precision Cable. CCT will undertake design as well as installation jobs anyplace in the continental United States and has, between its principals, about nine years LAN experience and over 40 years in CATV installations. Its personnel have worked for RFI Electronics, Storer Cable, Videophile and a military network contractor based in Denver called SSDS. Broadband is the company's center of gravity, although it will undertake fiber and other cabling jobs.

RTK Communications Group is a major player in CATV installation and has a division, LANstall, that specializes in LANs. Operating out of West Chester, Penn., the company can install a turnkey network, local or wide area, using twisted pair, coaxial cable, fiber optic or satellite technology.

Cable Services Company, based in Williamsport, Pa., also is a firm that can supply a turnkey network. It designs, engineers and stocks distribution gear from industry suppliers.

The LAN division of Nacom Construction Corp. also is actively pursuing network cabling jobs. The firm has been in the field of broadband installation for more than 15 years and has experience with coax, fiber and twisted pair in a variety of settings. Based in Columbus, Ohio, the company operates nationwide.

A node-based status monitoring product is a unique product put out by AM Communications, a Quakertown, Pa.-based company that provides turnkey design and engineering. Unlike most installation firms, it has a history of modem engineering and communication system design.

NATCOR is a recently founded company installing LANs, especially military and videoconferencing systems. New World Systems of Westfield, Mass. also specializes in satellite networks in addition to broadband.

System integrators manufacture their own modems, or will use other product in conjunction with their own modems.

Videophile and United Teleplex, both based in Denver; C&S Construction of Warrendale, Penn.; U.S. Cable Inc. of Appleton, Wis.; Tele-Wire Supply, recently merged into Anixter Communications; DLM Enterprises of Marietta, Ga.; AtLANta Technologies of Atlanta; Cavision Communications of Tipp City, Ohio; Kennedy Cable of Reidsville, Ga.; English Enterprizes of Orlando, Fla.; and Cablemasters Corp. of Lake City, Pa. are some of the firms active in LAN installations.

C&S Construction, like several other installation firms with experience in CATV, has formed a distinct operating unit to handle LAN jobs. Called Netcon, the group got its first job in September 1985.

The Navy installation links 50 buildings, and Netcon is providing the distribution gear as well as doing the install. Last year the company also become a distributor for General Instrument.

Modems

All system integrators manufacture their own modems, or will use other product in conjunction with their own modems. However, it's also possible to buy modem products independently. Broadband modems come in point-to-point and networked versions; using either synchronous or asynchronous data formats; transmitting data or voice; using fixed or assignable frequencies. Various modulation techniques are used. Frequency Division Multiplexing (FM), Quadrature-Phase Shift Keying (QPSK), Frequency Shift Keying (FSK), Bi-Phase Shift-Keyed carrier (BPSK) and Quadrature Amplitude Modulation (QAM) are a few commonly used techniques.

FSK uses two different frequencies to represent the 1 and 0 bits and is normally used to move data at relatively low rates. BPSK uses 90-degree shifts in the phase of the carrier to represent the 1 and 0 bits: positive 90 degrees for "1" and negative 90 degrees for "0". QPSK shifts the phase of the carrier into one of four states, allowing a significant compression of the bandwidth required to transmit. QAM uses phase and amplitude modulation to run two signals at the same frequency, but 90 degrees out of phase with each other.

LanTel, the Norcross, Ga.-based manufacturer of point-to-point voice and data modems, is in fact the only vendor of telephone-type voice products for broadband networks. The company, initially founded in July of 1984, has had a line of voice products using ring-down circuits (no dial tone; the phone is active when removed from the cradle) for some time. This year, however, it introduced its first switched voice product, the Series 800, which begins to offer users the types of features, such as call hold, call transfer, camp-on, auto-dial and conference calls, that are associated with PBX-

General Instrument is, without question, a leader in distribution systems for broadband LANs.

type products.

General Instrument is, without question, a leader in distribution systems for broadband LANs. But it also manufactures a frequency agile, point-to-point data modem, operating at mid-split and high-split channel pairing in both synchronous and asynchronous modes, as well as high speed (1.544 Mbps) T-1 modems using a synchronous data format and transmitting point-to-point.

C-Cor Electronics, which was quick to see the emergence of the broadband LAN market, likewise ranks among the leaders in distribution systems. But it also has a line of point-to-point data modems, operating with sync and async formats, transmitting at 9600 bps and operating on mid-split or sub-split systems.

Santa Clara, Calif.-based Zeta Laboratories has earned a reputation for reliability with its line of point-to-point modems, running at data rates from 19.2 to 64 Kbps. Zeta's products operate in sync or async modes, using BPSK or QPSK modulation at any frequency split. Zeta's equipment can be configured to transmit or receive at any frequency between 5 MHz and 350 MHz. The firm's also coming out with a line of backup power supplies for its modem line, frequency translators and rack assemblies.

A new point-to-point modem supplier, ISC Datacom, also is based in Santa Clara. Its first two products are the Model 1019 modem, transmitting at 19.2 Kbps, and the 1056 modem, transmitting at 56 Kbps. Both use QPSK modulation. The 19.2 version is available in either sync or async formats while the 56 Kbps version is synchronous. Both have nine transmit and seven receive frequency bands. Both models are controllable either remotely or locally.

Chipcom, the Waltham, Mass. company founded in 1983 for the specific purpose of manufacturing RF modems, has a line of Ethermodem products that run the Ethernet protocol over broadband networks. Transmitting at 10 Mbps, Chipcom offers five frequency ranges, all of which avoid conflicts with other popular networks such as Sytek, MAP, and the IBM PC network. Using the Ethermodem remodulator, two of the five ranges can operate simulataneously with all three MAP channels.

