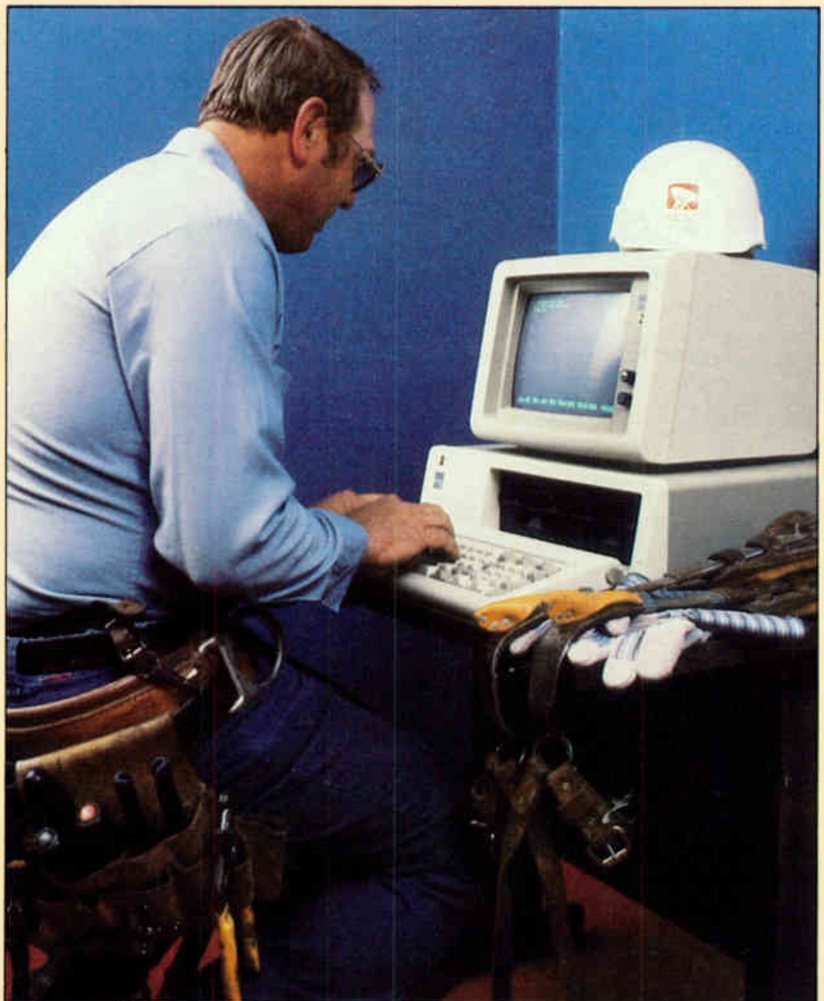
COMMUNICATIONS
TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers



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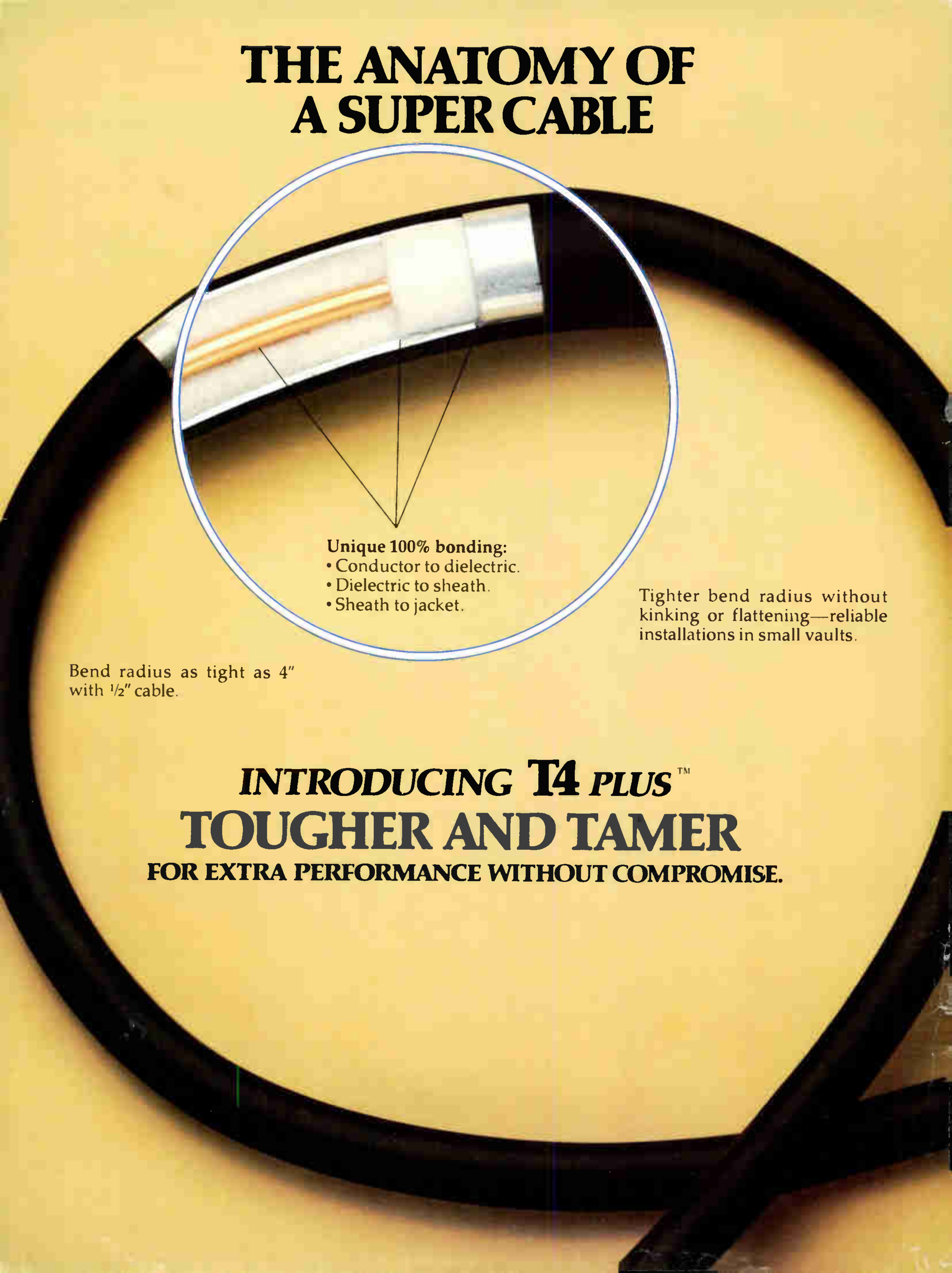
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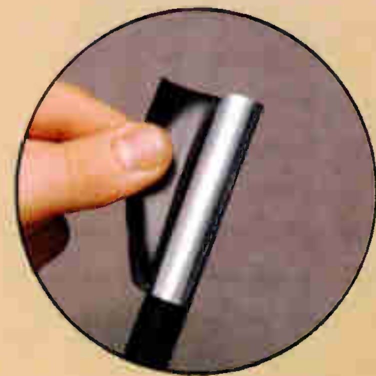

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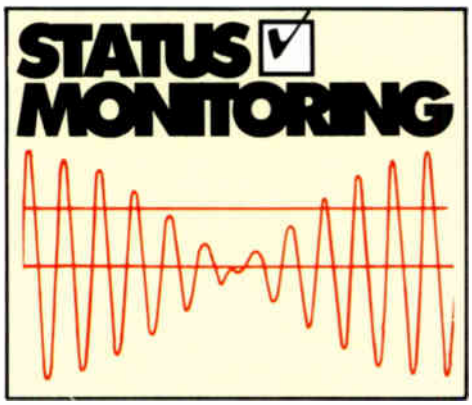

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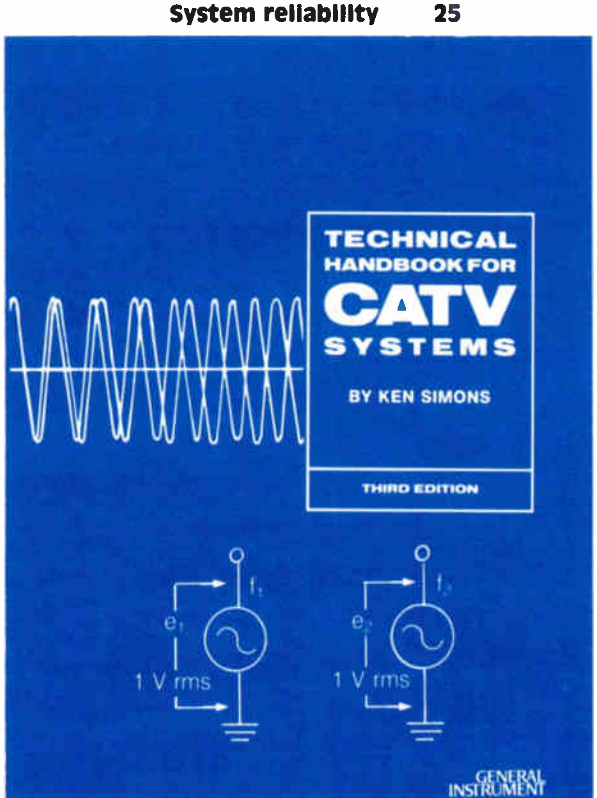

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Features

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Baseband or RF? Tough question. But Jerrold gives you an answer you'll be able to live with comfortably tomorrow, no matter which you choose today.

You see, our new STARCOM℠ V Advanced Baseband Converter and STARCOM℠ 450 RF Converter are compatible and can be used interchangeably within your system. So you can give subscribers a choice of cable services and operating conveniences.

Both converters bring you exceptional value, with these important features in common:

- ☐ Potting of sensitive circuits—prevents tampering.
- ☐ Dynamic trimode scrambling—prevents signal theft by changing scrambling modes on a pseudo random basis.
- ☐ Upgradeability to two-way IPPV.
- ☐ 256 tags, 2 million addresses.
- ☐ A/B switch option.
- ☐ Built-in self test—for easier servicing.
- ☐ Programmable time-out.
- ☐ Optional cordless remote control.
- ☐ Direct channel entry and AFT.

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The STARCOM V 550MHz Addressable Baseband Converter offers 82- or 164-channel capacity, selectable by an internal switch. With both video and audio scrambling. And more downloading parameters than any other converter. Here's a sampling:

- ☐ Flexible barker channel location—changeable at any time. Even different barker channels for different subscribers.
- ☐ Programmable output channel—cable operators can simplify inventory by stocking only one model for all systems.
- ☐ Custom channel assignment—lets you maintain off-air channel numbers.
- ☐ System ID code—prevents converter from being used on another system.

Subscriber features are equally notable. Some of the principal ones: volume control on the remote control; last channel recall; favorite channel scan; electronic parental control by both channel and rating.

There's a lot more you should know about, of course. See our STARCOM V brochure.

The STARCOM 450.

The STARCOM 450 Addressable RF 450-MHz Converter, as noted, has many of the same operator and subscriber features as the STARCOM V. It's state-of-the-art all the way. The fact is, the STARCOM 450 is probably the best buy in its class.

Check out these other important features:

- ☐ 66-channel capacity—internal A/B switching for expansion to 132 channels.
- ☐ Easy-to-use keyboard, on both the remote and on the converter, itself.
- ☐ Parental control.

Our STARCOM 450 brochure will give you complete information on this versatile, high performance converter.

Where to go from here.

Baseband or RF? The decision can be easy enough, if you decide on Jerrold. Because you not only get an open-ended choice, you get the technical support and after-the-sale backup of the major supplier in the industry.

For literature on the STARCOM V and STARCOM 450, you have only to call or write. Jerrold Division, General Instrument Corporation, 2200 Byberry Road, Hatboro, PA 19040. (215) 674-4800.

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The ball's rolling

Sometimes, as with any new project, unforeseen circumstances will arise—some for the better, some for the worse. In our case, it's the positive side that's showing itself. And for that, we at *Communications Technology* want to thank the industry in general and, in particular, our contributing authors and advertisers. Your past and continuing support can only help us all realize a worthy goal—the dissemination of pertinent information.

On another information front, the National Cable Television Association's 33rd annual convention and exposition soon will be upon us. With more than 15,000 attendees expected and with approximately 260 companies already having reserved exhibit space, this year's National Show surely will be an arena for information exchange. The technical sessions, in themselves, are a mouthful. Topics from commercial insertion to cable revolutionaries will be addressed by the industry's top technical leaders. The complete technical agenda begins on page 12. See you in Las Vegas.

Numerous calls have come into our office regarding Bob Luff's column in the April issue. If you haven't read it, you should; and if you did, I hope it raised your eyebrows. Signal leakage—and the interference it causes—is a serious matter. And, although Bob's article was ficticious, the problem *is* real. (This issue's feature on amateur radio makes mention of a 1982 rulemaking petition filed by the American Radio Relay League asking the FCC to prohibit CATV systems from operating in a portion of the mid-band.) Also, we hope the phone in James McKinney's office at the FCC has stopped ringing.

Other features in this month's *CT* also deserve mention. Robin Dickey, staff engineer at UA Cablesystems, has provided a five-act "smash hit" on the use of computers in the engineering department. On the system reliability side, Jerrold's Barry Breech and Lectro's Mason Hamilton offer advice on status monitoring and standby power. And, if that's not enough, the combination of voltage, current or power is covered in the second chapter of Ken Simons' handbook.

Not to leave any stone unturned, we've also included a short true and false quiz on FCC Rules and practices as they pertain to cable TV. If you read last month's article on the commission, you've been waiting for this; if not, there's still time. Good luck.

Toni Barnett

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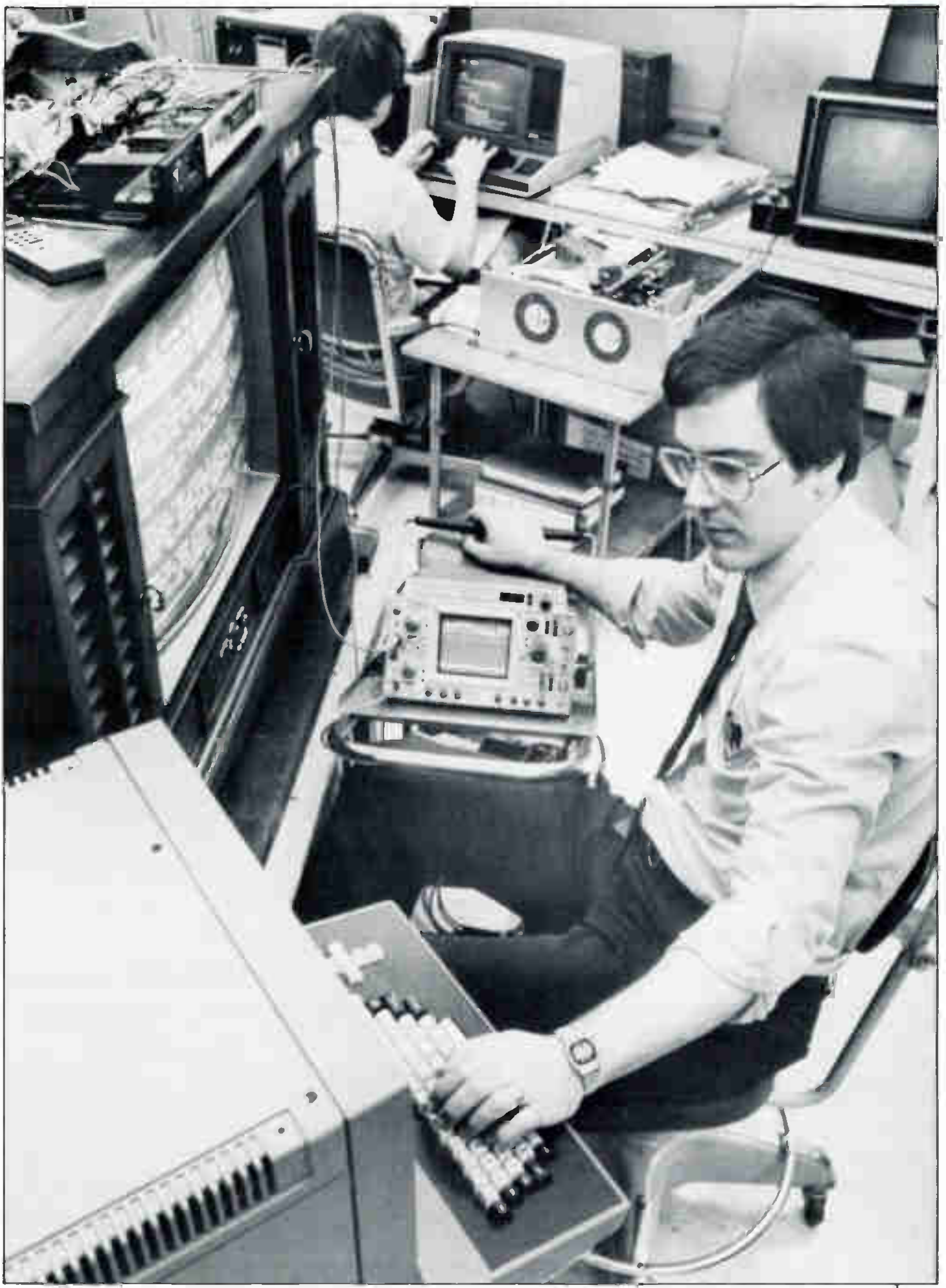
Zenith exec says decoders are key to teletext future



Gregory Woodsum, Zenith manager of videotex engineering, tests a World System Teletext format decoding system.

CHICAGO, Ill.—The success of teletext in the United States depends on the development of low-cost equipment compatible with different teletext systems, according to William Thomas, Zenith manager of cable television communications products.

"The consumer can be turned off by marketplace confusion. By working toward a goal of multistandard broadcasting and complementary multistandard decoders, the future of teletext can be assured," Thomas said at last month's Videotex '84 conference. Even without multistandard-broadcasting capabilities, he predicted, the number of teletext decoders installed in U.S. homes could reach 1 million in 1986—about 10 times the present level.

Broadcasters and receiver manufacturers currently support three teletext standards in North America: World System Teletext (WST), North American Basic Teletext Specification (NABTS) and Captions for the Deaf (CFD).