Tempe, Ariz.-based EF Data Corp. makes a family of BCM-1-1 modems, synchronous point-to-point devices that transmit from 56 Kbps to T-1, T-2 and T-3 rates. All are frequency agile. The T-1 version sells for $3,450 in single quantities. The standard operating range is 5 MHz to 400 MHz in 50 kHz steps.

Scientific-Atlanta, a traditional industry leader in satellite and distribution electronics, has a T-1 rate point-to-point modem using QAM modulation,

LAN products/ services marketplace

BROADBAND NETWORKS, INC.

± 1.5 dB PATH LOSS SYSTEMS
SPLIT-BAND TAPS
1.5 dB TAPS
SPLIT-BAND EQUALIZERS

P.O. BOX 8071, STATE COLLEGE, PA 16803
PHONE 814-237-4073

Reader Service Number 46

LANetCO GROUP INC.

CONSULTING ●
PROJECT MANAGEMENT ●
SYSTEM DESIGN ●
TRAINING ●

The Communications Engineering Service Company

6165 CROOKED CREEK ROAD
NORCROSS, GA 30092
(404) 263-8082

Reader Service Number 50

ERROR FREE EF DATA

Fully synthesized broadband cable and microwave modems

EF DATA CORP.
(602) 968-0447

1030 N. Stadem Dr.
Tempe, AZ 85281

Reader Service Number 47

HYPOWER·LANS

DISTRIBUTED BY ADVANCE Telecom Inc
SCOTTSDALE ARIZONA (602) 998-4441

Maintenance Free, Sealed Batteries are ideal for:

CABLE TELEVISION	ALL UPS, INSIDE USAGE	LOCAL AREA NETWORK SYSTEMS
COMPUTER SYSTEMS	TELEPHONE SYSTEMS	SECURITY SYSTEMS

14405 N. Scottsdale Rd. Scottsdale, AZ 85254 602-998-4441

Reader Service Number 51

Burnup&Sims
Lectro/Capscan

Steve Wagner
Vice President
Sales & Marketing

Power Supplies & Coaxial Cable for LAN & CATV

Cable Products Group • 8000 E. Prentice Ave., Suite C-5
Englewood, CO 80111 (303) 694-6446
CAPSCAN 800-222-5388/LECTRO 800-551-3790

Reader Service Number 48

Robert V. C. Dickinson
President

Dovetail Systems Corporation

Ben Franklin Technology Center
125 Goodman Drive
Bethlehem, PA 18015
(215) 691-0100

Reader Service Number 52

BROADBAND IS OUR LINE

C-COR® ELECTRONICS INC
60 DECIBEL ROAD
STATE COLLEGE, PA 16801
814-238-2461
TELEX: 510-670-3513

LAN AMPLIFIERS
STATUS MONITOR SYSTEM
MODEMS
POWER SYSTEMS

Reader Service Number 49

Aerial and Underground
L.A.N. CATV and Fiber
Optic Construction and
Installation Services

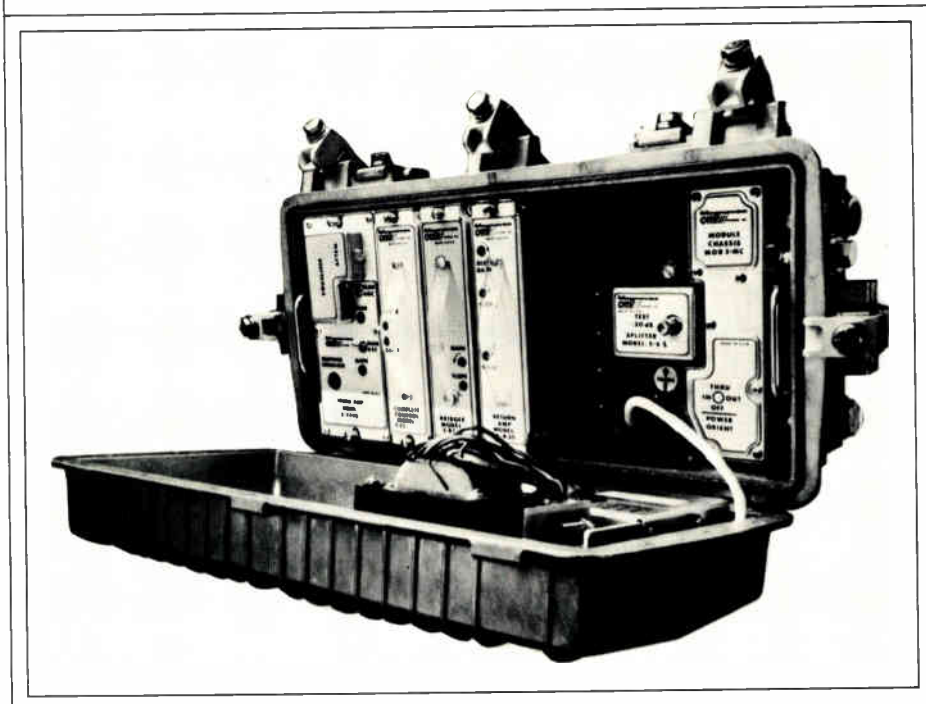
2184 Rice Ave.
Lake City, PA 16423

Cablemasters Corp.

814-774-2616

Reader Service Number 53

In the LAN environment, it's almost imperative that backup power be provided to the network.



Magnavox's 440 amplifier

operating synchronously, user-programmable for transmit level, transmit and receive frequency, diagnostics, identification and status.