"Based on existing information-provider support and hardware in the field, it could be argued that CFD is today's *de facto* standard. NABTS has network broadcast support and WST is available nationwide with a potential for significantly lower cost in the future," Thomas said.

Because the three standards do not interfere with each other, "There is no technical reason why a single vertical blanking interval could not support all three services simultaneously. A network provider such as NBC or CBS could carry both WST and NABTS versions of their services on the network level. At the local, or affiliate level, an appropriate choice could be made between local insertion, NABTS, WST or CFD," Thomas proposed.

"A positive indication of compatibility has been the demonstrations showing automatic reformatting from CFD to WST. Also, it has been reported that CBS will offer captions in both CFD and NABTS," he said. A competitive environment could result in the production of WST/NABTS-compatible decoders in 1985, and CFD/WST- and CFD/WST/NABTS-compatible decoders in 1986, he added.

Stressing that reduced decoder cost is "crucial" to the industry's success, Thomas speculated that the WST/CFD version would cost less than the three-standard version.

Also important to the future of teletext are special applications and local-origination programming. "The special application known as a closed-user group—which offers program tiering, scrambling and addressability—is taking off. For example, an agricultural service is currently provided that uses the text mode of CFD systems. Similar concepts may be explored by WTS and NABTS proponents to stimulate decoder demand while the prices remain relatively high. Local origination is the most important next step for broadcast services," he continued. "Most teletext observers agree that local origination adds very significantly to the appeal of teletext."

He cited WKRC-TV's local-origination efforts in Cincinnati and the recent announcement that KTTV, the Metromedia station in Los Angeles, will carry teletext during the 1984 Summer Olympics (Zenith teletext equipment and color video monitors will be used there to provide up-to-date information on Olympic events).

GI, Dolby team up for digital audio

SAN FRANCISCO—Dolby Laboratories Inc. announced that General Instrument Corp. will adopt a new digital audio system recently developed by Dolby for satellite and cable television audio applications. Under the terms of the licensing agreement, General Instrument will build subscriber decoders and Dolby Laboratories will manufacture professional encoders for the new process. The encoders will be used either at the up-link satellite earth station or the cable television system headend.

This new digital audio technique is an advanced form of ADM (adaptive delta-modulation) and will provide the highest audio quality at very low bit rates, thus requiring less bandwidth than PCM (pulse code modulation) systems, according to Dolby. The system is particularly useful for electronic delivery systems such as cable TV, satellite-delivered programming and DBS (direct broadcast satellite) audio systems, where the need for minimal error correction results in a much cheaper home decoder system than more conventional digital systems.

Tele-Engineering forms national sales network

FRAMINGHAM, Mass.—Tele-Engineering Corp. announced the formation of a national dealer network with the selection of six regional sales organizations to represent the company's AD CUE™ automatic commercial insertion equipment and PVS™ programmable video switching equipment for cable TV.

Victor Colantonio, Tele-Engineering's director of marketing, said that the company has signed agreements with the following suppliers: dB CATV Supply, Englishtown, N.J.; KBL Sales, Newark, Calif.; Mega-Hertz Sales, Littleton, Colo.; Mega-Hertz Sales, Kansas City, Mo.; Mega-Hertz Sales, Bedford, Texas; and NCS Industries Inc., Willow Grove, Pa.

Jerrold inks contracts with two operators

HATBORO,Pa.—Cable Services Co. Inc. of Williamsport, Pa., has agreed to purchase approximately $3 million in cable television electronics equipment from the Jerrold Division of General Instrument Corp. The agreement calls for Jerrold to deliver approximately 25,000 plain, pay and addressable converters, addressable controllers, Commander IV prepack headend equipment and SJ-450 amplifiers.

Cable Services' systems slated to receive the Jerrold CATV electronics include: Hershey, Fredericksburg, Norristown, Greenburg and Doylestown, Pa.; Loudon, County, Va.; Ponce, Puerto Rico; Ithaca and Chatham, N.Y.; Romeo, Mich.; Londonberry, N.H.; and Rockland, Mass. Jerrold began shipments in October of last year, and delivery is expected to continue over a 12-month period.

Adelphia Communications Corp. of Coudersport, Pa., has signed an agreement to purchase approximately $1.3 million in Jerrold cable television electronics.

Jerrold will supply this cable operator with plain and addressable set-top terminals in addition to an AH-2E addressable computer controller. The equipment will be installed in Adelphia's Bethel Park, Pa., Vermillion, Ohio, and Toms River, N.J., systems.

Shipments of converters began in December of last year and delivery is expected to continue over a 12-month period.

NCTA board chooses Mooney as president

CAPTIVA ISLAND, Fla.—Thomas Wheeler, president of the National Cable Television Association since 1979, announced his resignation last month. The NCTA Board of Directors immediately elected James Mooney, NCTA's executive vice president, to succeed Wheeler.

Elected officers of 1984-85 beginning with the conclusion of NCTA's annual convention June 3-6 are: Edward Allen, president, Western Communications Inc., Walnut Creek, Calif., to serve as chairman; Trygve Myhren, chairman and chief executive officer, American Television and Communications Corp., Englewood, Colo., as vice chairman; James Cownie, president, Telecommunications Group, Heritage Communications Inc., Des Moines, Iowa, as secretary; and John Goddard, president, Viacom Cablevision, Pleasanton, Calif., as treasurer.

Prime Cable selects S-A set-top terminals

ATLANTA—Prime Cable Corp. announced its intention to purchase approximately $20 million worth of Scientific-Atlanta addressable set-top terminals for use in its cable systems, principally in its newly acquired Atlanta systems. The terminals and related control equipment will be delivered over a 24-month period commencing in 60 days.

C. Ronald Dorchester, senior vice president of operations for Prime Cable, cites the purchase of the equipment as his company's first major step toward its long-term goal of upgrading customer service and technology in its Atlanta systems. These systems include the former Cable Atlanta, Cable DeKalb, Cable East Point, Cable Alpharetta and Cable College Park.

"Prime Cable is committed to the expanded programming and superior customer service afforded by addressable technology," according to Dorchester. "With this technology, cable TV subscribers can order changes in the programs they receive without having to schedule a service call or take the terminal in to be exchanged. Our plan is to install these set-top terminals in new and existing subscriber households to upgrade our level of service."

The selection of Scientific-Atlanta terminals was based on Prime Cable's experience with the Model 8500 set-top terminal installed in its Princeton, N.J., system.

Ortech appoints agency to promote new system

BUTLER, N.J.—Ortech Electronics Inc., manufacturer of a new addressable, off-premises pay TV security system, has appointed Carelli, Glynn & Ward Advertising as its agency of record. The Edison, N.J., firm was founded recently by Robert Geissler and Carmine D'Elio, former president and executive vice president, respectively, of Vitek Electronics.

CABLE '84

National show tech agenda

The following is the list of technical sessions to be presented at the National Cable Television Association's annual convention June 3-6 in Las Vegas, Nev.

Commercial Insertion: No Pain No Gain
Monday, June 4, 2-3:30 p.m., Room B

Vendors and cable operators join forces in this assessment of today's commercial insertion methods. Includes a report on progress toward formulating signaling and control "recommended practices." *Moderator:* Scott Tipton, director, R & F Systems, Home Box Office. *Speakers:* Paul Olivier, manager-production services, American Television and Communications Corp.; Ned Mountain, director of marketing, Wegener Communications; Roger Strawbridge, director of marketing and advertising, Adams-Russell Telecommunications; Ernest Tunmann, president, Tele-Engineering Corp.; Vern Bertrand, sales manager, Channelmatic; Jim Dixon, manager-control supervisor, Warner Amex QUBE.

Tests and Measurements
Monday, June 4, 2-3:30 p.m., Room D

Leading equipment manufacturers present new test methods. Hear about the latest analy-

tical techniques that can lead to better system performance. *Moderator:* Thomas Polis, executive vice president, Communications Construction Group Inc. *Speakers:* Bradford Kellar, development engineer, Raychem Corp.; Kenneth Crandall, principal engineer-research and development, Zeta Laboratories Inc.; Warren Braun, president, ComSonics Inc.; Don Groff, engineer, General Instrument, Jerrold Division; David Kelma, design engineer, General Instrument, Jerrold Division.

Cable Revolutionaries: Scanning the New Blue Skies
Tuesday, June 5, 9-10 a.m., Room B

Where would cable be without innovation? Design wizards and futurists contemplate 900 MHz, and teledelivery of video and computer software. This state-of-the-art session also will look at even higher quality image distribution for cable. *Moderator:* Wendell Bailey Jr., vice president, science and technology, National Cable Television Association. *Speakers:* Georg Luettgenau, senior scientist, TRW Electronic Component Group; Gary Arlen, president, Arlen Communications Inc.; Israel (Sruki) Switzer, consulting enginer, Cable Television Engineering. *Associated paper:* Bill Johnson, United Video.

Advances in Signal Relay via Satellite and Microwave
Tuesday, June 5, 9-10 a.m., Room D

Video relay technology is evolving in response to changes in technology and changing user needs. This session looks at some of these changes. *Moderator:* Jeffrey Krauss, vice president of corporate affairs, M/A-COM Development Corp. *Speakers:* Dom Stasi, vice president and general manager, Network Operations and Design Engineering, Warner Amex Satellite Entertainment Co.; Thomas Straus, chief scientist, Hughes Microwave Communications Products, Hughes Aircraft Co.; Jamal Saraff, senior staff engineer, Hughes Microwave Communications Products, Hughes Aircraft Co.; Jerrold Heller, senior vice president-Video Products Group, M/A-COM Linkabit Inc.

Audio: The New Playing Field
Tuesday, June 5, 10:30 a.m.-noon, Room B

All ears are tuned to cable's high-quality transmission promise with the advent of pay-cable audio services and multichannel television sound. Will it be a hit or strike out? Digital data transmission methodology in the cable environment is also covered. *Moderator:* Alex Best, manager-new business development, Scientific-Atlanta Inc. *Speakers:* Dennis Waters, president, Waters & Co.; Charles Wong, staff engineer, Oak Communications Inc.; Yuichi Kojima, Audio/Video Technology Center, Sony Corp.; Jim Wonn, manager of projects and equipment engineering, Group W Cable.

(Re)Building Tomorrows for Cable
Tuesday, June 5, 10:30 a.m.-noon, Room D

Hasty industry evolution has left operators with too many "best" choices in rebuilds or upgrades. Economic, procedural and mechanical considerations are reviewed. *Moderator:* F. Ray McDevitt, senior vice presient, Technical Operations, Warner Amex Cable Communications. *Speakers:* Joseph Preschutti, vice president-engineering, C-COR Electronics Inc.; Paul Brooks, project engineer, General Electric Cablevision Corp., Neil Neubert, director, audio/video engineering, Warner Amex Cable Communications; Norm Slater, project manager, network development, Cable Systems Engineering.

Data Communications
Tuesday, June 5, 3:30-5 p.m., Room B

The subject of data communications on CATV networks has caused much confusion: Is it a franchising promise or a major new revenue source? This session provides a status update. *Moderator:* Geoffrey Gates, vice president-engineering and technology, Cox Cable Communications. *Speakers:* Ernest Tunmann, president, Tele-Engineering Corp.; Lee Greenhouse, vice president, EF Hutton & Co.; John Lee Hughes, vice president, U.S. operations, NABU Network Corp.; Leo Shane, product manager-data products, General Instrument, Jerrold Division; James Mollenauer, senior consulting engineer, Codex Corp.

Distribution System Concepts
Tuesday, June 5, 3:30-5 p.m., Room D

Technical descriptions of timely aspects of distribution plant engineering. Fiber optic systems design and operational results, standby powering, the powering of off-premise devices, and RF amplifiers will be addressed. *Moderator:* Joseph Preschutti, vice president-engineering, C-COR Electronics Inc. *Speakers:* Robert Dickinson, president, E-COM Corp.; Thomas Hunter Jr., president, Data Transmission Devices Inc.; Robert Hoss, director of corporate engineering projects, Warner Amex Cable Communications Inc.; Harry Reichert Jr., engineer, General Instrument, Jerrold Division; Thomas Saylor, signal processing manager, Caltec Cablevision. *Associated publication:* Steven Grossman, project engineer, C-COR Electronics Inc.

Radiation Measurement and Prevention
Wednesday, June 6, 9-10 a.m., Room B

Is your system putting the cable industry in a regulatory ground zero? Violation of FCC leakage limits could bar cable from midband channels. An informative session for responsible operators—signal leakage quantification methods and how they fit into practical preventive maintenance programs. *Moderator:* William Petty, vice president-operations, Capital Cities/Cable Communications General Inc. *Speakers:* Ted Hartson, director of engineering, Capital Cities Cable Inc.; Sandy Livermore, product specialist, Magnavox CATV Systems Inc.; Jody Shields, Southern division engineer, UA Cablesystems Corp.; Gregg Nydegger, chief technician, Cardinal Communications Inc.

The Final Link: Today's Home Terminals
Wednesday, June 6, 9-10 a.m., Room D

Seasoned professionals look at set-top terminals, the final interface between a cable operator and his subscribers. Includes an overview of video scrambling and operational characteristics of modern terminal design. *Moderator:* Stan Guif, vice president-system engineering, Oak Communications Inc. *Speakers:* James Farmer, divisional technical manager-distribution data products, Scientific-Atlanta Inc.; John Schilling, manager, converter design engineering, General Instrument, Jerrold Division; Mircho Davidov, director of corporate research, Oak Communications Inc.; Dell Heller, Viacom Cablevision.

Addressability: Coming of Age
Wednesday, June 6, 3:30-5 p.m., Room B

You want addressable equipment to simplify operations and save you money. How do you get there from here? Veteran operators share their experiences and advice on "going addressable." Current directions in the technology also will be covered. *Moderator:* Joseph Van Loan, vice president-engineering, Viacom Cablevision Inc. *Speakers:* Robert Rast, vice president-research and development, American Television and Communications Corp.; J. Curt Hockemeier, general manager, Cox Cable Oklahoma City; Mike Burgess, manager-systems test engineer, Wegener Communications; Steve Lafferty, manager-data communications products, Wegener Communications; Graham Stubbs, vice president-design engineering, Oak Communications Inc.

Cable Distribution Plant
Wednesday, June 6, 3:30-5 p.m., Room D

Operators and manufacturers turn their attention to a variety of plant characteristics and field test methodologies. A comprehensive talk on preventing two-way plant problems, technical audit methodology and digital control of trunk signal levels. The effects of feedforward on high speed video and data signals are addressed. *Moderator:* Robert Luff, vice president-engineering, UA Cablesystems Corp. *Speakers:* Richard Citta, manager-engineering systems R&D, Zenith Radio Corp.; Ronald Hranac, Western Division engineer, Jones Intercable Inc.; F. Ray McDevitt, senior vice president of technical operations, Warner Amex Cable Communications Inc.; Roy Thompson, senior director, QUBE engineering, Warner Amex Cable Communications Inc.

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For more information contact Zenith CATV Sales, 1000 Milwaukee Ave., Glenview, IL 60025, (312) 699-2110.

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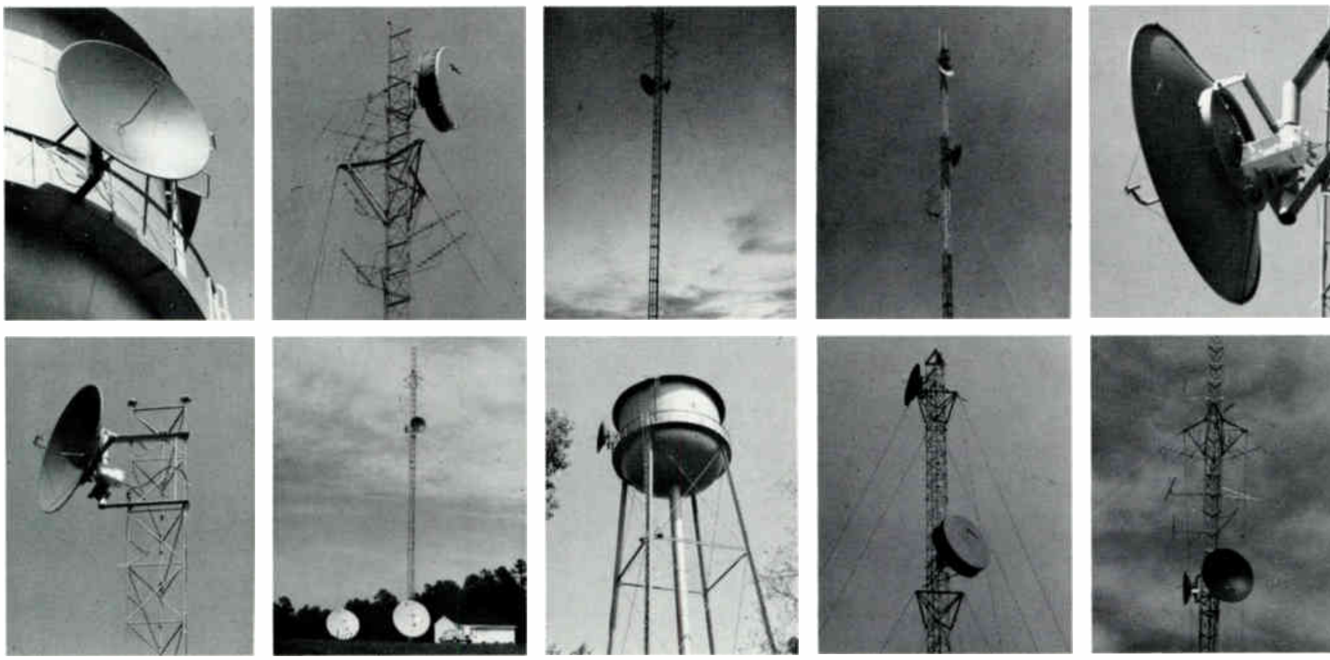

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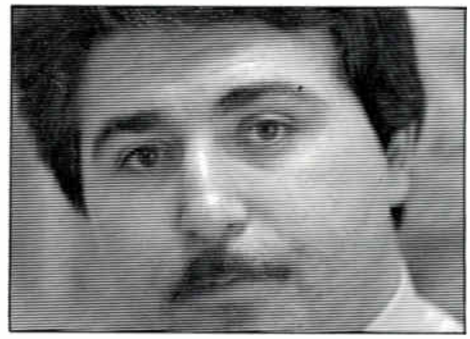
The splice is right! But, what's under the heat shrink?