Scottsdale, Ariz.-based Fairchild Data Corp. has a frequency agile, point-to-point synchronous M505 RF modem transmitting from 56 Kbps to 10 Mbps in 50 kHz steps. It operates over the 5 MHz to 400 MHz frequency range and uses QPSK modulation. Fairchild also produces versions of its modems adapted for MAP networks.

Radyne Corp. has the frequency agile, synchronous CMS-1200 modem which uses QPSK modulation, operates at 32 Kbps to 15 Mbps from 4 MHz to 440 MHz in either 50 kHz or 100 kHz steps. The Bohemia, N.Y.-based firm also has a line of broadband modems.

Amplifiers

LANs are designed using the same signal level, distortion and noise levels as CATV networks. Jerrold, for example, recommends 56 dBmV into the network from all outlets; 6 dBmV delivered to each outlet, across the entire bandpass; C/N running from 57 to 43 dB; hum modulation not exceeding two percent; carrier-to-second order of -60 dB or better; carrier-to-CTB of -53 dB or better; outlet isolation of 20 dB or better; peak-to-valley response of 3 dB; headend signal level of 32 dBmV in the forward path and 37 dBmV in the return path; and response flatness of 1 dB.

There are, however, some differences in amplifier selection. It is relatively uncommon to design a LAN using 550 MHz to 600 MHz equipment for the top operating frequency. And under most circumstances, feedforward wouldn't be the technology of choice. Most LAN applications simply don't have the requirements for system reach or bandwidth to justify the cost of either feedforward or 550 to 600 MHz technology. And since some networks are small enough to use a maximum of two line extenders, LEs can be a practical, cost-effective choice. GI's Helmut Hess, applications engineer, recommends using "as many LEs as you can get away with." Commonly used amplifiers in the LAN setting would include the Jerrold X-2000 mainstation, JLE-7-451-HS or JLE-MS-450-HG or JLE-MS-450 line extenders.

C-Cor Electronics product fitting the bill would include the LAN-100 with 5 to 112 MHz return passband and LAN-101 with 5 to 186 MHz return passband. Also recommended for CATV institutional networks or extraordinarily large LANs are the model T-5XX series and FT-5XX feedforward trunk amplifiers.

Scientific-Atlanta has the Series 6560 mid-split trunk amplifier line, the Series 6570 high-split line, Series 6550 line extenders and the 6501, 6502 and 6810 distribution amplifiers.

Magnavox carries the series 108 mid-split trunk amplifier line (with a 108 MHz split) as well as the series 174 mid-split line (with a 174 MHz split). Magnavox's mid-split line extender offerings include the 108 and 174 versions.

All the mainstation manufacturers offer status monitoring, automatic gain and slope control modules and other accessories.

Broadband Engineering, part of the Augat Communichathionhs Group, has a hnew model DAX mid-split data amplifier with 30 dB forward and reverse gain, 5 to 112 MHz return and 150 to 450 MHz forward passband. It will be available in July. The company also sells a custom headend for LANs, including redundant amplifiers, DC power, battery charger and test point panels for around $9,500.

The Data-200 LAN amplifier, the Data-450 LAN amplifier, VFA-200 and VFA-450 amplifiers, the BDA-450-2W amplifier and NE-4 LAN Network Expander are part of Broadbafnd'sa LAN nproduct line.

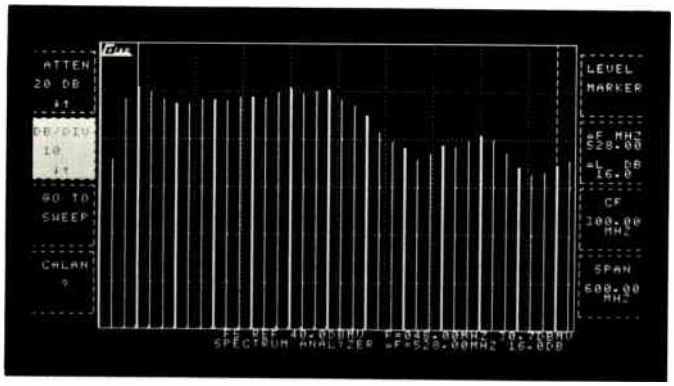
Texscan's mainstation line is the T Series, offering 300 to 450 MHz bandwidth. Line extenders in the T Series also are available.

Standby power

In the LAN environment, it's almost imperative that backup power be provided to the network. For broadband applications, this will involve standby or uninterruptible power supplies (UPS). Standby units provide power to the LAN when AC power fails for any reason. Uninterruptible units go a step further and are designed to kick on within milliseconds of any sensing of loss of AC power. UPS normally also includes power conditioning. Standby units without high-speed transfer

How to Improve the PICTURE QUALITY of Your Data Carriers:

PICTURE 1
Spectrum Display



PICTURE 2
Frequency Response

Performance degradation on a broadband network can result in a significant expense in lost information. But how do you monitor your system when traditional sweep equipment adds its own problems?

Introducing the CALAN, Inc. Model 1776/1777 Sweep System/Spectrum Analyzer.

Frequency response testing has never been easier. The Model 1776/1777 protects the carriers on the system, allowing continuous frequency response testing even during heavy system loading.

600 MHz Spectrum Analyzer

As if precision frequency response measurement isn't enough, a 5-600 MHz Spectrum Analyzer in the same portable package reads Carrier Levels, Carrier-to-Noise, Intermodulation, and Ingress — all with the same instrument.

Included is direct entry of the Center Frequency and Frequency Span, digital markers to verify the absolute level, and a Peak Hold mode which allows readings even on randomly-keyed carriers.