By Anthony J. DeNigris
President, Nationwide CATV Services Inc.



In the pursuit of technological excellence, the cable television industry has made tremendous strides over the years. Coaxial cable has come to bear a greater burden in signal carrying capability. The specifications and sophistication of electronics and the reliability of amplifiers, power supplies and, especially, headend equipment is now the "stuff of which dreams were once made." The physical design of much of the equipment today is such that ease of maintenance and speedier trouble-shooting is a reality, as is the realization of improved ruggedness and the ability to withstand severe weather conditions. But you can't expect sophisticated equipment to work properly unless it's installed properly.

For the sake of example, let's view the modern CATV system as a huge forest, wherein every individual part of a cable system represents a totally functioning tree, however small or large. In a real forest, when a tree is struck down by lightning, the rest of the forest continues to function. In a cable system however, when even the smallest twig on a tree is severed (such as when a corroded stinger on a power coupler erodes through) some, or most of the cable forest functions no longer, or at least, not until the field tech gets it back together and working.

With regard to the task of putting it all together in the first place, splicing of the system should not be underplayed. I am a firm believer that a strong percentage of rebuild activity is attributable to the quality (or lack thereof) of the original splicing. I am also convinced that in hiring personnel for construction activities, even linemen are scrutinized to a greater degree than are splicers. If the line crews putting the cable up could be looked upon as lumberjacks, then it is the splicers who should be regarded as the craftsmen who make fine wood carvings. Curiously however, in most build situations, project managers and site supervisors will spend a good deal of time inspecting line crews and observing how the cable is going up throughout the build; but in the final inspection it ends up being the "look of the splicing" that is studied most.

The emphasis really ends up being just how nice (or not so nice) the splicer has made everything look, but this is not surprising in itself. After all, when most of us purchase a new car and it boasts sleek lines, a shiny paint job and the door shuts solidly, we believe that the rest of the car will function with the same degree of perfection that we experienced when we first "took a look" at the cosmetics of the car. However, just because the car starts and can drive away from the lot is no guarantee against it containing some mechanical faults that could inevitably cause a future problem. Applying this analogy to the arena of cable TV, one might come to find that it's what's under the heat shrink that counts.

Beginning with the basics

At first, some people might believe that techniques in splicing CATV plant are pretty basic and that not too much change has taken place through the years in the "way it is done." Bearing in mind that new tools have appeared and better connectors and equipment have been developed, basics are basics, right? I highly disagree, because as the industry grew so fast, the true basics were never truly implemented and enforced. This could be construed as a tricky statement and should not be taken literally. What it attempts to communicate however, is that although the engineers responsible for designing connectors, housings and tools have perfected the proper methods at the time, too many types of everything were popping up. Every splicer had a different set of basics, let alone their own short cuts and "better ways of doing it." If you take any 10 splicers today, no two of them will perform identical procedures on identical equipment.

Most recently, I was utterly dismayed when I discovered some splicers filling voids in connectors and connector ports on housings with silicone grease. In response to my questioning this "once thought to be proper" procedure, the answer given was, "We just did this in the last system we worked on."

The procedure just mentioned is obviously a "basic" that is still implanted in someone's system specs out there. But the problem with this practice is that whenever a void exists around a center conductor of a portion of cable that is "properly" spliced through a connector and into a housing, it is designed for that space (air) to be there. When silicone grease is placed in the void, the dielectric material (previously air) will now cause the dielectric constant (an electrical characteristic) to change, which in turn causes the capacitance to alter and therefore changes the impedance of the section of signal path.

What do you get? Well, maybe ghosting or signal degradation on some frequencies, etc. The reason for using silicone in the first place was to prevent corrosion and moisture from getting in; but silicone should be used only on the threaded portions of the connector and housing, as well as the O-ring seal, *never* to completely fill the space in these areas.

Striving for perfection

I have a firm conviction about getting performance, and that is: "There is only one way to do something the right way." Some examples:

- Heat shrink tubing

(1) It should be long enough to extend as far as possible over the housing port (which, by the way, usually are not long enough to allow proper use of heat shrink tubing in the first place) so as to be able to seal well past the O-ring seat of a properly torqued connector, and long enough to provide adequate sealing at the rear of the connector as well.

(2) It should be wide enough to surround the connector freely before shrinking, and still allow for complete sealing down to the cable size.

(3) When in the process of applying heat (a torch), the tubing should be uniformly heated and rotated forward so as to push the tubing up as it shrinks over the housing port. And it should be heated from the housing port side first, so that it is able to completely shrink around the housing and then worked back towards the rear.

A word of caution. There exist certain brands of electronics housings that are manufactured utilizing soft alloys. In one instance, I experienced splitter housings that cracked at the connector posts when screwing the connector in by utilizing what a seasoned splicer would expect to be normal pressure. If this situation is not watched for, and the heat shrink doesn't cover the crack, moisture will soon destroy the connection. Even if the heat shrink does cover the crack, the connector will be loose and moisture may eventually get in anyway.

- Preparing the cable (let's cover the don'ts in this case)

(1) Round jaw cable cutting pliers are the worst things to use in order to dress cable for entrance to a connector. Some splicers like to

hold these pliers loosely and utilize the taper of the jaw to score the cable, and then they snap and wiggle the cable sheath at the scored point to break the sheath away. This practice makes for the messiest cut possible, and causes burrs and slivers of aluminum to fall into the cored section of the cable and can literally mangle the cable right from the start. A razor knife is just as disastrous.

(2) Strongly avoid hacking at the center conductor when removing dialectric from the exposed section of the center conductor. A knife, although widely used, is not recommended. Instead, some of the specialized tools available today are designed to handle this task properly. Hacking the "stinger" only ends up leaving weakened and scored center conductors that will inevitably end up snapping at some time in the future when the splicer is long gone and a blizzard is raging; but the system manager wants the standby guy out and the system back on and working—now!

(3) Never allow the tip of the center conductor to become flared or widened as cutting pliers used perpendicular to the stinger usually do. Instead, make two cuts diagonally and snip the conductor into a semi-point. Always check to ensure that the proper connector is utilized so that the inlet seizing grips in the connector can do their job. In the case where the opening is too small for the diameter of the center conductor and the splicer tries to force the cable into it anyway, it is highly likely that he will cause the center conductor to bend inside the splice and probably short against the inside of the sheath. Remember that there are different size center conductor diameters for different brands of cable, and all connectors utilizing seizure grip inlets do not accept all sizes of cable. Should a center conductor having too small a diameter be inserted into too large a connector opening, then the possibility exists for an open contact at any time.

- Loop forming

It is not only the appearance of the finished product that is affected by proper forming of loops, but once this is accomplished, the purpose for having loops in the first place can now be served. This in turn will make for a more functional and lasting piece of workmanship and will lessen the possibility for failure of splices down the road. Consider the following:

(1) Cable extending from the rear of a connector (out of the splice) should not have any bend in it whatsoever which may even slightly cause a kink in the cable at or near the entrance to the connector. A rule of thumb for this specification is 6-8 inches out of the rear of the connector prior to any bending in the cable.

(2) Cable should not be allowed to twist in the loop when tightening the connector. This means that adverse pressure is being placed on the center conductor inside the fitting, which could cause damage, as well as poor appearance of the finished product. How many times have we all seen loops facing the sky?

(3) The actual forming of the cable is a highly delicate procedure. I am sorry to say that I still see cable being abused during this practice. Every bend in a piece of cable should be accomplished with a proper tool made especially for this purpose. Hand bending, although every splicer thinks they are great at it, should be avoided. The possibility for error is too great and there is no correcting a kink once it is there. And with jacketed cable, one may not even see what is happening when it occurs.

One final note

We have only scratched the surface when it comes to evaluating the do's and don'ts of splicing and the pitfalls of poor workmanship. The individual facets of this "art" are too numerous to be explored in any real depth in this article. What should be realized, however, is that perhaps some of us are a little too comfortable and set in our ways. Getting back to the basics is sometimes what is really necessary in order to protect the investment made for today's sophisticated systems. One thing to remember when getting back to the basics, is that the basics *must* be established on merit. Coordinating the specifications of the pertinent manufacturers and formulating standard procedures for workmanship based upon those specifications is essential. What some splicers were accustomed to in someone else's system may not prove to be right for yours.

Getting started...a rational plan

By James B. Emerson
AM Cable/E-Com

In an aging cable system, it may seem an impossible task to stop "putting out fires" and to begin a preventive maintenance regimen that will help you to avoid those "fires." However, this "impossible," like most others, just takes a little longer. Steps that will create benchmarks and limit your frustration are:

- Definition—your system topology versus major components, particularly with respect to your present records.
- Analysis—of maintenance records and your own good sense to place problems in perspective; area versus component versus condition.
- Planning—of your P/M mission with respect to your resources, however limited, should aim at the potentials for greatest outage damage first.
- Organizing—of your resources and indoctrinating your personnel toward a thoroughly positive P/M attitude.
- Implementing—to make it happen, no matter how small the start, determination and consistency will win.
- Record keeping—both doing and using your day-to-day documentation are the "key" to a successful P/M program.

Let's look at some more practical aspects of the steps to P/M success.

Definition of a given system of course implies current as-built maps, including a "backbone" trunk map for clarity. But this only defines *topology*; you need much more.

Your present maintenance records are "gold" with respect to establishing realistic direction and schedules for P/M work. How "rich" you are depends upon how much time you spent digging the "mine." If you keep a daily trouble log, plus tags for component problems and work orders for system techs, you're probably on target.

If these records cover more than a year or two, you've got a good resource. If records show *detail* of symptom(s), time of day and weather, plus what was done to restore normal service, you're well ahead of the game.

As you've no doubt seen by now, your P/M chore is directly related to *what* can be expected to fail *where* and *when*. You simply want to get there first. *How* failures and degradations occur is also very important.

Analysis of all defined information will permit summarizing "common denominators" of potential troubles and failures. Logic and common sense are your most potent weapons. Also helpful are mean time between failure (MTBF) ratings given by equipment manufacturers (although this is a rare resource in cable TV, keep bugging them).

Typical summaries you can use may include: What problems occur during storms of different types and during different times of day? Does lightning or surge damage repeat in certain areas, or is it uniformly dispersed? How often do failures occur among certain types of equipment? Are any failure clues evident, such as a fall in level or rise in hum-mod prior to failure?

You can spend a lot of time listing and categorizing analysis data and it is nearly always time well spent.

Planning your specific approach to P/M is never "cast in concrete." Your plan should change as you get a better and earlier handle on problems leading to failure. While the best way to handle P/M is to use a separate, dedicated crew, you may not be able to afford to when starting. However, you really must dedicate some man-hours regularly if you hope to see results.

Planning must take into account the historical analysis you've done to establish minimum test timing cycles for various equipment, topology and climatic or environmental aspects; your resources in terms of equipment and man-hours available, versus any "attitude" problems involved; and your ability to document problems and results.

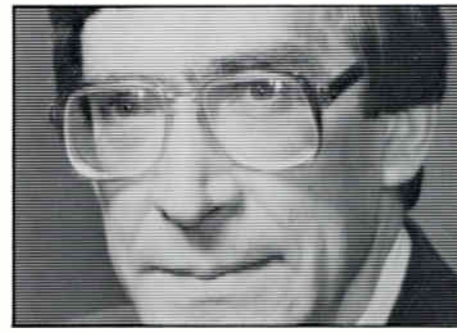
Organizing your resources in order to carry out your plan really has more to do with people than with equipment or time. A very complete indoctrination in P/M will work wonders. Somehow the time will be "found" once each tech understands how P/M relates to being called out after midnight in sub-zero temperatures on a catastrophic failure that need never have occurred.

Your system and company management will back you up to the hilt so long as they understand the relationship of P/M to holding down unscheduled subscriber interruptions.

You may find that while you still have to deal with last night's problems first thing in the morning, a good deal of P/M can be done once the crew is in the problem area. So long as the P/M work is accomplished, organizing it together with repair work will help utilize resources more effectively. Too dogmatic a plan can defeat itself while flexible organization can move you ahead.

Implementing, even in the worse case of small resources, will find your flexible organization following a well-defined but somewhat loosely structured plan. So long as you document either acceptable performance or degradation in key plant areas before outright failure occurs, you will have the opportunity to head off catastrophe and be a hero.

Whether we're a hero or fool is quite often the result of circumstance. All that P/M does is to improve your view and your ability to change negative circumstances. Your determination, above all else, will ensure the consistency that is the hallmark of a successful P/M program.



Record keeping separates the men from the boys in P/M. Even when you start with poor records, the results of P/M efforts will provide you the means for problem analysis which you *must* have to keep the P/M program fresh and relevant. In fact, if you do nothing more than check out each part of the plant where trouble occurs, thoroughly documenting each step, you will soon build up a wealth of usable information.

Things that you keep careful track of include: What environmental conditions prevailed before, during and after a failure? What electronic conditions were present at or near the failure site (such as AC line voltage, hum-mod, S/N ratio, etc.)? When was the last outage at or near the site and what type was it? Was the failure cause a repeat in this area, or of the particular device itself?

Forms and, more importantly, procedures needed to stay on top of P/M are a daily log, work order forms and equipment tags. It matters much that enough description of fault, conditions and results are entered. Writing "a book" is not needed, one-word or one-line data will suffice quite nicely. The important thing is to *do* it and to do it very consistently.

Next month we'll don our Sherlock Holmes garb as "P/M detectives," because if you don't know why something happened or when to expect it again, you can't head it off.

James Emerson is currently engaged in engineering sales for AM Cable Television Industries' E-Com subsidiary, which engineers and manufactures digital interface equipment and addressable systems for cable television.

A member of the Society of Cable Television Engineers, Emerson was elected to senior grade in 1978, to the Board of Directors in 1981 and served as Eastern vice president during 1982. Emerson is a well known author and speaker and is chairing the Atlantic Show engineering program for the third year.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'. . . the applications are limited only by the shortsightedness of the users'

Computer is great tool for modern engineers

By Robin Dickey
Staff Engineer, United Artists Cablesystems Corp

At United Artists Cablesystems, both engineering and management are now using computers extensively for a wide variety of purposes. Beginning in 1979 with little more than a snapshot idea of the power of computing, we raised the curtain to an audience of hardware and software and have ourselves become the players in what has become a progression of acts. After stages of trial and error, calculated risks, and now five years of invaluable experience, we can evaluate our past use of the computer, and more importantly examine the impact it will have to our cable engineering future.

Act one: Testing the waters

Just as the micro market was beginning to surge five years ago, the benefits of a microcomputer to an engineering department became evident and the decision was made to purchase a TRS-80 Model I. Its first uses were primarily for word processing and data filing, using programs that were constantly losing data due to mishandled disks, miskeying entries and software and hardware malfunctions. Disk drives were an add-on feature and unreliable for the day-in day-out use they received. We learned, after many cases of losing days and weeks of work, the meaning of "backup."

The Model I is an eight-bit machine with 12,000 bytes of read-only memory (ROM) in which BASIC is stored, a black and white monitor, a detached keyboard and an expandable random access memory (RAM) of 16 K. At first, cassette tapes were used to store programs and data, but an urgency for speed of performance expedited the purchase of two floppy disk drives with a controlling board as well as a line printer. The disks were single density, single sided capable of storing about 80 K each, and the number of cables necessary for this comparatively rudimentary system made the Model I a real octopus. The total package, excluding software, was $3,400.

Due to a small office environment, the word processing on the Model I was a real treat. Data file processing was also a nice feature of the system but probably the source of the biggest problems. The programs were slow, especially the sort routines (200 to 300 files took 20 to 30 minutes), and with the large volume of data occupying the disks, errors were frequent. Our evaluation lab used it to keep an inventory and status project reports as well as a buyers guide and equipment list for companywide use.

The introduction of the electronic spreadsheet for the microcomputer, however, was perhaps the single most important factor in securing a management level commitment to the microcomputer for our continued engineering use as well as for use throughout the company; management had seen Visicalc reduce the weeks and months of budget preparation to mere minutes.

Act two: Getting our feet wet

The next phase soon followed with the purchase of several TRS-80 Model IIIs. This system was still an eight-bit micro with a 16x64 character display, two disk drives, 48 K of RAM, but the device itself was self-contained and stood as a less formidable piece of equipment compared to the Model I, and with an Epson MX-80 printer, this system only cost about $3,000 in 1981.

Both the software support and user support for the Model III became increasingly better with a number of magazines providing a wide variety of software and hardware. In an effort to choose the best, most reliable of these products, the Engineering Department, mostly by trial and error, found printers, plotters, digitizers, speech synthesizers and an assortment of software to fit our needs.

The computer was quickly put to work preparing the engineering budgets using spreadsheets for analyzing department travel, vehicles, salaries, personnel and overall expenditures. In addition, word processing had now become a major function of the Engineering Department and was used for all correspondence, documents and reports, as well as lengthy policy manuals including our "Construction Practices Manual" and "Headend Practices." Many data base files were also put on the Model III including tower and earth station inventories and maintenance schedules, tool and test inventories, license renewals, etc.

The disk handling still remained the weak link in the computers. The problems ranged from dirty and misaligned disk drive heads to dust, Coke bottle rings and coffee spills on the disks, and only with better maintenance and user knowledge did the reliability improve.

The more we used our Model IIIs the more we liked them and the more dependent we became on them. It was at this point that we realized the ideal situation was to link our machines either by phone lines or hard wire lines in order to communicate with one another and exchange information directly rather than continually swapping data disks. RS-232 communications ports were installed in some of the machines and a series of modems were procured and discarded as we slowly learned about baud rates, word size, stop bits, parity checking, duplex and terminal programs. But, as engineers are known to do, we always sought an easier method or a better way, so we experimented with all kinds of software and peripherals to better solve our problems.

One of the engineers investigated pay-per-view ordering strategies by linking a couple of different speech synthesizers to the RS-232 ports and aided one of the vendors in developing a telephone ordering scheme using a computer voice to answer incoming calls and telephone touchtone response by subscribers.