Now, your testing can be on your schedule — when you want, and where you want, with 12 VDC battery or 110 VAC line operation. Plus, the 1776 is weather-sealed to operate even under extreme conditions.

Isn't it time you had the advantage of picture-perfect maintenance capability? You might even grow to enjoy watching your data.

Picture that.

CALAN
CABLE AND LOCAL AREA NETWORKS

CALAN, Inc.
R.R. 1, Box 86T
Dingmans Ferry, PA 18328
(717) 828-2356

Reader Service Number 62

New taps and wallplates are examples of how the growing broadband LAN business has spurred product innovation.

switches (which kick on within 4 to 10 milliseconds) might not kick in fast enough to prevent loss of data that isn't stored in individual work stations or in transit. Uninterruptibles generally work quickly enough to prevent loss of data at workstations that hasn't been saved (is in active memory).

Typically, standby units come in a metal enclosure and contain batteries, chargers, square wave inverters and a high speed switch. Under normal AC powering conditions, the inverter is in a state of rest. When AC voltage drops past a predetermined point (15 percent, for example), the load is switched to the inverter, which draws DC from the batteries and converts the power to AC. When AC returns, the load is transferred back to the line, the inverter is shut off and the batteries are automatically recharged.

A UPS is typically on-line continuously and maintains output voltage with a percentage of nominal (possibly ±three percent). The UPS consists of a rectifier/charger, battery and inverter and normally converts commercial AC power to DC. DC then is used to charge the battery and in turn the inverter, which reshapes the DC into AC. When AC line power drops, the batteries kick in to compensate.

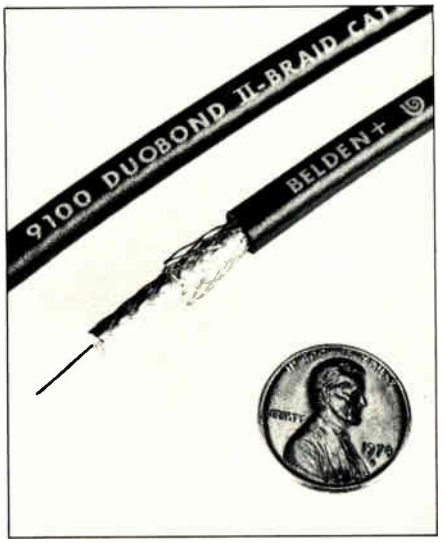
Alpha Technologies, a traditional leader in power supplies for broadband, offers both standby and UPS supplies as well as line power conditioners. Alpha's standby unit switches from AC to DC in less than four milliseconds. Lectro Products offers several products, including the Super Sentry and Sentry II standby supplies. The switch from AC to DC typically takes 15 to 20 milliseconds. C-Cor Electronics offers a supply that switches from AC to DC in less than 16 milliseconds. Cable Power's unit switches in eight to 16 milliseconds; Control Technology's in 15 milliseconds; Data Transmission Devices in 10 milliseconds; Larson Electronics in 0.5 milliseconds; Powerguard in 15 milliseconds; and RMS Electronics in 16 milliseconds.

Cabling

Trunk cabling typically used in LAN applications ranges between 0.412 and an inch in diameter and usually run 0.500 inches or larger in size. For feeder applications, 0.500-inch cabling is commonly used. Drops are RG-11 or RG-59. Inside buildings, compliance with the National Electrical Code is required, and that means either running PVC cable inside conduit or using teflon-coated cabling.

Flooded cables are available for direct burial applications, as are jacketed and armored cables, cables with built-in messengers (support cabling), air or foam dielectric. Some drop cables come color-coded to aid tracing.

General Instrument's Comm/Scope Division, Scientific-Atlanta and Times Fiber, Trilogy, Capscan and Belden are the major manufacturers of 75-ohm



Belden Duobond drop cable

cabling products. Orders can be made either directly from the manufacturers or through their distributors (Anixter, Cable TV Supply, CWY and others).

Passives

New taps and wallplates are examples of how the growing broadband LAN business has spurred product innovation. Broadband Networks, for example, is producing a line of split-band taps featuring upstream and downstream control of tap loss values in 1 dB steps. Mid-split and high-split versions are available. Eight tap values, from 11 to 33 dB are available.

LRC Electronics, one of the Augat Communications Group companies, also has a new Accu-Tap, a directional coupler offering 1 dB adjustments (14 dB to 45 dB in a four-way coupler; 17.5 dB to 48.5 dB in an eight-way coupler). The Accu-Tap also has an RF and AC bypass switch, allowing 24-hour maintenance without affecting total system performance. A self-terminating wallplate also is made by the company.

RMS Electronics, which recently had good success with sales of passives in the European LAN market, has produced a new Data Tap Series. Available are a single output directional coupler, two-way directional coupler, four-way and eight-way directional couplers, passing the 5 to 550 MHz frequencies.

Test equipment

Broadband LANs can't be certified or maintained without the use of spectrum analyzers, signal level meters, radiation detectors, sweep systems, carrier generators, time domain reflectometers and sweep generators.

Spectrum analyzers are made by Texscan Instruments, Hewlett Packard, Tektronix, CaLan, IFR Systems and Wavetek. Sweep generators are made by Wavetek, Texscan and HP. Sweep systems are made by CaLan, Wavetek and Texscan. SLMs are made by Sadelco, Texscan, Leader Instruments and Wavetek. Radiation testers come from Comsonics, Texscan, Vitek and Wavetek. Carrier generators are made by Dix Hill, Applied Instruments and Texscan. Riser-Bond Instruments, Biddle Instruments, Lanca Instruments, and Comsonics make TDRs. Dovetail Systems, a new company founded by a long-time RF modem designer, plans to introduce a new leakage detection system.