Several BASIC programs were also created. A program originally designed by Magnavox was modified and converted to the Model III to analyze different design criteria and check system specifications. This program is now nearly 800 lines long and fully uses all the capabilities of the computer. Another program was written to analyze third order beats for a 52-channel example system because distortion problems are a concern in systems planning channel expansion.

These BASIC programs took the computer somewhere between 10 and 14 days to run on the Model III. It quickly became apparent that we needed something faster, so we purchased a compiler, which brought such unruly programs to manageable run times. Other engineering calculations also were made—such as system operating specifications, a phase analysis calculation to check proposed improvements made by HRC headends, and a trouble call program to determine the major causes of outages in some of our larger systems.

The computer was quickly becoming a useful and productive tool in nearly all areas of our daily work. Through our interest in computers and the desire for them to communicate with each other for data transfer and personal communications, we were intrigued by the new idea in the computer field of "Office Automation" or the "Paperless Office." We contracted Southwest Research Institute to determine what type of office system would best suit our needs.

Their report focused our attention to DEC and Data General minicomputers running integrated software covering all of our present functions and then some. We investigated their systems as well as others but ultimately determined they were all in the infant stage and were too restrictive in their software concepts. The final decision in the fall of 1983 was to purchase the fast rising IBM PCs, which we felt could eventually be worked into a network scheme as smart terminals, while allowing us the flexibility of software and hardware support we had become accustomed to.

Act three: Learning the strokes

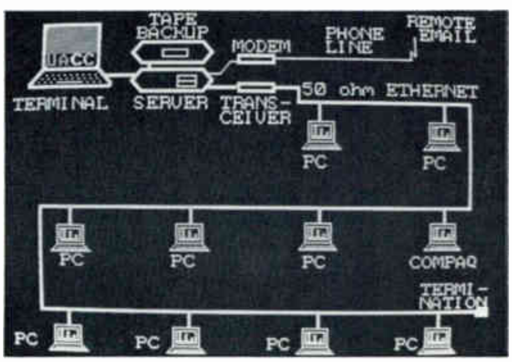
The IBM PC is a substantially more business-oriented machine than our previous computers. Its 16-bit power allows a much greater memory capacity (up to 512 K RAM in several of our machines), which has been needed for many of our projects. Processing speeds have increased with this larger memory compared to the TRS-80s. Sort routines that took 20 to 30 minutes now take less than a minute.

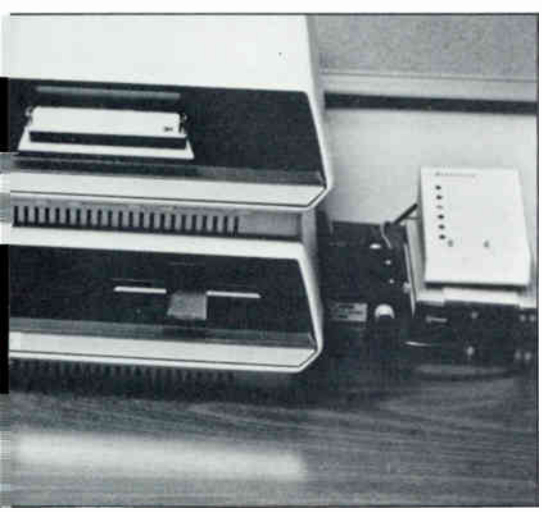
In retrospect, it is hard to imagine the things we squeezed onto 48 K. The disk capacity of the IBM PC is nearly twice that of the Model III, our handling and maintenance as well as improved quality of disks and disk drives has increased greatly. Once we grew accustomed to the PC keyboard and displays, we had few complaints, and have provided a variety of color monitors and word processing keyboards for various users' needs.

The capability of the PC to accept added memory and a various array of I/O boards inspired us to utilize internal clocks, 320 K or higher and at least one serial RS-232 port. Some have internal modems, graphics boards, color graphics boards and hard disk drives. The average system cost is around $6,000 for a fully loaded machine and printer.

Transferring from the TRS-80 Model III to the IBM PC requires access to both machines, as shown in the office arrangement above.
A local area network system block diagram is easy to show on the personal computer screen, right.
The local-area network system server, below, consists of the network terminal (l), tape backup and hard disk drive (c), and a tranceiver, power line monitor and 1,200 baud modem (r).

Our experience with the TRS-80 Models I and III made the implementation of the IBM PCs much easier since we knew what types





of software we needed. For us, the key to microcomputer productivity lies primarily with the software programs, their ease of use for both technical and non-technical personnel, and flexibility to handle the wide variety of uses we have created. For example, the word processing program must be easy enough and flexible enough for all users to whip out a short half-page memo or large documents such as our reports.

Our larger data base needs are being met by DBase II and the Versaform program for such data as our "Engineering Buyers Guide," purchase orders and training reports. For the smaller data file and spreadsheet needs we use Lotus 1-2-3 by Lotus Development Corp. The spreadsheet programs have come a long way in the past couple years, and are to the point now where it has its own programming language to produce very complicated calculations. Our use of it is mainly for budgeting, product comparisons and cost analysis for such projects as scrambling techniques and converter selections.

Act four: Taking the plunge

Once we had several of the powerful IBM PCs in the office we soon saw the importance of being able to transfer information from one to the other without having to hand carry floppy disks back and forth. After a great deal of investigation into the local area networks, we finally decided on 3Com Corp.'s Ethernet system. The system utilizes an Altos network server (a multiuser micro) with 50 ohm coaxial cables linking the PCs in series to the Altos' hard disk drive of 40 M (million) bytes. Thus we now have the capability to share data files.

The cabling had to be done in series, with 50 ohm terminators at the ends to prevent reflections from impedance mismatch, because of timing problems caused by two computers trying to transmit simultaneously. Each computer on the network is equipped with an Ethernet expansion board that serves as its transceiver to the system. The transmission rate is at 10 megabits per second with hard disk transfer rates at 4.8 megabits per second. This makes access times up to 20 times faster than accessing the floppy disks. The use of the 3Com system makes it essentially the same as adding 40 megabytes of disk storage to every machine connected to the system.

We initialized the system with one user, then two so we could get the bugs out before any major data was added to the hard disk. After having seen the ability of the microcomputers and their file sharing technique we set about devising our own office automation software. What we have come up with is one menu from which users may run various applications. We minimized the number of keystrokes required to access each program and data files to make the system more "user friendly." We now have 10 computers on the network with possible expansion plans to link the entire San Angelo, Texas, corporate office.

The newest software entry we have is Email by 3Com, or better known as electronic mail. This menu option gives us the ability to write memos and attach files quickly and easily to be sent to any user on the network. Users have the option to make quick replies or to forward the message to other users. Remote access of Email is also available by using a communications program through a phone connection.

In addition, through the use of MCI mail, an electronic message may be sent via phone line to other computer users or as telegrams or overnight letters. Other menu items now include an "Engineering Project Status Report" and a calendar program.

The shared environment has thus far been a great success. At first the 40 megabytes of storage seemed a large amount, but the success of the system has caused numerous applications to be implemented and consequently, we have depleted the capacity to about 5 megabytes.

Act five: Going for the distance

We have come a long way since our first Model I and we now anticipate a continually expanding use of the computer in both engineering and management, corporate and system level.

In the near future our present configuration should be expanded from 40 megabytes to possibly 80 megabytes or more for additional office users as well as remote users who also could access all the capabilities of the network. This could be accomplished by setting aside a PC linked to the system to be remotely taken over via phone connection. By enabling this feature system managers and chief engineers could send and review reports and other information without lag times created by the mail system.

All company office locations across the nation could be equipped with similar networks and the servers might be linked over dedicated phone lines to allow access to a great deal of data in the shared environment.

For example, one of the projects we are working on presently is to analyze more effectively the field findings of the corporate quality control department. We hope to use statistical sampling and reporting to ensure our limited resources are utilized to their fullest. In the future it may be possible to utilize the small portable computers for faster data collection and field testing. This data could then be transferred to a central data base for further analysis. Another application may include automation of our evaluation lab testing equipment to more quickly test and compare products.

Curtain call

The progress we have made in the past five years is astounding. We have gained the improvements of speed of computing, the growth in numbers of workstations, and the capability to share data. The costs have increased per workstation, but the power of each system far outweighs those costs with improved performance, ease of use and compatibility. The applications are limited only by the shortsightedness of the users. The more experience we gain, the more useful they become; we believe the forecast for computers in CATV is indeed optimistic.

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'Status monitoring . . . today is considered by many to be a necessity more than a luxury.'

System reliability, reduced costs promised

This article seeks to explain not only the fundamental principles of status monitoring and control techniques, but to acquaint the reader with why status monitoring and control is important in today's multi-purpose cable communications systems.

By Barry Breech
Jerrold Distribution Systems Division, General Instrument Corp

Status monitoring was created during the 1970s by the major equipment manufacturers (primarily General Instrument's Jerrold Division and Magnavox) as an amplifier add-on product and mainly as an incentive to sell these amplifiers. Just another bell and whistle with limited functionality, the early version of status monitoring didn't go over too well with cable system operators. Result: the technology was shelved.

The convergence of a number of events may be safely linked to the eventual emergence in importance of status monitoring equipment. Not the least of these events was the development of two-way interactive cable and the advent of advanced applications such as alarm and home security, civil emergency alert systems, pay-per-view, institutional data transmission and telephony over the cable system. Multiple system operators have made use of status monitoring and its promise of higher reliability as a means of winning franchise awards.

Rebirth of status monitoring

Other events in this scenario include the need by cable operators to reduce the cost of maintenance in their existing systems as advanced age (and more frequent repairs) started to set in. The ballooning cost of labor and service equipment (precipitated in part by the economic stagflation of the late 1970s) and the voice of the subscriber to local governments (making heard his complaint about the intermittent problems of CATV systems) all helped set the stage for the "rebirth" of status monitoring technology.

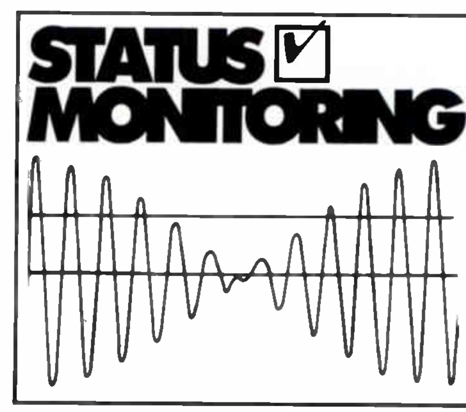
In many senses, the bottom line for cable operators was this: Recurrent system outages represented not only a loss of revenue for the operator, but lessened his competitive edge at franchise renewal time.

When municipalities included system reliability as a requirement for the granting of franchises, the need for status monitoring was clearly stated. Status monitoring grew from an add-on frill to help equipment manufacturers market amplifiers to an absolute necessity for the system operator. Equipment manufacturers proceeded to dust off their old status monitoring products, and went to work on updating them to current state-of-the-art technologies. But requirements changed drastically. CATV plant operators wanted more than the ability to tell if an amplifier was providing output or not. They wanted to be able to control certain amplifier functions, such as reducing RF ingress through return feeder switching, and determine whether the units had switched to standby power supplies.

Many other players have joined the field since Jerrold and Magnavox first broke ground. Companies such as Century III Electronics (now a part of Jerrold) and Lindsay have made their presence known. The 1980s saw Scientific-Atlanta, Texscan, C-COR and GTE-Sylvania (now a part of Texscan) enter the fray of equipment manufacturers. Many manufacturers have gone on to expand the functional capabilities of monitoring and control by employing microprocessor technology.

Daily requirements

Today, requirements for status monitoring systems have grown and now include the

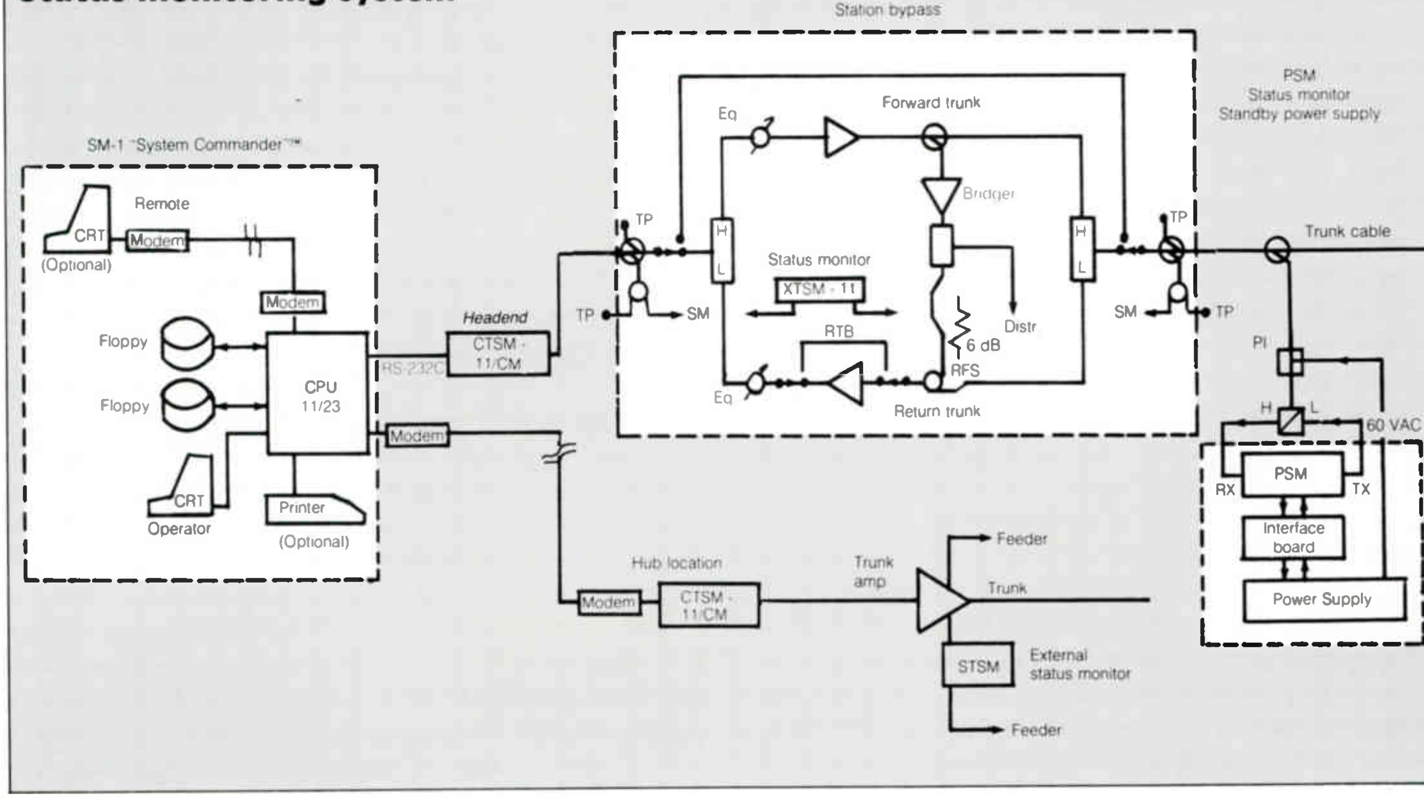


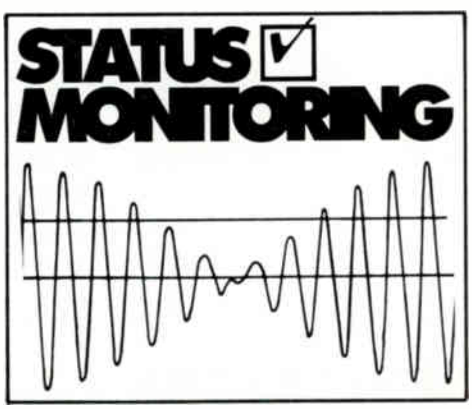
ability to do more extensive monitoring of the total CATV plant—even the ability to control various system functions from a remote location. The present market for status monitor and control equipment demands technology that can provide information on the overall operating condition of the CATV plant, detect and diagnose faults in a system before disruptions of service occurs and control certain amplifier and standby power supply functions for multiple hub systems, both locally and remotely from the master headend.

The primary objectives of today's status monitoring and control systems are basically these:

- Increased reliability
- Reduced downtime
- Reduced maintenance costs
- Knowledge of equipment operation over entire plant
- Better utilization of manpower for maintenance and system operations
- Prevention of catastrophic failures through trend analysis and alarm histories

Status monitoring system





Incorporating microprocessor technology in status monitoring systems provides the operator with the ability, among other things, to check whether an amplifier or standby power supply station is functioning and to measure a number of different types of related data.

The unit that performs status monitoring functions is called the transponder unit. It usually fits within the station housing. In order for the transponder to perform different measurements, an analog-to-digital converter (ADC) has been added to the transponder unit. It can measure the following: RF levels, temperature (with sensors), AC/DC power and current levels. Together, the microprocessor and the ADC are capable of performing numerous control and monitoring functions.

Status monitoring functions

Some of the more common amplifier functions monitored are forward and return RF level measurements. These measurements consist of the forward and return carrier frequencies used by status monitoring equipment for commands and data transmissions. It is possible to get RF measurements by a variety of methods: using AGC (gain) and ASC (slope) voltages for approximations; searching for a hardware fixed limit with a programmable attenuator and counting the attenuation required to reach it.

The amplifier's status monitoring module usually measures forward RF levels and reports this information back to the headend or hub site. The return (reverse) RF level is normally measured at the headend or hub site.

Other functions performed in the amplifier include control of a return feeder switch for the opening and closing of this path. Some amplifier equipment manufacturers offer the capability of attenuating the return feeder path upon command of the SM (status monitor) system, controlling other amplifier switches, and have an amplifier housing tamper switch to monitor intrusion.

Power doubling, redundancy, and feedforward technologies are offered by several amplifier manufacturers. This adds a slight problem to the status monitoring of the trunk amplifier because of the way these amplification techniques work.

In power doubling or redundant forward trunk amplifiers, a failure in one of the two amplifier circuits will show up as a drop of 6 dB in the forward trunk amplifier's output, as measured by the monitoring unit. Therefore, the monitoring of the amplifier's output level requires precision measurement techniques to verify this type of failure mode.

With feedforward technology and its inherent failsafe qualities, the cable operator will not have any indication of a failure in one of the two amplifier hybrid IC circuits because there isn't a drop in output level. In order to detect a failure in a feedforward trunk amplifier, the operator or technician can use a status monitoring technique to control the DC power to both the feedforward amplifier circuits through micro-switches, turning them off and on, one at a time. It is recommended that this be timed so as not to interfere with programming to subscribers, say at 4 a.m. This technique also could be executed automatically by the status monitoring computer. If during the switching process the forward RF is lost, the previous circuit turned off would be the suspect one. Once pinpointed, repair personnel can be dispatched. It should be noted that the amplifier status monitoring module performing this type of control is normally a module in the housing.

External units and standby power supplies

Not all amplifier status monitoring is done with an internal module; external units or stand-alone transponders also can effectively perform this task. However, these stand-alone units have their own set of requirements, including their own power supply, high and low pass filters, placement inside a weather-proof housing and connection to the monitored amplifier through external cables. External units are compatible for monitoring other CATV manufacturer's equipment, and can perform control provided they accept TTL communications. Some of the CATV power supplies on the market are compatible for monitoring and control in such a way.

Channell

Channell pedestals are constructed of the highest quality, field proven ABS plastic and are designed to meet all the requirements of the CATV industry.

The extreme strength of ABS plastic (this is the same material used to produce such high impact items as football helmets, racing car crash helmets, automobile dash boards etc.) and the dome type structure of Channell pedestals provide incomparable durability in all phases of installation.

Channell pedestals provide the following advantages:
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- Corrosion proof
- Will not draw and hold heat
- Extremely durable
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- A very low profile

The dome structure facilitates 360° access, and is supplied to the field with **factory installed hot-dipped galvanized stakes.**

All Channell pedestals are available with hasp or the intertite locking system.

ANIXTER COMMUNICATIONS

The CPH-658 will house any tap, filter, equalizer or splitter.

Dimensions: 6.5" diameter, 11" - 16" above grade
Weight: 4.5 pounds with stake
Shipping: 8 per carton
Basic Unit: Shipped complete with stake attached and hasp lock.

The CPH-1016 will house any tap, and line extender combinations or small amplifiers.

Dimensions: 10" diameter, 21" - 29" above grade
Weight: 11 pounds with stake
Shipping: 2 per carton
Basic Unit: Shipped complete with stake attached, hasp lock and designated drop holes in base.

The CPH-1730LPB is an extremely versatile low profile, trunk amplifier housing with enough room for taps and splitters. This asthetically pleasing pedestal sits only 17" above ground and will house any trunk amplifier.

Dimensions: 17" diameter, 16" - 24" above grade
Weight: 50 pounds
Shipping: 1 per carton
Basic Unit: Shipped complete with ground skirt, hasp lock and mounting bracket

The DCPH-1730LPB (INSET) will house any dual line extender combination. (Dimensions same as CPH-1730LPB.)

The CPH-816 will house any tap and splitter combination.

Dimensions: 8" diameter, 21" - 29" above grade
Weight: 8 pounds with stake
Shipping: 4 per carton
Basic Unit: Shipped complete with stake attached, hasp lock and designated drop holes in base.

The CPH-1022 will house any tap, splitter and line extender combinations.

Dimensions: 10" diameter, 21" - 35" above grade
Weight: 13 pounds with stake
Shipping: 2 per carton
Basic Unit: Shipped complete with stake attached, hasp lock and designated drop holes in base.

The DCPH-1006 dual plant pedestal will house two taps or two couplers.

Dimensions: 10" diameter, 11" - 19" above grade
Weight: 8.4 pounds with stake
Shipping: 2 per carton
Basic Unit: Shipped complete with stake attached, hasp lock and designated drop holes in base.

The DCPH-1016 dual plant pedestal will house any two tap and splitter combinations.

Dimensions: 10" diameter, 21" - 29" above grade
Weight: 11 pounds with stake
Shipping: 2 per carton
Basic Unit: Shipped complete with stake attached, hasp lock and designated drop holes in base.

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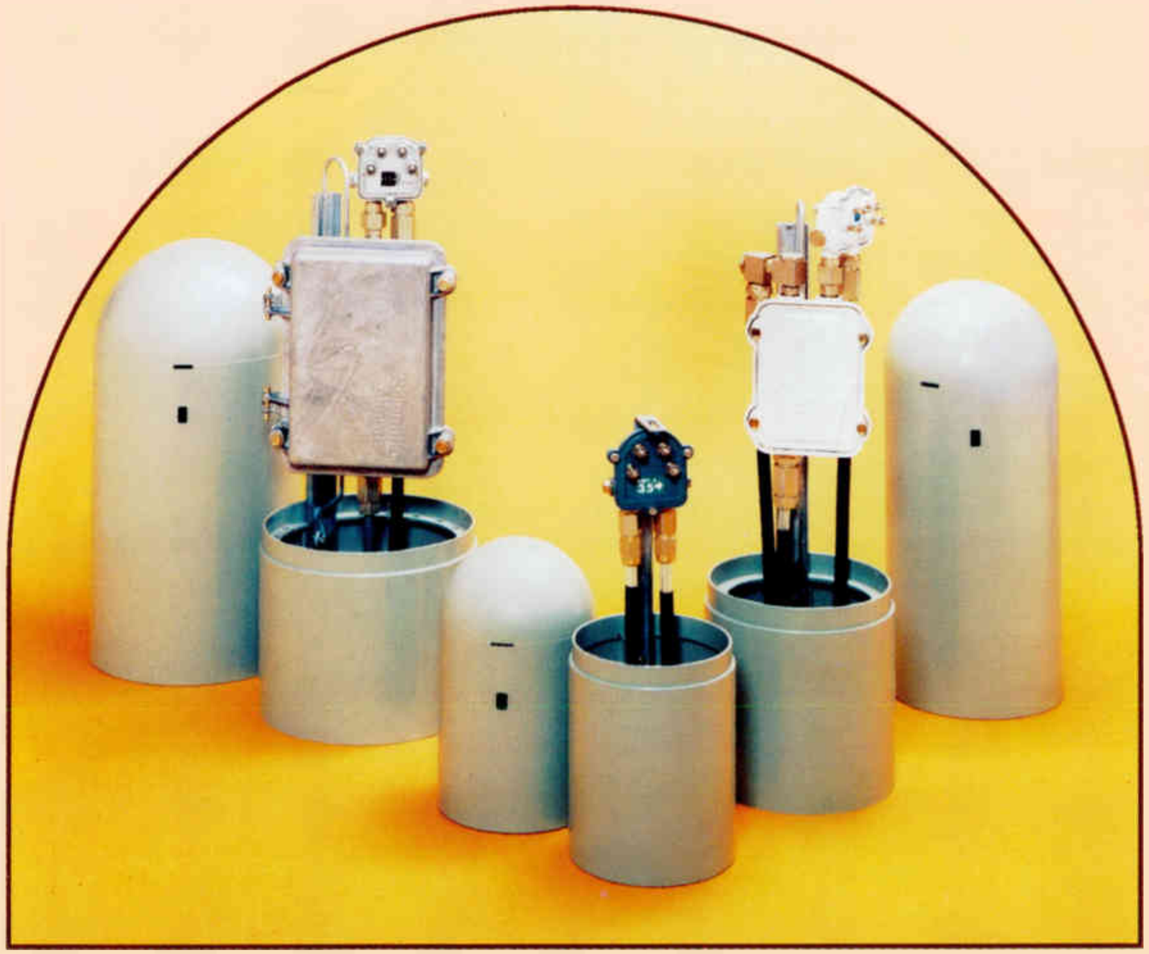
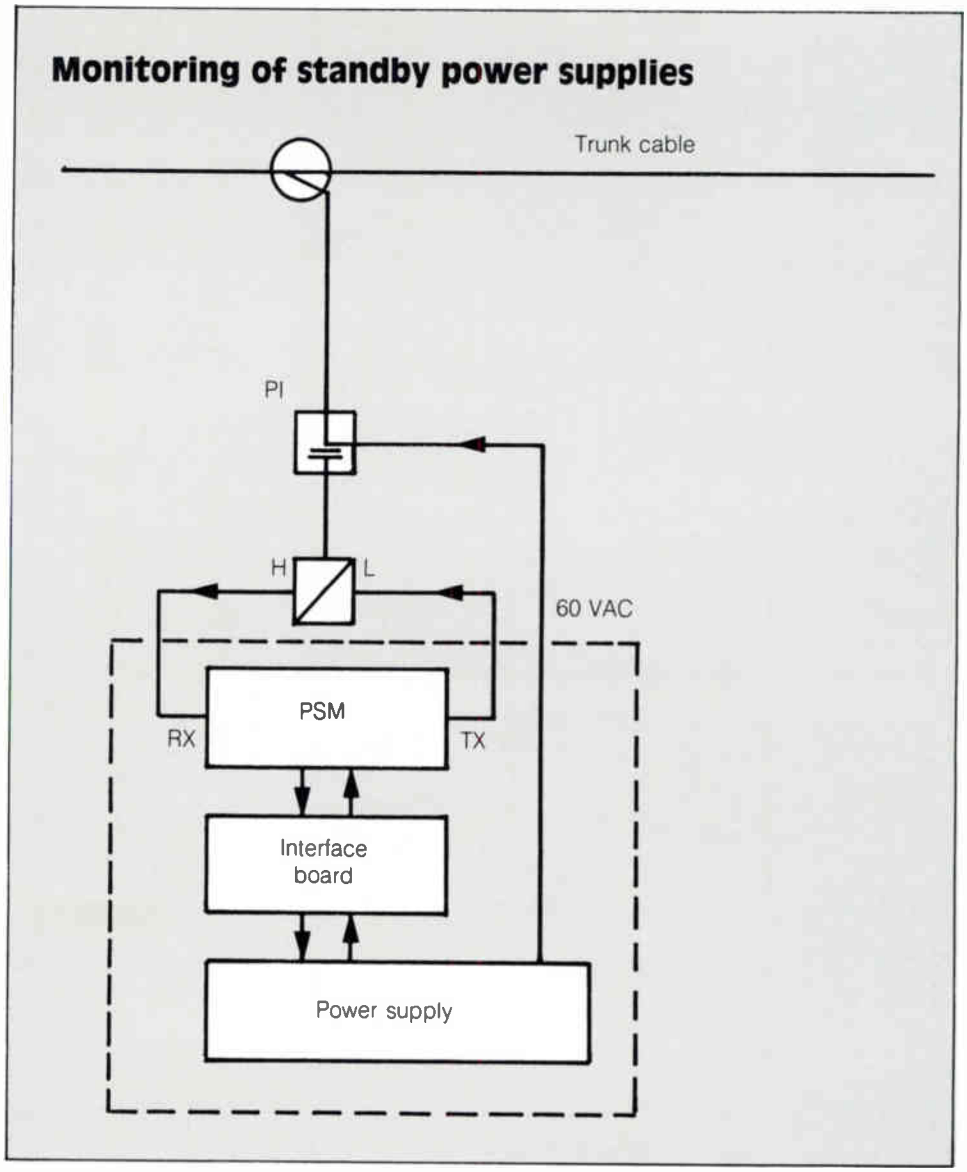


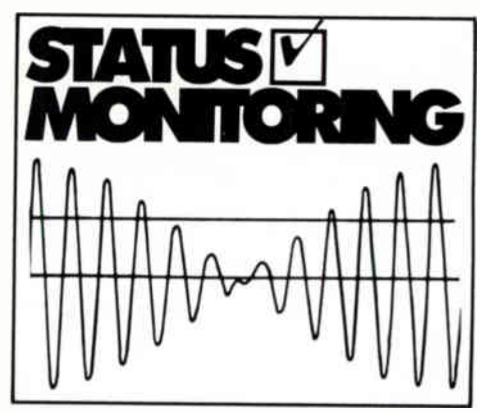
Channell

PEDESTALS



Some amplifiers can be equipped with (internal) redundant DC power supplies. Information on which supply is operating is reported back to the status monitor unit. It is possible to report the switchover statuses of external standby power supplies through the use of a port in the amplifier's housing and an external connection to the standby power supply. This port has limited capabilities for reporting the statuses of the standby power supply.

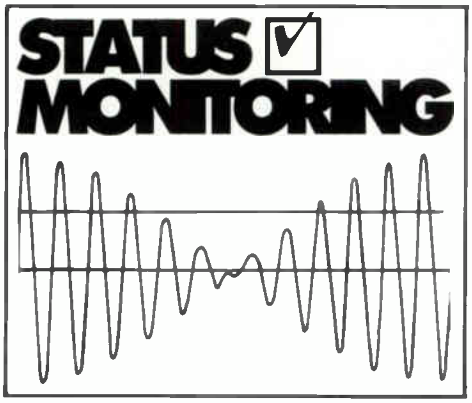
An improved method of monitoring and controlling a standby power supply is specifically to design the status monitoring module for this type of power supply and have it mounted internally. In this manner, it is possible to measure accurately the temperature, battery voltages and system load levels. Additional digital statuses are also sensed, such as cabinet tampering, charger/inverter malfunction and AC/standby switchover. Jerrold and Texscan offer this type of unit, which also allows for manual command of the AC/standby switchover for exercising the batteries. Both manufacturers have standby power supply status monitoring modules compatible with those of Alpha Technologies.



Crucial to all of this, however, is the organized presentation of the information generated by status monitoring equipment. Such vital information is essentially useless to the CATV plant operator if it cannot be presented in a manner that helps to control and manage a cable system effectively. This leads us to the subject of using the status monitoring system.

Using status monitoring

There are a variety of main operator interfaces, starting with manual transceivers



equipped with LED and toggle switches for data display and commands. This type is the least expensive of the man-machine interface units on the market, however, manual transceivers have the least amount of functionality.

Other types of man-machine interfaces include personal computers and professional minicomputers with video monitors. In order to determine the number of amplifier and/or standby power supply transponder modules the status monitoring system can communicate with, it is first necessary to choose a main computer and a method of interfacing. Equipment manufacturers that offer a computer as a headend unit use a serial communication link. Personal computers have the limitation of a small number of serial lines. Professional minicomputers, like those made by the Digital Equipment Corp., can support a large number of serial lines and consequently, a large number of transponders.

The RF cable modem (modulator/demodulator) is the interface between the status monitoring transponders in the RF amplifiers and/or standby power supplies and the main computer. Most cable systems have an RF cable modem that converts between RF broadband and RS232-C computer formats. Use of a modem allows for the central location of the computer and a remote location for the plant's transponders. Communications between these devices is done over telephone lines or data modems for transmission via broadband (microwave/AML/FML, satellite and cable).

Jerrold bases its own status monitoring and control system on the DEC PDP-11 23 minicomputer, which has the capability to connect to 16 RF cable modems via serial RS232-C links. Each RF cable modem can communicate with 512 transponders (a total of 8,192 transponders per headend system). The computers have software allowing for the display of data in an easy to use format, storage of alarm histories for later analysis, and trend analysis of the transponder's data for video display. It is information like this that helps the cable operator to foresee problems before they become critical and to allow for corrective maintenance to be scheduled at his convenience.

Systems of the future

Today's status monitoring systems feature many important capabilities. There are, however, ways in which technology may be able to improve upon monitoring and control systems as we know them.

For example, future status monitoring systems will be taking some direction from the process control industry. Distributed control of the cable system will become more prevalent with microprocessors used in transponder units, a microcomputer for the remote hub device, and a professional minicomputer at the headend office to connect all the remote hubs together. The main headend computer will have multiple video terminal capabilities, in addition to being able to support multi-color graphics.

Status monitoring will expand beyond amplifiers and standby power supplies and, eventually, status monitoring and control systems will oversee headend equipment. The SM systems will also control backup tuning and replacement upon detection of failure in frequency agile output converters.

The challenge

Another foreseeable application for a status monitoring system will be the examination of data modems used in a cable system. Institutional networks, especially, will depend on the continued functioning of data modems so crucial to these networks. Modems offer computers the ability to "talk" to each other, and only the computer to which it is connected "knows" if the modem is working. In the event of a malfunctioning modem, the cable operator will be unaware of problems. One of the challenges for status monitoring equipment manufacturers is to devise a method whereby the data modem will report back to the status monitoring headend computer to notify the system operator of any failures.

Finally, the future could possibly bring stand-alone status monitor units for placement in home or business sites to diagnose transient problems, at remote hubs or buildings to check on air conditioning systems, entrance ways and electrical generating equipment. Other challenges: combining security, addressable headend, and status monitoring functionalities with separate video terminals for each.

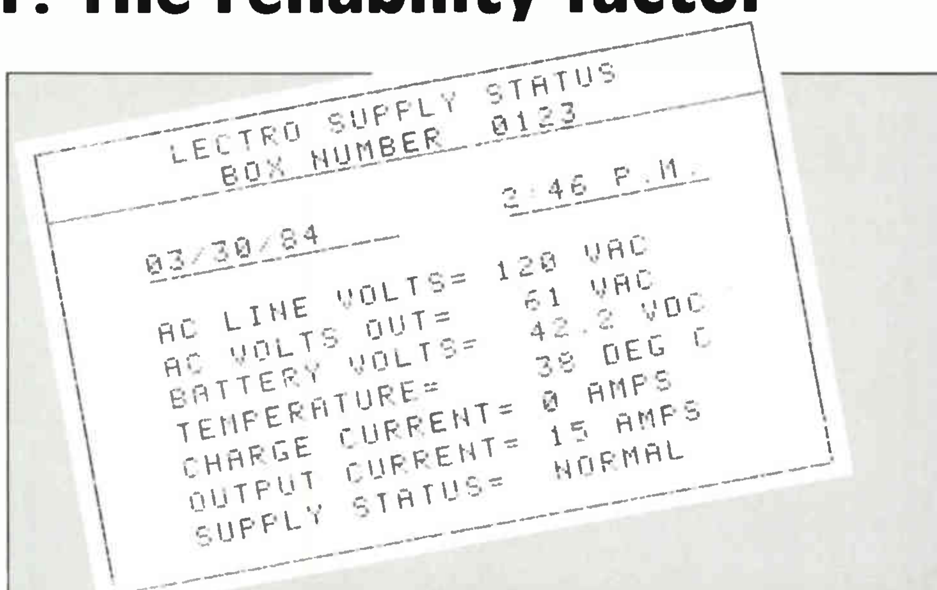
As with other cable technologies, status monitoring has come a long way, and today is considered by many to be a necessity more than a luxury. A status monitoring and control system offers the operator an instant overview of a system's critical components, provides a smoother running system and, last but not least, peace of mind.