So there you have it. An introduction to major players in broadband LANs. Not every company active in broadband LANs, to be sure. There are a multitude of electronics houses and installers who can provide connectors, splicing and crimp tools and other parts, cabling, or test equipment. Telephone companies, long experienced at installing cable, also are in the market. But this review is a fairly complete introduction.

—Gary Kim

MultiPort issues given full airing

Further comments on the **EIA MultiPort**: In this space last month we pointed out two things that apparently won't work when the MultiPort device is implemented. However, according to **Joe Van Loan**, the Viacom engineering VP who chairs the NCTA subcommittee charged with garnering support for MultiPort, we may gave made a mountain out of a molehill or, at least, an issue out of an observation or two.

Regarding the inability to channel map, Van Loan says that's not a problem limited to MultiPort alone because channel mapping also won't work for anyone with a cable-compatible TV set. "Those systems that channel map may incur the ire of customers who buy cable-ready TVs and find their channels are different than those shown in the guide," reports Van Loan. "They're on a collision course with those consumers." Because there was no practical way to accommodate channel mapping in cable-ready sets, the EIA/NCTA joint committee which developed the IS-6 standard chose not to pursue that feature, he adds.

As for pay-per-view, Van Loan admits that no way presently exists for direct ordering of events, but notes that as PPV grows as a service, later versions of MultiPort could accommodate those needs. For example, PPV modules that are being offered by several converter vendors for about $45 could also be adapted to MultiPort, said Van Loan. That addition would likely double the cost of the unit but allow instant ordering of events, he said.

For those operators that prefer the convenience of infrared remote, Van Loan notes that for a small incremental charge, an infrared receiver could be added to the two-way adapter. A hand-held remote unit capable of communicating the request would be needed, "but that's achievable," Van Loan said. Finally, the issue of an infrared standard was considered by the IS-15 committee when MultiPort specs were being written, but it was determined that it would remain unaddressed until the Home Bus committee concluded its work, which includes in-home infrared remote control usage. At that time, Van Loan said, the same standard would likely be applied to MultiPort.

"Certainly there are challenges (to making MultiPort as transparent as possible), but they aren't faults," said Van Loan. "As the device evolves, those challenges can and will be met."

I stand corrected.

New products that made their debut at last month's NCTA convention in Las Vegas included the following:

Jerrold unveiled a new series of line extenders intended to offer significant performance improvements over previous models. The JLC series offers 450 MHz conventional technology in high gain (JLC-6) and intermediate gain (JLC-7) and will replace the JLE series. Both units offer lower noise figures and improved composite triple beat numbers, resulting in lower equipment costs per mile. Also highlighted was a new status monitoring system which will monitor forward and return levels, amplifier currents and powering status, and control return feeder and bypass switches in trunk amps. As part of an overall demonstration of impulse technology, Jerrold unveiled Cable Stock Exchange, a new service that allows subscribers to see the current values of personally selected stocks instantly. The service is provided through cable systems to homes equipped with Starquote units, but is not predicated on addressability. On the **Tocom** side, a new generation of PPV software was introduced. Designed for use with the Tocom Micro-ACS addressable control and 5503-VIP converters, the system provides information about purchased events.

Reader Service number 100

Scientific-Atlanta has introduced a new digital set-top terminal. The Model 8528 has all the features of the 450-MHz Model 8525, but operates up to 550 MHz. The terminal's infrared remote allows programming of frequency lineups and service authorizations while the subscriber options transmitter can add parental control and remote control functions, eliminating the need for PROM programming. Also, a new standalone power supply status monitoring system was shown. The system provides an overview of the power supply status for the entire system or for critical locations. The system is expandable and has a wide range of user-defined functions. Finally, S-A announced fall delivery of its IPPV system, introduced last December.

Reader Service number 101

New from **Pioneer** are two enhanced versions of its M3 addressable controller software, M3P-5.0 and M3P-6.0. Both versions offer additional operator flexibility in reporting functions, database and system operation. The improvements also include control of multiple hub sites with different operating parameters and direct bar code reading. Also, the company announced the availability of the BA-5000N addressable converter. It offers enhanced BTSC transparency, improved PPV features and expanded tag capability.

Reader Service number 102

C-Cor Electronics turned a few heads by entering the converter market. The company has become the marketing arm for a plain, non-addressable box designed and built by Eastern International. The 550-MHz box features IR remote disable, an external power supply, surge and static discharge protection and multiple tuning standards. But the real news is that the boxes are available *immediately*. Also, C-Cor introduced the PT-500 Series PHD (power hybrid doubling) trunk amplifier. The intermediate range amp provides improved output performance and rounds out the product line.

Reader Service number 103

A new feedforward power amp was introduced by **Hughes Aircraft**'s microwave products division. Designed to extend the range of Hughes' AML line extender, the new AML-FFA-160 can transmit up to 60 channels, operates in the 12.7 to 13.2 GHz range and provides distortion cancellation at CARS-band frequencies. The new amp promises to extend the range and number of possible receive sites of the line extender in multichannel applications.