Standby power: The reliability factor

By Mason Hamilton
National Sales Manager, Lectro Products Inc

Standby power was introduced to the cable television industry in 1973. As best can be determined, there were two manufacturers that made the initial attempt at producing a combination regular 30 or 60 volt power supply with a standby inverter built-in. There were also system operators that experimented with making a standby unit for their own use. One of these operators, Davis Communications, set up a small manufacturing shop in its DeKalb County, Ga., cable system office. Other passive and active products were manufactured in addition to the standby unit.

Although the product was conceived with the best intentions, the reliability of these early versions was lacking severely. Failure rate was almot 100 percent. Warranty and/or repair from the manufacturer was practically


LECTRO SUPPLY STATUS
BOX NUMBER 0123
03/30/84 2:46 P.M.
AC LINE VOLTS= 120 VAC
AC VOLTS OUT= 61 VAC
BATTERY VOLTS= 42.2 VDC
TEMPERATURE= 38 DEG C
CHARGE CURRENT= 0 AMPS
OUTPUT CURRENT= 15 AMPS
SUPPLY STATUS= NORMAL

Typical printout received when interrogating status of a power supply.

nonexistent. By 1976, standby power was suffering from a credibility gap that caused the original manufacturers of the product to give up, and created a difficult situation for a new manufacturer.

Movies prompted innovation

The necessity for a reliable standby power system became paramount with the inception in the early '70s of additional services in the cable industry. Stand-alone movie services were the prime reason to assure uninterrupted service to cable subscribers who were paying extra dollars to view a movie once a night, week or month. The big problem in ensuring that these subscribers receive their pay-per-view programs, was the capability to have power to all the amplifiers throughout the cable system.

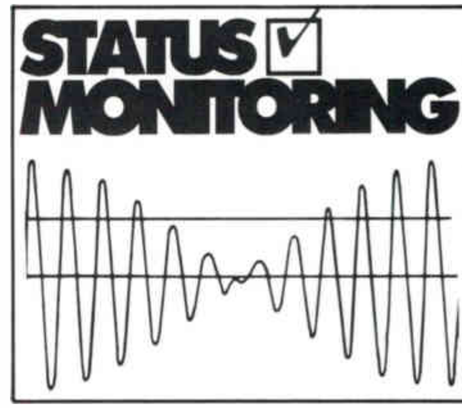
This capability was an extreme problem in high lightning areas of the country. Such an area was, and still is, Central Florida from Sarasota across to Cocoa Beach. This area has more days of severe thunderstorms with damaging lightning strikes than probably any other part of the world. In 1975, from this environment came a new product with an old and proven inverter design used in World War II U.S. aircraft. The product and the people involved have proven the viability and reliability of standby power for use in cable systems since that time.

Four basic designs

In just the past three years, standby power manufacturers have increased from six to 16. In spite of this influx there has been no major innovation over the three DC-to-AC and one DC-to-DC designs. They are as follows:

1) The basic ferroresonant (FR) transformer necessary to power distribution amplifiers, with a separate standby section that switches on by means of electronic or mechanical relays when commercial power is interrupted. This design has been, and continues to be, the most desirable due to its reliability and versatility, i.e., the operator may purchase only the FR portion and add the inverter section (with its transformer) when and if necessary or desired. The latest models of this design are totally modular in that they plug-in/pull-out without disturbing any wiring within the housing. This feature allows the cable operator the utmost in ease of maintenance without disrupting power to the cable system when one or the other module is removed from the housing. Total isolation from power is obtained by using pre-grounded connections for safety.

2) A single-driven inverter ferroresonant that in most designs utilizes electronic switching as standard. Probably the one advantage this design has is in switching time to standby operation. That would be from five to 10 msec as compared to 15-25 msec in the mechanical relay design switching. A major problem to be considered in this design is the possible failure of the electronic relays that could send power back into the power line creating a hazard to a power company lineman. Another factor to consider is the one-module concept. Both ferroresonant and standby are in one module. Some of these designs require hand wiring changes to remove. While the maintenance is being performed the cable system is without any power from that point in the system.



3) The third AC-to-DC design is actually the first design attempted back in the early '70s. This is the creature that gave standby power a bad name in those early days. It incorporates the inverter being on at all times. The 120 VAC

is fed through a rectifier to the batteries which then power the continuously running inverter. The operation requires no switch over. This would be the ideal operation if somewhere, someone could figure a way to keep the unit operating in the atmosphere/environment that a cable television standby power supply has to operate.

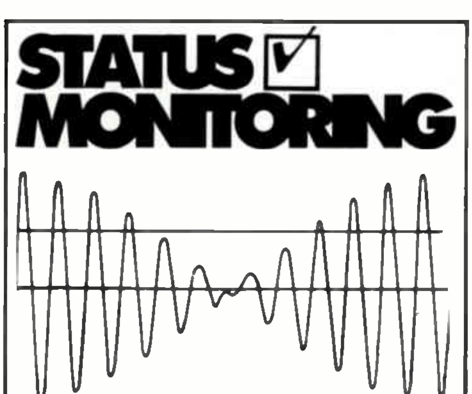
4) The DC-to-DC concept utilizes a strand mount amplifier-type housing for each amplifier station that is to be standby powered, including line extenders. This design does not connect in any fashion to the regular 60 VAC power supply. The batteries utilized are usually two small 12 volt gel cells that fit into the standby housing. The switch time from line to standby varies according to manufacturer from 0 to 200 msec. The standby is wired directly to the DC supply in each amplifier. Recharging of the battery is accomplished by using the 60 VAC power on the cable. This design can be very expensive if the entire cable system is to be covered by standby. However, if only the trunk is covered the cost runs very close to the more expensive DC-to-AC types. Maintenance can be a problem due to the quantity of units needed and the possibility of heat causing breakdown of the gel cells. This type standby has had very limited use as far as can be determined.

Without exception, type #1 has been the most popular over the years. Feature for feature there is very little difference in any of type #1 and #2. Four or five of these types are manufactured in Canada with the rest being good old American products. Several of the designs looked at lately are crammed full of circuitry, some with as many as 17 trim pots. One must wonder upon seeing these electronics if this is an engineer's dream or nightmare.

'Keep it simple—Make it fun'

The theory some engineers have seems to be "More is Better." A good philosophy is "Keep it Simple—Make it Fun," i.e.: Why put more circuitry in a device to cause problems if it doesn't give you any great advantage in accomplishing the job? Remember, the majority of standby units are only called on to operate once a year for an average of 30 minutes. As best as can be determined all standby units have regulation now, some slightly better than others, although it doesn't buy the operator much due to the relatively short time the standby mode is in operation. It does, however, cut down on efficiency. The specmanship game is alive and well.

Some other factors such as overload and surge protection, battery charger design and operation, 24 VDC or 36 VDC operation, batteries over or under electronics, etc., are somewhat difficult to address strictly from reading a specification sheet. A spec sheet is written based on the assumption that all conditions are ideal. Unfortunately, shortly after a unit is installed, batteries have had a small amount of use, temperature variations, additional amplifier(s) added to system, etc.; you can throw the spec sheets away. The standby power supply you buy (unless it was a dud to begin with) is only going to be as good as the maintenance program performed. The 2 percent, 3 percent or 5 percent regulation; the 8 amp, 6 amp, 5 amp, 4 amp, or 3 amp battery charging; the 2 hours, 3 hours, 3.5 hours, 4 hours or even 6 hours aren't going to make any difference without maintenance.



Maintenance is essential

Probably 70 percent of the cable systems using standby power today do not have any maintenance program to ensure that the unit will function when called on. A common answer to the question, "How are our standby power units operating?" asked by major cable engineering vice presidents is, "They aren't." "*Why?* Don't you check them from time to time?" "Uh; No. Uh, was I supposed to?" The engineers who do have a program in place in their systems follow this outline (with a form taped inside the cabinet and another to match in a record book for comparison and ready reference in the office).

- Cycle unit into standby mode for five- to 10-minute run.
- Visual inspection to housing (unusual wear and tear, nuts and bolts).
- Visual/tightness test of various wiring connections (inputs, outputs, grounds, etc.).
- Check all wet cell batteries for proper fluid levels. If fluid is required, use distilled water for best results.
- Using a hydrometer, check each cell for specific gravity. (One bad cell equals a bad battery; one bad battery equals no standby power.)
- With unit in normal operation (no standby), disconnect one battery lead and check voltage on each battery. A fully charged battery should read between 12 and 13 VDC. If a battery reads 10 VDC or less, it is most likely bad. It would be wise to change it out, and check it more carefully at the shop. (Record date and which battery was replaced.)
- With one battery lead disconnected and unit in normal operating condition (no standby), check battery charge voltage for power supply manufacturer's recommended charge voltage. Obvious indication of improper charge voltage setting would be boil over of battery fluid.
- Corrosion on battery terminals may be removed by using baking soda. Anti-corrosion liquid and sprays are available to prevent or hamper corrosion.
- Cycle the unit into standby again for a five-minute period as a final check. Log all information from record book to record sheet inside housing.
- Return to normal operation, close and lock door. (Total maintenance time—approximately 30 minutes.)

Note: All voltage readings should be taken with a digital multimeter for accuracy. No other test equipment is required for field maintenance.

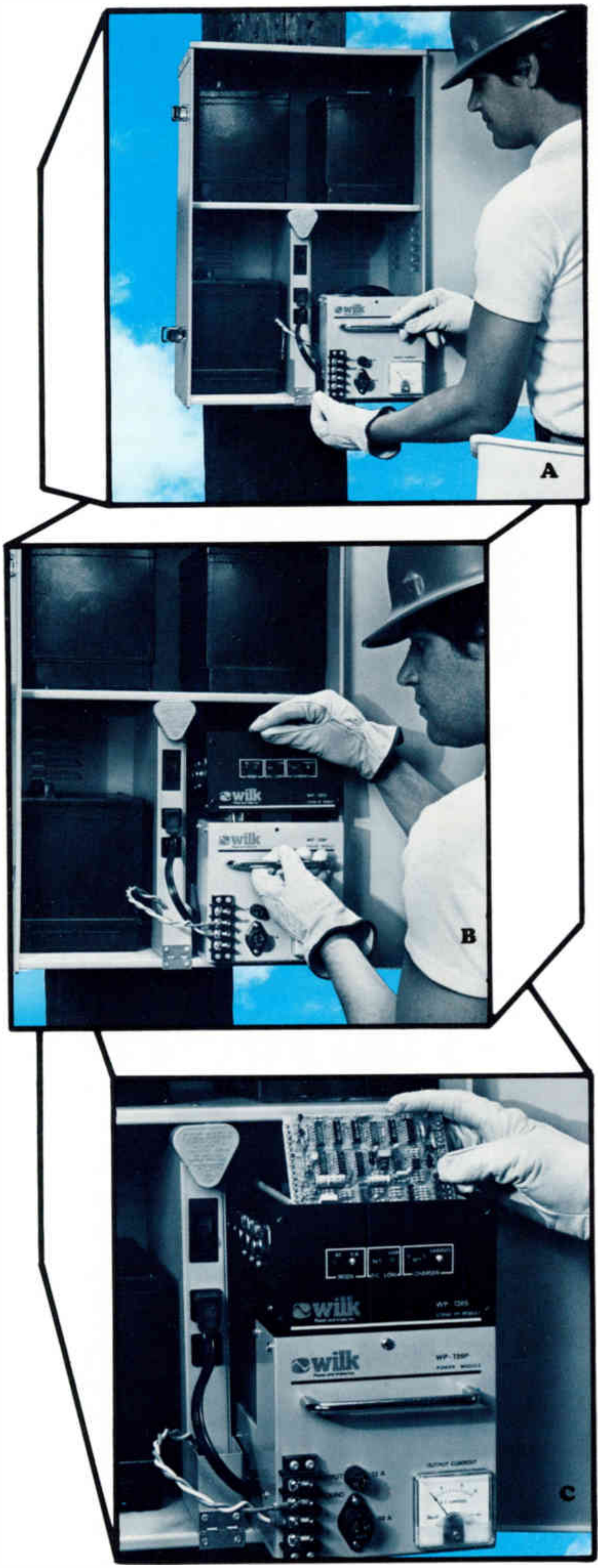
Important parameters

Probably the single biggest problem encountered with standby power is improper battery selection. The batteries that are designed for standby operation are deep cycle lead calcium 105 amp hr. minimum. An 80 amp hr. gel cell has proven itself worthwhile for consideration in usage and in tests. Never use maintenance-free or other automotive-type batteries in standby applications. They were not designed for, and will not give, good service in this application.

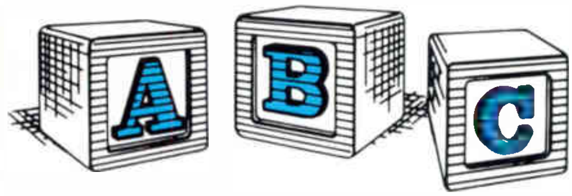
UL approval has been raised as a factor in the selection/approval process recently. Some of the manufacturers are now either approved or in process of obtaining approval by Underwriters Labs. It was learned recently that the manufacturers who have advertised this approval do not actually meet the approval specification in *every* unit produced. The UL approval only covers the AC line input connection box on those units with approval. By the utilization of a UL approved line cord, most power supplies would qualify for UL approval. After all, what other component in the cable distribution system *is* UL approved?

In order to make a qualified decision on the proper standby brand for your use it is suggested that you go through the evaluation process with two or three of the leading manufacturers' units. If you don't have time or do not want to go through this process, call the manufacturer for a user list of their products. Select several of each manufactuer's users at random to call for a reference on the product. In your inquiry, be sure to ask the question, "Is the factory and field service rated as excellent, good, fair or poor?" If still in doubt, purchase a unit from each of the manufacturers that have the best references. Install a system in areas where major outages occur and monitor.

Your subscribers deserve the ability to have pictures available at all times. You, as a system operator/engineer, deserve to cut down on your service calls caused by power outages. Operators and engineers both deserve a proven, reliable standby power supply to ensure these factors.



Wilk's modular standby power supply- As easy as



Wilk Power and Video's CATV standby power supply features a unique, totally modular compact design which allows easy plug-in installation of components whenever you wish. This simply means that if you (A) are not ready for standby power now, you can invest in the power supply today, (B) any time later simply add a plug-in standby power module, and (C) when you're ready for Status Monitoring, just plug in Wilk's Status Monitoring Module.

This modularity also means that all parts are readily accessible for ease of maintenance, and yet this rugged heavy-duty unit offers long-term reliability with power to spare. The unique composite ferro-resonant transformer design regulates voltage in both utility and standby modes, sustaining the output voltage within 3% of the 60V nominal.

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Amateur radio and cable television

'Radio amateurs can be important allies to the CATV industry.'

The term "radio ham" is often heard and refers to a non-commercial radio operator who is governed by the Amateur Radio Service rules under the Federal Communications Commission Part 97. A radio amateur is perceived differently depending upon one's knowledge of and association with the ham community. To some he may be considered as one who has large and mysterious antennas on his property and stays up all night looking for rare contacts around the world. To others he may appear as one involved in communications for public service or community events. In some cases the ham is a neighbor who is suspected to be responsible for interference to television reception. Even in the CATV community there is a great diversity of knowledge about this hobby group. This article is aimed at presenting a broad brush picture of amateur radio with special emphasis on its interaction with cable television.

By Robert V.C. Dickinson,
Director, E-COM Laboratories Division, AM Cable TV Industries

Amateur radio began around the turn of the century when numerous non-commercial experimenters attempted to duplicate and refine the experiments of Marconi and other early radio pioneers. In those days, there were no regulations so there were no restrictions on frequency, power, etc., imposed upon these experiments. Early commercial communications took place at frequencies below the broadcast band but were soon stimulated to move higher by radio amateur findings. As commercial communications grew governments around the world set up regulatory agencies that governed commercial communications and, at the same time, restricted non-commercial (amateur) operations.

In the United States amateurs were allowed to operate only on wavelengths of 200 meters and below (1500 KHz and above), which at that time were considered to be unusable for communications. Contrary to these ideas radio amateurs soon proved that communications over much longer distances and with lower powers were possible at higher frequencies. Messages through amateur channels were often relayed to locations at far greater distances than available through commercial channels. In 1914 the American Radio Relay League (ARRL) was organized by Hiram Percy Maxim and Clarence Tuska for the purpose of serving the public interest through amateur radio.

When World War I broke out amateur radio operation was forbidden by the government. Even though amateur operations were banned during this period radio amateurs became some of the foremost developers of radio communications during the war. The Amateur Radio Service was reopened late in 1919 as the result of work of Maxim and others who took the matter to Washington. As experimentation continued, a series of frequency bands (160 through 6 meters) were established by law for the exclusive use of amateur radio. By use of these bands, transcontinental, in fact worldwide, communications became commonplace. Over the years, as technologies have been developed and higher frequencies employed, the Federal Communications Commission has authorized other amateur bands throughout the electromagnetic spectrum. Table 1 gives a listing of the frequencies now available for radio amateur use.

Table 1:
U.S. amateur radio frequency allocations

Frequency band	Emissions
kHz	
1800-1900	A1, A3
1900-2000	A1, A3
3500-4000	A1
3500-3775	F1
3775-4000	A3, A4, A5, F3, F4, F5
4383.8	A3J/A3A
7000-7300	A1
7000-7150	F1
7075-7100	A3, F3
7150-7300	A3, A4, A5, F3, F4, F5
10100-10109	
10115-10150	A1, F1
14000-14350	A1
14000-14200	F1
14150-14350	A3, A4, A5, F3, F4, F5
MHz	
21.000-21.450	A1
21.000-21.250	F1
21.250-21.450	A3, A4, A5, F3, F4, F5
28.000-29.700	A1
28.000-28.500	F1
28.500-29.700	A3, A4, A5, F3, F4, F5
50.000-54.000	A1
50.100-54.000	A2, A3, A4, A5, F1, F2, F3, F4, F5
51.000-54.000	AØ
144-148	A1
144.100-148.000	AØ, A2, A3, A4, A5, FØ, F1, F2, F3, F4, F5
220-225	AØ, A1, A2, A3, A4, A5, FØ, F1, F2, F3, F4, F5
420-450	AØ, A1, A2, A3, A4, A5, FØ, F1, F2, F3, F4, F5
1215-1300	AØ, A1, A2, A3, A4, A5, FØ, F1, F2, F3, F4, F5
2300-2450	AØ, A1, A2, A3, A4, A5, FØ, F1, F2, F3, F4, F5, P5
3300-3500	AØ, A1, A2, A3, A4, A5, FØ, F1, F2, F3, F4, F5, P5
5650-5925	AØ, A1, A2, A3, A4, A5, FØ, F1, F2, F3, F4, F5, P5
GHz	
10.0-10.5	AØ, A1, A2, A3, A4, A5, FØ, F1, F2
24.0-24.25	AØ, A1, A2, A3, A4, A5, P, F1, F2, F3, F4, F5
48-50, 71-76 165-170, 240-250	AØ, A1, A2, A3 A4, A5, FØ, F1, F2, F3, F4, F5, P
Above 300	AØ, A1, A2, A3, A4, A5, FØ, F1, F2, F3, F4, F5, P

Note

The types of emission referred to in the amateur rules are as follows:

Type AØ—Steady, unmodulated pure carrier.
Type A1—Telegraphy on pure continuous waves.
Type A2—Amplitude tone-modulated telegraphy.
Type A3—A-m telephony including single and double sideband, with full, reduced or suppressed carrier.
Type A4—Facsimile.
Type A5—Television.
Type FØ—Steady, unmodulated pure carrier.
Type F1—Carrier-shift telegraphy.
Type F2—Audio frequency-shift telegraphy.
Type F3—Frequency- or phase-modulated telephony.
Type F4—Fm facsimile.
Type F5—Fm television.
Type P—Pulse emissions.

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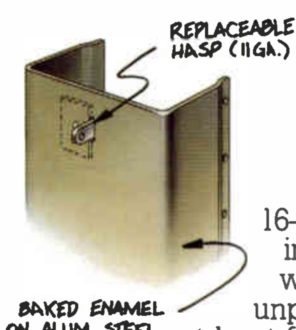

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Hams aid in development

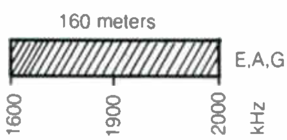
The federal government has always been aware of the value of amateur radio since many important developments in radio communication have come from the ranks of the hams. These developments have often preceded commercial and military employment. During World War II thousands of skilled amateurs contributed to the development of many secret radio devices and other important military electronic equipment. The members of the amateur community include many top development engineers in communications, propagation and computer fields. These have taken their professions and extended them as

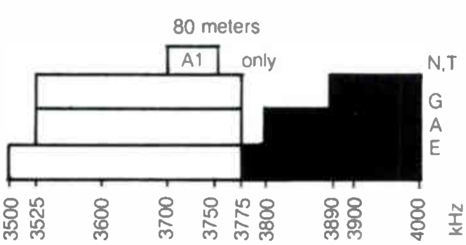
U.S. amateur frequency and mode allocations

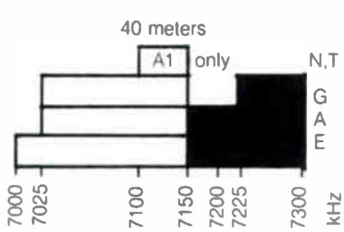
Power Limits: All U.S. amateurs are limited to 200-W PEP output in the Novice segments. On all other segments, with certain exceptions in the 160-meter, 10-MHz and 420-MHz bands, 1500-W PEP output is permitted. (A-m operations will use old power limits and standards until June 1, 1990.) Also, there are erp limitations for stations in repeater operation. (See 97.67, FCC Rules.) At all times the power level should be kept down to that necessary to maintain communications. (Revised as of December 1983.)

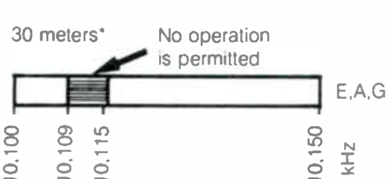
Bandwidth limitations

Frequency (or phase) modulation: On frequencies below 29.0 MHz, the bandwidth of F3 emission shall not exceed that of an A3 emission having the same audio characteristics.









*The segment 10,109-10,115 kHz is not available at this time because of daily use by a priority government radio service. Additionally, in the permitted segments of operation, amateur stations must avoid interfering with stations in the Fixed Service because the band is allocated on a primary basis to the Fixed Service and these stations have priority

Television and facsimile: On frequencies below 50 MHz, the bandwidth of A4, A5, F4 and F5 emissions shall not exceed that of an A3 single-sideband emission.

On frequencies between 50 MHz and 225 MHz:

(1) The bandwidth of A4 and A5 single-sideband emission shall not exceed the bandwidth of an A3 single-sideband emission.

(2) The bandwidth of A4 and A5 double-sideband emissions shall not exceed the bandwidth of an A3 double-emission.

(3) F4 and F5 emissions shall utilize a peak carrier deviation no greater than 5 kHz and a maximum modulating frequency no greater than 3 kHz or, alternatively, shall occupy a bandwidth no greater than 20 kHz. (For this purpose the bandwidth is defined as the width of the frequency band, outside of which the mean power of any emission is attenuated by at least 26 decibels below the mean power level of the total emission. A 3-kHz sampling bandwidth is used by the FCC in making this determination.)

Below 225 MHz, an A3 emission may be used simultaneously with an A4 and A5 emission on the same carrier frequency, provided that the total bandwidth does not exceed that of an A3 double-sideband emission.

Digital transmission

The use of Baudot, ASCII and AMTOR is permitted on any amateur frequency where F1 emission is permitted, subject to the following requirements:

(1) The *sending speed* shall not exceed the following:

(i) 300 bauds on frequencies below 28 MHz;

(ii) 1200 bauds on frequencies between 28 and 50 MHz;

(iii) 19.6 kilobauds on frequencies between 50 and 220 MHz;

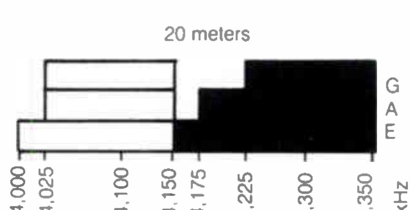
(iv) 56 kilobauds on frequencies above 220 MHz.

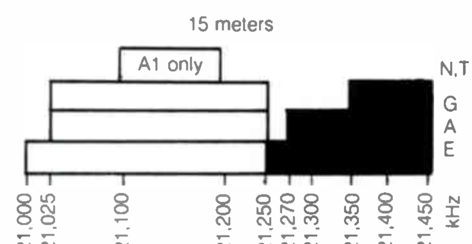
(2) When type A2, F1 or F2 emissions are used, the *radio or audio frequency shift* (the difference between the frequency for the "mark" signal and that for the "space" signal), as appropriate, shall be less than 1000 Hz.

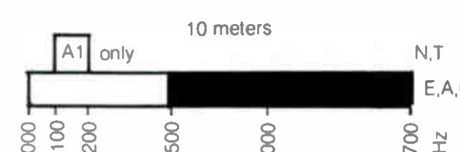
(3) When type A2 or F2 emissions are used, the highest fundamental modulating frequency shall be less than 3000 Hz.

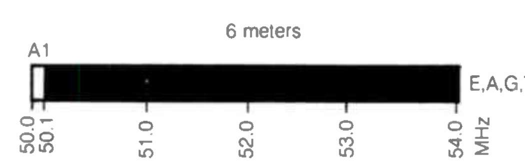
The International Telegraph Alphabet Number 2 (commonly known as Baudot) transmission shall consist of a single channel, five-unit (start-stop) teleprinter code conforming to the International Telegraph Alphabet Number 2 with respect to all letters and numerals (including the slant sign or fraction bar); however, in the "figures" positions not utilized for numerals, special signs may be employed for the remote control of receiving printers, or for other purposes indicated in this section.

The American Standard code for Information Interchange (commonly known as ASCII) shall conform to the American Standard Code for Information Interchange as defined in American National Standards Institute (ANSI) Standard X3.4-1968.









Key

☐ = A1 and F1
▨ = A1 and A3
■ = A1, voice, SSTV and fax
E = Extra

A = Advanced
G = General
T = Technician
N = Novice

hobbies thereby augmenting their contributions to their technologies.

The amateur radio community extends worldwide. There are amateurs in virtually every country and part of the world, giving

The International Radio Consultative Committee (CCIR) Recommendation 476-2 (commonly known as AMTOR) shall conform to the specifications of CCIR 476-2 (1978) Mode A or Mode B.

The *use of any digital* code is permitted on amateur frequencies above 50 MHz, except those on which only A1 emission is permitted, subject to the following requirements:

(1) Communications using such digital codes are authorized for domestic operation only (communications between points within areas where radio services are regulated by the U.S. Federal Communications Commission), except when special arrangements have been made between the United States and the administration of any other country concerned.

(2) The bandwidth of an emission from a station using such digital codes shall not exceed the following (where for this purpose the bandwidth is defined as the width of the frequency band, outside of which the mean power of any emission is attenuated by at least 26 decibels below the mean power of the total emission; a 3-kHz sampling bandwidth being used by the FCC in making this determination):

(i) 20 kHz on frequencies between 50 and 220 MHz;

(ii) 100 kHz on frequencies between 220 and 1215 MHz;

(iii) On frequencies above 1215 MHz any bandwidth may be used provided that the emission is in accordance with §97.63(b) and §97.73(c).

(3) A description of the digital code and the modulation technique shall be included in the station log during all periods of use and shall be provided to the Commission on request.

All modes: The carrier frequency plus modulating frequencies must be contained within amateur allocations and within appropriate subbands.

Note: Some amateur bands are shared with other services. Some geographical limitations exist for the 420-MHz band. For details, and for information on specialized modes, see *The FCC Rule Book (ARRL)*. For information on repeaters, see the *The FCC Rule Book* and *Repeater Directory*.

160 meters: Extra, Advanced and General may use some segments at 1.9-2.0 MHz. Limitations are on a geographical basis; see *The FCC Rule Book (ARRL)* for limitations on this segment. There are *no* geographical limitations on the 1.8-1.9 MHz segment. (Note: A1 and A3 only are permitted on the 160-meter band.)

Other—All modes, except as noted.

'Problems occur when there are points in the cable system where external radio frequency energy can leak in.'

amateur radio a truly worldwide flavor. Regulations exist under the umbrella of the WARC (World Administrative Radio Conference) in Geneva so that amateur frequency assignments throughout the world are generally compatible. Using rather modest equipment it is possible for an amateur to communicate with virtually any spot on the globe using the proper frequencies, antennas, etc., at the proper times. Amateur radio has done much to stimulate international goodwill and understanding.

Making contacts at long distances is called "DXing" (DX standing for distance). DXing is often the purpose for the large wire antennas and large rotatable beam antennas that are seen at amateur station locations. Amateurs exchange QSL cards for record of their contacts. QSL stands for "I am acknowledging receipt" and is one of the terms of what is known as the "Q code," universally used to expedite communications. QSL cards are usually postcard size bearing all types of interesting pictures, texts, etc. Some amateurs can show thousands of these from all over the world as record of their radio contacts. Many awards are available for making a specific series of contacts such as WAS for "worked all states" and the DX Century Club for 100 or more DX contacts.

Communication techniques

In amateur radio there are a number of ways of communicating. Standard voice communication is probably the most common and is usually undertaken in one of the three major modes; amplitude modulation, frequency modulation, or single sideband. Where voice is used it is normally known as a "phone" contact. The earlier, and in some ways more efficient, means of communication is known as "CW" (actually ICW standing for Intermittent Carrier Wave). CW employs Morse code where the message is sent character by character using the familiar "dots and dashes." CW has the advantage of being copyable with extremely low signal levels and under adverse receiving conditions. The equipment is simpler but the one stumbling block for many is learning the Morse code. Many amateur radio clubs give Morse code training for those interested in learning. Certain licenses are available where only low speed code is required for a limited period allowing "on the air training."

Over the years, CW and phone have been the basic means of amateur communications, however, since World War II many new areas have developed. One of these was radio teletype (RTTY), which was given a boost soon after the war when Western Union was willing to release old teletype machines for amateur use. RTTY now is practiced using both codes including Baudot and ACSII. On the low frequency bands there are some speed restrictions, however, these are relaxed at VHF and above. This type of data communications system has developed into far more than point-to-point communications between two amateurs. Today "packet" networks are being developed where modern highspeed computer protocols are employed and messages can be relayed through the amateur network in an extremely efficient manner. Under certain conditions, unattended communications are possible so that amateur networks provide many of the advances of the sophisticated modern communication networks of this decade.

Some radio amateurs have never been satisfied with the mundane but always look for new opportunities in technology. Prior to the launch of the Telstar I communications satellite in 1962, radio amateurs already had begun to plan for the building and launching of amateur satellites. Two years of work by amateurs went into the construction of the 10-pound Oscar I satellite, which was launched piggyback aboard the Discover XXXVI on Dec. 12, 1961. While this unit did not provide for two-way communications but merely carried a beacon, subsequent amateur satellites have been built by amateurs in the United States, England, France and Russia, which provide transponders so that amateur satellite communication is now rather commonplace.

A small group of amateurs using more sophisticated equipment communicate with one another by bouncing signals off the moon, which indeed qualifies as an advanced achievement. This mode is called "EME" standing for earth-moon-earth. With the power restrictions of the amateur services this only can be done with the most sophisticated receiving equipment and antennas.

Amateur radio is not solely for the high technology buff. Many radio amateurs are involved simply for the person-to-person contacts that are made both locally and around the world. "Ragchewers," as these radio talkers have been dubbed, represent a strong fraternity of friends linked together by amateur radio.

Providing a public service

Public service has always been a by-word for the amateurs. Many amateur radio clubs have been formed to provide radio communications for public service activities. Training is offered and many drills are conducted to increase operating proficiency. There are several nationwide exercises every year where amateurs set up portable stations and practice for real emergencies. These groups are maintained in readiness for the unexpected storm or disaster. Other public service activities include communications for events such as parades, races and community programs of various types. Some amateur groups also have special activities for handicapped persons interested in amateur radio.

'The majority of leaks in the field occur in drop cables.'

Amateurs also provide free traffic handling services. It is possible to send a message through amateur channels without charge to many areas where there are no legal restrictions. This is not in competition with commercial carriers, but is another means of organizing and maintaining efficient communications while providing a public service.

Mobile operations by amateurs is another facet of this technical hobby. Equipment operating on numerous amateur bands can be installed in vehicles allowing more flexibility and better response in emergency situations. Handheld transceivers are a further addition to a flexible communications system to support community activities or emergency operations. To support mobile and local emergency communications, amateurs have established many repeaters on the VHF and UHF bands providing for more reliable communications and expanded coverage areas. A repeater is located at a high clear location to provide good coverage of a large area. Each user actually transmits to the repeater rather than the party for whom the communication is intended. The repeater re-transmits simultaneously on another frequency thereby greatly increasing the range of each user. VHF repeaters represent an important development for the extension of reliable communication. They are, as we shall see later, one of the prominent factors in CATV/amateur radio signal leakage problems.

The scope of amateur radio

Referring again to Table 1, some explanation is in order to further demonstrate the scope of amateur radio. The second column labeled "Emissions" specifies the emissions that are legal in these frequency assignments. This list portrays the breadth of technology involved in amateur communications. As you can see, not only telegraphy and voice modulation are included but facsimile, television, carrier and frequency shift keying, frequency and phase modulation, and even television and pulse are included. Not listed in the table are further restrictions governing the bandwidth of the signals in the appropriate amateur bands. Due to lack of spectrum at lower frequencies only slow scan TV is used, but in the high megahertz and gigahertz bands full bandwidth television signals are authorized. Power limitations exist throughout the bands depending upon the frequency and modulation type. The highest amateur powers are in the order of 1 kilowatt, which is probably no more than the local broadcast station and certainly less than the major network stations.

Amateur equipment for many years was

(Continued on page 53.)

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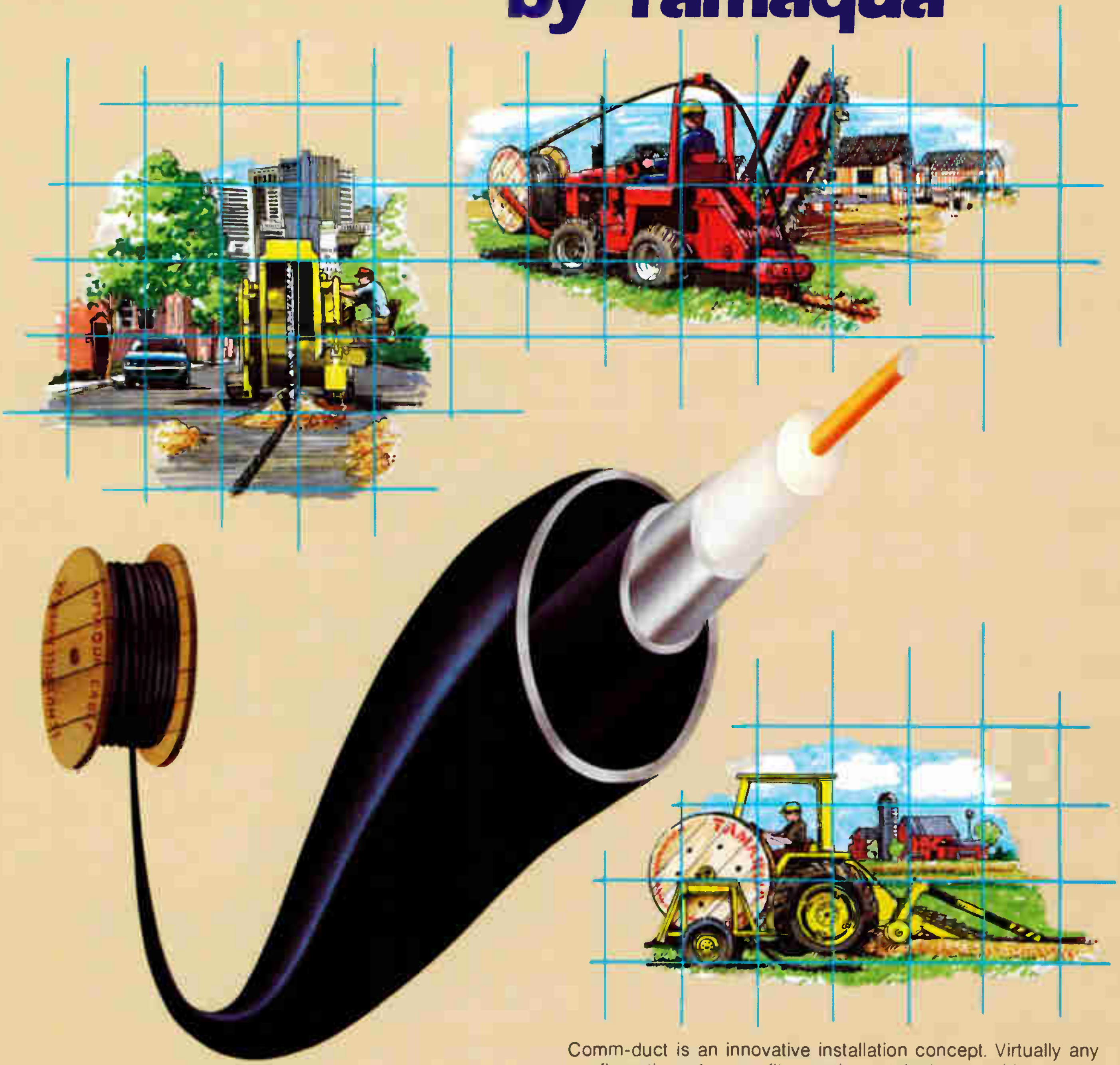

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Amateur radio and cable

(Continued from page 40.)

largely home built. The training benefits of building your own equipment are considerable. As electronic technology has developed, many more amateurs are buying commercial equipment, but more time is being devoted to system rather than component design.