Reader Service number 104

Panasonic, meanwhile, showed two new non-addressable converters. The TZ-PC130 and TZ-PC160 are RF and

Continued on page 84

product profile

Standby power suppliers

Alpha Technologies

The AP Series of standby power supplies from Alpha is designed for CATV or broadband communications systems. Consisting of a power module, an enclosure and various options, the AP Series can be configured to meet specific needs. The power module features a grounded three-prong line cord input; a barrier terminal strip for battery, output and options connections; an output current meter; a 30-amp battery fuse or 40-amp breaker; a 15-amp output fuse; line-on and standby indicators; and a heavy-duty, high-temperature transformer. A front-panel pushbutton on the unit allows exercising and testing of all power supply functions.

The AP Series from Alpha operates at an efficiency level of 85 percent (typical) and a frequency level of 60 Hz (nominal). Transfer time is less than 16 msec., and recharge time is 16 to 18 hours.

Enclosures from Alpha come with a variety of options: polemount, battery tray, heavy-duty pedestal, steel or aluminum construction and dual module.

The UP Series of uninterruptible power supplies from Alpha provides automatic performance monitoring, which regularly tests all standby functions of the module. In addition, local and remote indicators permit monitoring of standby/alarm condition from the ground or remotely through relay contacts. With the UP Series, output power experiences no interruptions.

For more information on either the AP or UP Series of power supplies, contact Alpha Technologies, (206) 647-2360.

Burnup & Sims/Lectro

The Sentry II standby power supply from Lectro features a ferroresonant module that is fully compatible with the company's Mini-Brute unit. The Sentry II offers an output of up to 15 amps at 60 VAC; and the standby module of the Sentry II, with 36 VDC input, will continue to run plant for up to three hours. Utilizing the same basic inverter and battery charger designs as the rest of the Lectro line, the unit is fully modular to eliminate fumbling with wires. Output regulation and automatic restart circuits are designed into the Sentry II to provide more standby time and convenience.

Options for the Sentry II include a 20- or 60-second inverter retransfer delay, an event counter, heavy- and extra heavy-duty input surge arrestors and output surge arrestor. Output efficiency is 85 percent for the power supply, with AC to DC transfer time typical at 15 to 20 msec.

Lectro's newest standby power supply, the Super Sentry, provides 92 percent efficiency and is fan-cooled for longer transformer life. Status monitoring interface options are available for the Super Sentry, which also includes an event counter/timer as standard features.

For more information on the Sentry line, contact Burnup & Sims/Lectro, (404) 543-1904 or (800) 551-3790.

Cable Power

Cable Power recently added several new models to its line of power supplies. The 737-15XL series has been expanded to include the new 747-20 model, which delivers an output of 2 × 10 amps at 60 VAC (1200 watts). Each output channel is individually electronically current limited. All existing models are available in several configurations: pole and pedestal mount, top-mounted batteries on insulated shelf, bottom-mounted batteries with slide-out tray and more.

The new non-standby power supply, model NS-60-15, is housed in a compact cabinet and incorporates an inside-mounted commercial AC-breaker box for its utility power input. The unit has a no-load to full-load regulation of less than 2 percent.

Cable Power also offers a full line of UPS power supplies for use in headend and computer-related applications. These modules are a true sine wave (less than 5 percent THD) no-break design to protect sensitive and sophisticated equipment. Rack-mount and standalone configurations are available.

For more information, contact Cable Power, (206) 882-2304.

Control Technology

The Citation II standby power supply from Control Technology is a two-battery compact system which utilizes high-efficiency PWM regulation in the standby mode. The Citation II uses a cycle battery charger with variable length equalize cycle and the exclusive battery overcharge alarm system, which prevents destruction of the second battery by overcharging upon failure of the first. The Citation II also features automatic self-test diagnostics which automatically test batteries and inverter for satisfactory operation approximately every 10 days.

Also from Control Technology, the Apollo standby power supply is a 15-amp, three battery supply utilizing ferroresonant output in both primary and standby modes, thereby providing substantially constant output voltage and waveform in modes. The Apollo also features cycle battery charging and a battery overcharge alarm.

Both units are tightly regulated in both primary and standby modes and feature total modularity: inverter readily removable without disturbing the cable powering. In addition, both the Citation and the Apollo utilize overcurrent and short-circuit protection of the output and surge protection on the input for high reliability.

For more information, contact Control Technology Inc., (214) 272-5544.

Continued on page 84

EFFICIENCY EXPERT

New SUPER SENTRY Standby Power Is 92% Efficient

If an inefficient power supply has been robbing you of profits, it's time to call in the efficiency experts, LECTRO. The new SUPER SENTRY standby power supply operates at 92% efficiency in normal full load mode. And that can mean significant savings on your electric bill. As much as 10% over other power supplies.

The SUPER SENTRY is the newest innovation in Lectro's Super Line. To get all the facts about the Super Sentry, the Super Ferro, and the Super Brute, call 1-800-551-3790. Ask for the efficiency expert.

LECTRO

A Burndup & Sims Cable Products Group Company

Reader Service Number 63

92%

classifieds

HELP WANTED

Baker Scott & Co. EXECUTIVE SEARCH
1259 Route 46 Parsippany, NJ 07054 201 263-3355
Specialists in the COMMUNICATIONS INDUSTRY
CABLE TV/BROADCAST DIVISION TELECOMMUNICATIONS DIVISION
POSITIONS AVAILABLE AT ALL LEVELS OF MANAGEMENT, COAST TO COAST
Call or write in CONFIDENCE
FEE PAID
"WE DON'T TALK CABLE, WE KNOW CABLE"
PRINCIPALS DAVID ALLEN & JUDY BOUER

ENGINEER
Broadband, Communications and Electronic System

Michigan State University has an advanced level opening for a seasoned, operations-oriented communications engineer. This position requires the application of extensive and diversified engineering principles and methods to the operational development of a large broadband LAN and various electronic systems.

Examples of typical tasks are the following. Plan, develop and coordinate large and vital broadband cable and electronic systems as well as smaller complex projects. Develop preventative maintenance programs for broadband television and data networks, and other electronic systems. Design broadband cable trunks and distribution systems. Consult on maintenance and troubleshooting problems for broadband cable, general analog, digital and radio frequency communication systems. Assist with the development of improved and innovative operational procedures for high technology systems in a university environment. Develop, direct and implement technical training of personnel. Applicants must have a BSEE and reasonable progressive and responsible experience in planning/designing broadband and other electronic systems, installations and equipment. Some supervisory experience is also required. Registration as a PE in the State of Michigan is desired.

Contact Michigan State University Employment Office, 110 Nisbet Building, 1407 S. Harrison Road, East Lansing, MI 48824. Refer to Position A654.

MSU is an Affirmative Action/Equal Opportunity Institution.

EQUIPMENT FOR SALE/WANTED

WANTED:
SURPLUS CABLE EQUIPMENT
Jerrold, Oak, Hamlin & Scientific Atlanta equipment.
Highest Prices Paid
Cable Equipment Brokerage Co.
(818) 709-3724

REVERSE SPIRAL
FOR CATV DROP WIRE
Westay Reverse Spiral Grips Are Guaranteed to Resist Rust and Corrosion
WESTAY COMPANY
P.O. Box 1450
Oakdale, CA 95361 (209) 847-6660

AERIAL BUCKET TRUCKS
Large selection geared for CATV
STANDARD TRUCK & EQUIPMENT CO.
1155 Hill St. S.E.
Atlanta, GA 30315
Phone: 1-800-241-9357
BUCKET TRUCKS

FOR SALE
S.A. 54 Channel Converters/Descramblers, Jerrold JSX/JRX Converters/Descramblers, Sylvania 54 Channel Converters/Descramblers, Jerrold Amps/Housing-300 MHz/727 meters, **Call: Midwest CATV Engineering (219) 259-8611**

FOR SALE
Manual and remote converters, 170 negative F traps, 86 positive A traps and a Scientific-Atlanta feed forward testing device. Call (414) 422-1700. Ask for Larry Cirillo.

CHANNELCUE
Line equipment and meter repair
LEE ENTERPRISE
623 4th STREET • P.O. BOX 590 • OESHLER, NEBRASKA 68340
(402) 365-7520

MLE
Main Line Equipment Co.
1650 West 180th Street
Gardena, CA 90248
A Better Source
For all your requirements
CONVERTERS
New — Used — reconditioned and all used equipment
BOUGHT — SOLD
JUNE SPECIALS
Z TAC — ST 1000 — ST 1088
—Sylvania 4040's
—RC 2 W's
—OAK Gamuts
—Magnavox Taps
—Econocodes
HOWARD — MARK — SY
(213) 715-6518

TENTH BRAD Anniversary

If you're not on our MONTHLY PARTS MAILING LIST you should be!
Here's why . . .

JSX Top Case	3.65
18 Button Keyset	.38
5 Button Keyset	.28

Minimum Quantity 100 Pieces
Ad Prices Good Through April 87

Call
1-800-382-BRAD
In NY 518-382-8000
Ask For Parts Sales
CLEARLY BETTER

BRAD THE CONVERTER PARTS HOUSE™

BUSINESS DIRECTORY

Advertiser's Index

	Reader Service #	Page #
Alpha Technologies	5	9
Anixter Communications	65	86
Belden Trading	4	7
Broadband Engineering	42	69
Burnup & Sims	63	81
C & S Construction	39	66
Cable Resources Inc.	12	22
Cable Tek	45	73
Calan	62	77
Carson Industries	11	21
Channell Commercial	10	17-18
Channel Master	22	38
Eagle Comtronics	18	31
FM Systems	17	30
GNB Inc.	26	53
General Instrument/LAN Division	38	65
General Instrument/ Network Cable Division	40	67
Johnson Controls	25	51
LRC/Vitek	13	23
Laser Precision	41	68
Leaming Industries	20	33
Lightning Deterrent	16	29
Magnavox	1	2
Pico/Merit Communications	44	72
Midwest Communications	6	11
Panasonic	23	40
Pioneer	64	85
RMS Electronics	7,43	13,71
Sachs CATV	27	55
Scientific Atlanta	3	5
Sitco Antennas	9	20
Southern Cable Television Assoc.	14	24
Standard Communications	8	15
Telewire	37	60
Time Manufacturing	19	32
Trilogy Communications	2	3
Triple Crown	15	25
Wegener	21	35
Weldone Trading	28	57

Creative Management Systems has introduced a new retrieval system called CARDS.

Continued from page 79

baseband models, respectively, that feature favorite channel memory, last channel recall, accommodate 68 channels and can be configured for HRC or IRC systems by a single switch.

Reader Service number 105

In other product news, **Creative Management Systems** introduced a new retrieval system called CARDS (corporate and regional data summary system). A menu-oriented system, CARDS maintains hundreds of decks of user-selected data elements in summary form for immediate inquiries and reporting. Each deck contains dollar amounts and/or statistical counts for items like promotions, packages, services, PPV events and more.

Reader Service number 106

A line of split-band feeder equalizers that improve the performance of single-cable broadband LANs used to configure MAP, TOP, IEEE 802.4 and IEEE 802.7 system is being offered by **Broadband Networks**. The units can pad the reverse path as well as equalize coax cable attenuation characteristics in both forward and reverse signal paths. Insertion loss has been improved to one dB at 450 MHz by combining the functions of filter and equalizer circuits on a single printed board. The mid-split unit has a return path frequency bandpass of 5 to 115 MHz and a forward bandpass of 150 to 450 MHz. The high-split device passes 5 to 186 MHz for return paths.

Reader Service number 107

Zenith Electronics has expanded its line of LAN products with the introduction of "LANcard," which enables IBM-compatible computers to communicate at 0.5 MBPS. The new product makes the Z-LAN the only system that allows full peer-to-peer PC connectivity throughout a 30-mile area, according to the company. The 500C LANcard is an intelligent bus-adapter card designed for simple installation in a PC expansion slot. Each is sold with an external modem to provide the interface to the Z-LAN 500 network. Standard LANcard models are available to operate in 10 frequency pairings for sub-, mid- and high-split systems.

Reader Service number 108

—Roger Brown

Correction

Because of a typesetting error in the April issue of *CED*, it appeared that Compu-Trace Inc. and Cable Television Services Inc. were commonly owned when, in fact, they are two separate converter repair companies. *CED* apologizes for any misunderstanding this may have caused. Also, in the May issue's Billing Callbook, available options for CMS' System 1 should have been listed as integrated accounts payable and general ledger. We apologize for the error.

Continued from page 80

Data Transmission Devices

Data Transmission Devices manufactures a broad line of standby and non-standby power supplies for the cable industry. The line includes standby supplies in two-, three- and four-battery configurations with 12-, 15-, 18- and 24-amp ratings. Non-standby supplies are available in 12-, 15-, 18-and 24-amp versions and feature full module interchangeability with DTD standby supplies. The company's standby supplies feature DTD's "feedback" battery charger (designed to minimize battery maintenance while maximizing life), inverter output regulation, an auxiliary generator input and a slide-out battery tray as standard features. All Data Transmission products are U.L. recognized.

For more information, contact DTD, (617) 532-1884.

Power Guard

Designed for operation at up to 90 percent efficiency, Power Guard power supplies feature a modular design that allows direct and instant interchangeability with modules rated at 5-, 10- and 18-amp outputs, as well as standard 15-amp modules. The housings that accept these modules come in ground mount, pole mount, rack mount and a series of retro plates that will convert most existing supplies to a Power Guard modular supply.

According to Power Guard, savings on power bills of up to 60 percent can be realized with the proper selection of module ratings in each location.

For more information, contact Power Guard, (404) 354-8129.

RMS

The RMS series of standby power supplies utilizes the Power-King™ ferroresonant supply as its primary source of power. The Power-King is automatically switched to a reliable, efficient inverter supply when the input power to it is removed. Upon return of the utility power, the load is transferred back to the ferroresonant source. In the inverter mode, the source of power is either a two- or four-pack of heavy-duty batteries.

The model PS-SB60/30 power supply from RMS incorporates the following features: cycle charging circuits, low-noise ferroresonant transformer in the AC section, time-delay relay, primary input circuit protection, on/off primary overload circuit breaker, input and output pilot light indicators, 115 VAC convenience outlet and an output current meter.

For more information, contact (800) 223-8312 or (212) 892-1000.

—Lesley Camino

THE ELIMINATOR

Finally, a powerful tool that eliminates remote control inconvenience.

Introducing the Pioneer SmartRemote™ — one remote that can learn eight different functions of virtually any home entertainment system.

So tell your subscribers to fastforward their Fisher® VCR. Change the volume on a Sony® television. And still operate all the features of Pioneer's BA-5000 addressable or BC-4000 series standard converters.

But don't be intimidated by its power: The SmartRemote™ arrives individually packaged with its own instruction manual and a full bar code for accurate tracking. We'll even provide training for your sales reps or CSRs and promotional assistance through preprinted bill stuffers*.

Teach your subscribers the art of elimination. For more information on the most affordable learning remote in the industry call Pioneer today at 1-800-421-6450.

PIONEER®

PIONEER COMMUNICATIONS OF AMERICA, INC.

600 East Crescent Ave. • Upper Saddle River, NJ 07458 • (201) 327-6400
Outside New Jersey (800) 421-6450
Reader Service Number 64

Fisher and Sony are registered trademarks of Fisher Corp., and Sony Corporation of America, respectively. *Minimum purchase quantity required.

Today's addressable solution...

Impulse pay per view is easily implemented by the addition of this add-on sidecar that is compatible with the entire Starcom® VI family of convertors.

...That also works tomorrow

Anixter now stocks Jerrold addressable convertors that are Hamlin compatible and impulse expandable. These convertors offer more control and better security plus the ability to change-out compatible systems at your own rate.

The new family of Jerrold Starcom® VI addressable products also includes the DPV-5 model which provides volume control for increased subscriber satisfaction. All DP Starcom® VI addressable units will accommodate impulse sidecars that allow you to offer pay per view events.

So, when you want an addressable convertor, come to Anixter. And, when you want that addressable convertor to deliver impulse pay per view, come back to Anixter.

We have the JERROLD products to meet your addressable needs with or without impulse, now and in the future.

To order call toll free 1-800-323-0436

ANIXTER®

Wiring Systems Specialists

Voice • Video • Data • Power

CORPORATE HEADQUARTERS:
ANIXTER BROS., INC., 4711 Golf Road, Skokie, IL 60076 (312) 677-2600 — Telex 289464

ANIXTER® **DEPT. JER**
4711 Golf Road, Skokie, IL 60076

☐ Please send me more information on Jerrold Addressable Convertors

Name _____

Title _____

Company _____

Address _____

City _____ State _____ Zip _____

Telephone _____ CED61

Reader Service Number 65