The American Radio Relay League is the largest of several radio amateur associations. The ARRL publishes its journal called *QST*, as well as numerous publications on amateur technology, training and operation.

The amateur community represents a hobby group with high technical standards and contributions, and one that continues to participate heavily in public service activities. The amateur community is far more technically minded than the average television viewer or CATV subscriber. On that basis, radio amateurs can be important allies to the CATV industry and should be so considered.

Interaction causes interference

The hobby of amateur radio is extremely challenging but it is not without its complications. As radio communications and electronics have developed so have interactions between various services. Amateur radio transmitters are sometimes the cause of interference to other electronic equipment such as telephones, stereos and television receivers. Part 97 of the FCC regulations sets limits on spurious radiations that must be adhered to by amateurs. These regulations are brought to bear in cases of interference. More often than not the amateur equipment is well within specifications and the interference is a result of some mechanism not under the amateur's control. Traditionally, amateurs have been cooperative and eager to assist in elimination of interference to the neighbor's radio, TV, etc. The American Radio Relay League publishes some excellent material designed to assist in elimination of this type of interference.

Television interference has been one of the amateur's bigger problems since some television channels are harmonically related to the amateur bands and some TV sets are sensitive to overloads from signals not actually in the desired channels. The advent of cable television was a blessing to the amateur community since CATV signals are delivered to the subscriber's TV without the use of an antenna. They are also delivered at optimum levels for the TV set through shielded conductors. This means that instead of attempting to receive extremely small TV signals from long distances, much larger signals are supplied in a shielded medium making any interference smaller relative to the designed TV signal. This has reduced the number of amateur TVI complaints. Some interference is still experienced due to the susceptibility of certain TV sets to direct pick-up, however, most of the problem has been eliminated as a result of CATV delivery.

Although CATV was a real step forward for the radio amateur, the same glow of relief was not transferred to the cable operator. Instead, any cable subscriber experiencing any type of interference appeals directly to the cable operator. In all cases the burden of the proof is on the cable operator so he must expend effort in diagnosing the complaint. If, through a rigorous procedure, it is determined that the fault is in the TV receiver and not the cable plant or converter, the cable operator is sort of off-the-hook. If the same complaint involves a radio amateur, than he must make his peace with the viewer.

If the aforementioned were the only interference problems we encountered with the amateurs we would be most fortunate. Far bigger problems occur when there are points in the cable system where external radio frequency energy can leak in. Ingress, as it is called, subjects all viewers downstream of the ingress point to the same type of interference. Direct interference by amateur signals leaking into the cable system was seldom a problem for the 12-channel operator, since there are no frequencies used simultaneously by the amateur and the cable system. Add the mid-band and you come up with one such common usage area that is called the 2 meter band (144-148 MHz), which falls in channel E.

On channel E, output from an amateur transmitter can do a lot of damage to the TV picture, particularly if the leak is a bad one and there is considerable ingress. Since the frequency of operation within any amateur band is an arbitrary choice of the particular amateur and since there are various modulations, etc., there is not a single distinctive pattern of interference. Video is usually disturbed. The aural carrier of channel E is outside of the 2 meter band, but aural interference can be caused by signals near the picture carrier or in certain conditions of overload. Whatever the case, the cable operator is often faced with a number of complaints and sometimes a difficult job in locating the source of the problem.

That is not the end. Where signals leak in they also leak out, therefore, the TV signal in channel E may be a source of interference to the amateur service in the 2 meter band. The nominal channel E visual carrier is at 145.25 MHz. This frequency is often used as the output frequency of 2 meter amateur repeaters. The problem to the amateur will become significant when the signal that he receives from the cable system begins to equal the level of the signal he is trying to receive on the amateur band. If he is trying to communicate over a great distance, the signal he is trying to receive may be very small and interference from the cable system will be the most severe. (Interfering signals only a few dB above the desired signal will probably make communications impossible.)

While smaller signals can be annoying and disruptive, when the leak is severe, even the sync sidebands above and below the visual carrier can cause interference. In this situation the cable operator has to deal with the amateur rather than the subscriber. In larger capacity cable systems the same effect is duplicated in the amateur 1¼ meter band (220-225 MHz) and in the amateur 70 cm band (420-450 MHz). Thus cable signal leakage in regard to the amateur radio service is a two-edge sword. Cable system quality can be reduced by ingress and interference can occur to authorized over-the-air services due to egress.

Signal leakage tolerances

One of the first considerations is the fact that a cable system is supposed to be a closed system. We all know that such things are never perfect and conditions such as "absolutely no leakage" are never achieved. In consideration of how much leakage can be tolerated, we have two frames of reference. The first is legal as established by the provisions of the FCC Regulations Part 76 for the Cable Television Service. The other is practical and involves how much leakage it takes

'Local amateurs may be recruited to be on the lookout for leaks and report them to the cable company.'

to cause unacceptable interference. Part 76.605 (a) (12) requires that, by using a specified measurement technique, measured leakage field strengths should not exceed the specified limits. For frequencies from 54 to 216 MHz no more than 20 microvolts per meter is allowed when measuring at a distance of 10 feet from the cable. Above and below this frequency range the limits are relaxed to 15 microvolts per meter at 100 feet. However, in the upper range conscientious operators stay within the 20 microvolts per meter at 10 feet. It is practical to limit leakage to these levels in a modern CATV system that is properly built and properly maintained.

There is also paragraph 76.613 (b) that declares that the cable operator must not cause harmful interference to any other licensed radio service and if he does he must cease operations as required to eliminate the interference. The question then becomes, "What is harmful interference?" The answer to that question is probably one that can be only determined in a court of law. Making such a determination in a court of law should obviously be avoided, hence it is to the cable operator's advantage to avoid causing such interference.

One problem associated with amateur radio interference is that the sensitivity of amateur receiving equipment is generally excellent. Submicrovolt signals will break squelch and are intelligible. With simple antennas submicrovolt signals at the input of the amateur receiver can be generated with field strengths in the 1 microvolt per meter region. One microvolt per meter is 26 dB below 20 microvolts per meter, just to give you an idea

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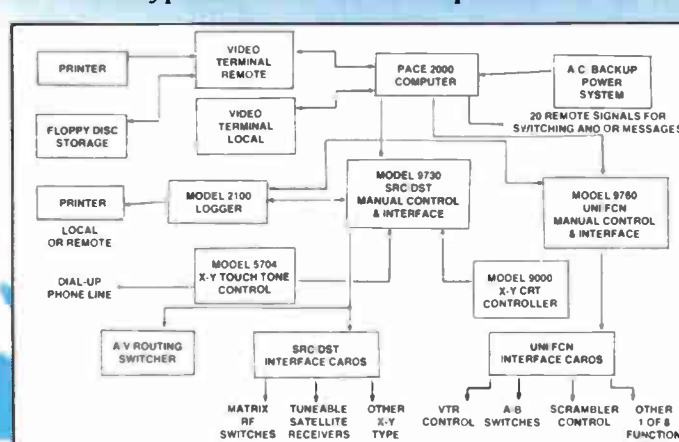

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'The advent of cable television was a blessing to the amateur (radio) community.'

of the magnitude of the problem. This type of integrity is difficult to maintain in the cable system but not impossible. It would be nice to maintain this type of integrity throughout the system, however, Part 76 only demands 20 microvolts per meter, so that greater integrity only need be achieved to satisfy interference complaints.

You might ask, "How serious is this problem?" We all know by now that signal leakage is a very serious problem in the eyes of the Federal Aviation Administration and the FCC. The FAA's concern in the late 1970s led to the interim rules that now govern. In relation to the amateur problem the ARRL filed RM-4040 in early 1982 to protect the amateur frequencies from CATV interference. RM-4040 asked the FCC to prohibit CATV systems from carrying signals in the amateur 2 meter and 1¼ meter bands. If this were ever passed it would be a precedent that would open the door to similar requests from communication services throughout the spectrum—the beginning of the end. It is incumbent upon the CATV industry to clean up and maintain system leakage integrity or we will all be in big trouble.

Leakage sources

So where do these leaks in the cable system occur? Well, there are really no surprises. Poor connectors and/or bad installation on the hard cable are obvious sources. As everyone knows, connectors with integral sleeves are a must. The sleeves are necessary so that cold flow does not produce bad or intermittent connections, while the integral feature assures that the sleeve will not fall out prior to or during installation. Torquing these connectors is an important matter. Torquing to manufacturers specifications is encouraged, however, some have found that additional tightening is sometimes necessary. Cable cracks, or holes in the sheath caused by abrasion are obviously good places for RF energy to pass in and out of the system. Improperly gasketed or secured housings in amplifiers and passives can allow leakage. In all of these cases if the equipment is properly installed and maintained the integrity should be good.

The majority of leaks in the field occur in drop cables. Fortunately, the signal level there is lower, but still sufficiently high to do a lot of interfering under the proper circumstances. Triple or quad shielded drop cable is highly recommended, even though it may not be necessary to prevent ingress from local TV signals. Fittings are a prime source of trouble. F fittings with long integral sleeves are a must to ensure good contact with the shield and to prevent premature failures from flexing. The more elusive problems are those caused by illegal connections, or leaking auxiliary devices, such as VCRs and switches for video games, etc. In converterless installations the TV set itself may be the culprit, due to radiation of the internal twin lead.

Coping with shared frequencies

It is not the point of this article to give a detailed treatment of these causes and their repairs. All of the above is fairly common knowledge. What seems more important is how does one go about adequately maintaining the cable system to avoid problems with the amateurs and at the same time avoid them with other radio communications services sharing the same frequencies as the cable. While it has been said that "eternal vigilance is price of freedom," we well might transform this for the CATV industry by stating that "eternal monitoring is the price of integrity."

Your cable system is large enough and complex enough that it is unreasonable to assume that you can put it together right once and have it stay that way forever. As a matter of fact, the FCC recognizes this point in Part 76.610.(d), which states that you shall monitor regularly. The FCC requirement is absolutely minimal. The prudent operator will do much more. The most practical method seems to install leakage detection receivers in the company maintenance vehicles that traverse the system often in routine travels. One efficient method of handling leaks is that all technicians in the field be required to report all leaks and that a separate crew be assigned to fix them. Various cable operators and MSOs have established comprehensive procedures that they employ very effectively.

One extremely important factor is the leakage monitoring equipment. To detect the leaks discussed above requires a sensitive leak detection system. Some systems now on the market will not detect the smaller leaks. Their use, therefore, may not reveal leaks that may become the source of amateur complaints. It may seem that we have strayed somewhat from the discussion of amateur radio, but we will quickly return by observing that some amateur receiving equipment can double as leak detection equipment. By using a crystal controlled or synthesized two-meter transceiver (only the receiver portion) set to receive the channel E visual carrier, the leaks are detected simply by the breaking of squelch.

Equipment having a meter to indicate signal level (an "S meter" in the trade) can be calibrated to give signal level indications. Detection and measurements are made by using a simple vertically polarized two-meter mobile antenna. While it may seem that the polarization is wrong, since the cable is horizontal, it can be shown that there is a large vertical component and as a matter of fact a vertical antenna tends to receive the signal both sooner and later as you drive down the street near the cable. Even more sensitive indications may be obtained by using a receiver capable of single sideband suppressed carrier reception. In this case there is no squelch, but a constant background hiss is heard. When very small leakage levels are encountered a tone is also heard. This tone is simply the beat frequency between the signal on the cable and the signal to which the receiver is tuned. Care must be taken to tune the receiver properly to obtain the beat note. Using a drop or induced leak will allow proper tuning to the channel E visual carrier prior to making actual survey runs. When the CATV cable runs through backyards and easements it is difficult to patrol, therefore more sensitive indications will assure a more thorough job of monitoring, even when this distance is one half block or more.

There is another advantage of amateur equipment for CATV leakage monitoring. Many amateurs possess it and much of it is mobile and could, therefore, be used for monitoring. I am suggesting that local amateurs may be recruited to be on the lookout for leaks and report them to the cable company. As mentioned earlier in this article, the radio amateur is many steps above the average CATV subscriber in terms of his technical knowledge and competence. He is, therefore, someone that can usually talk on the same level with the cable technician. Making friends with the radio amateur may add substantial technical support to your operation. A good rapport with the amateur community, perhaps represented by the local clubs, can turn what might be a group of nasty interference complaints into a cooperative effort to solve whatever problems exist.

A few cable operators have told complaining amateurs to "take a hike." This has done a great deal of harm but fortunately only has happened in isolated cases. On the other hand, many cable operators have taken special care not to antagonize and actually to help the amateur community. In many cases they have given talks at amateur club meetings, invited amateurs to see their headend and studio operations, etc. In cases where interference was severe and the job of correcting it was a big one, some cable operators have off-set their channel E visual carriers to avoid a local repeater. Cable operators have allowed the hams to mount their repeater antennas on headend towers, and even the repeater equipment inside the headend building. One can think of numerous ways to work with the hams. In all of these cases, the rapport has been improved and generally the antagonism disappears and the operator gains. Many cable systems have amateurs as cable technicians. This is obviously a situation where the cable technician wearing two hats can be helpful to both sides.

All in all, the cable operators' experience with the amateur community can be a good one, if properly handled. Amateur radio and cable television have a lot in common. Amateur training can help a cable technician to do his job better. Information about cable systems presented to the amateur community will develop a better understanding and create new interests. Proper understanding and treatment of radio amateurs is an important and positive matter, so use it wisely.

The FCC: A hands-on quiz

In last month's issue of "Communications Technology" the feature on the Federal Communications Commission (page 54) forewarned of a short true and false quiz on the Commission and its practices. So as not to disappoint all of you that read the article and have been boning up, here it is. Special thanks to CATV Specialist Chris Papas of the FCC's Powder Springs, Ga., Field Operations Bureau for providing the materials on the Commission, as well as the quiz and its answers. All right then, if your #2 is sharp and you have a spare, begin the quiz—and good luck.

	True	False
1) The FCC technical standards for cable systems are covered under Part 76 of the Rules.	( )	( )
2) The Rules require all cable operators with more than 1,000 subscribers to have a copy of the Rules at their local office.	( )	( )
3) The technical standards under Subpart K of the Rules apply to all classes of signals delivered on cable channels.	( )	( )
4) The operator of each cable television system with more than 1,000 subscribers should conduct complete performance tests of that system at least once each calendar year at intervals not to exceed 14 months.	( )	( )
5) The results of these tests must be submitted to the FCC.	( )	( )
6) No tests are required of systems with less than 1,000 subscribers under any circumstances.	( )	( )
7) Operations in the frequency bands 108-136 and 225-400 MHz are covered under Section 76.610 of the rules.	( )	( )
8) The operator who wishes to use the frequencies 108-136 and 225-400 MHz must notify the Commission of proposed use of any new frequency or frequencies in these bands and may not commence use of any frequency or frequencies in these bands without prior approval by the Commission if any of the transmitted carrier or other signal components are capable of delivering a peak power equal to or greater than 10^{-5} watts at any point in the cable plant.	( )	( )
9) The transmission or carrier or other signal components capable of delivering peak power equal to or greater than 10^{-5} watts at any point in a cable television system is prohibited within 50 kHz of the two frequencies 156.8 MHz and 243.0 MHz.	( )	( )
10) Part 76.613 deals with interference from a cable system.	( )	( )
11) 10^{-5} watts is equal to 28.75 dBmV.	( )	( )
12) A Class I cable television channel is any TV broadcast originated signal that can be obtained from off-the-air, microwave or satellite sources.	( )	( )
13) When an operator is conducting the annual performance tests of the system, the tests must be made from the antenna pickup point to any subscriber terminal including the effects of any microwave CARS equipment.	( )	( )
14) All Class I signals must be delivered to the subscribers with at least a level of 0 dBmV.	( )	( )
15) All must-carry Class I signals shall be carried on the cable system without material degradation in quality.	( )	( )
16) The 36 dB ratio of visual signal level to system noise requirement applies to all Class I channels.	( )	( )
17) Performance tests conducted by the system shall be retained at the local business office for at least 5 years.	( )	( )
18) The maximum allowable signal leakage for the frequencies 54-216 MHz at 10 feet from the cable is 20 uv/m.	( )	( )
19) Signal leakage detection equipment being installed in the system at 109 MHz does not have to be coordinated with the FCC since the signal is not a visual or aural carrier.	( )	( )
20) A subscriber is responsible for repairing the signal leakage eminating from his house drop.	( )	( )

The answers to the quiz can be found on page 82.

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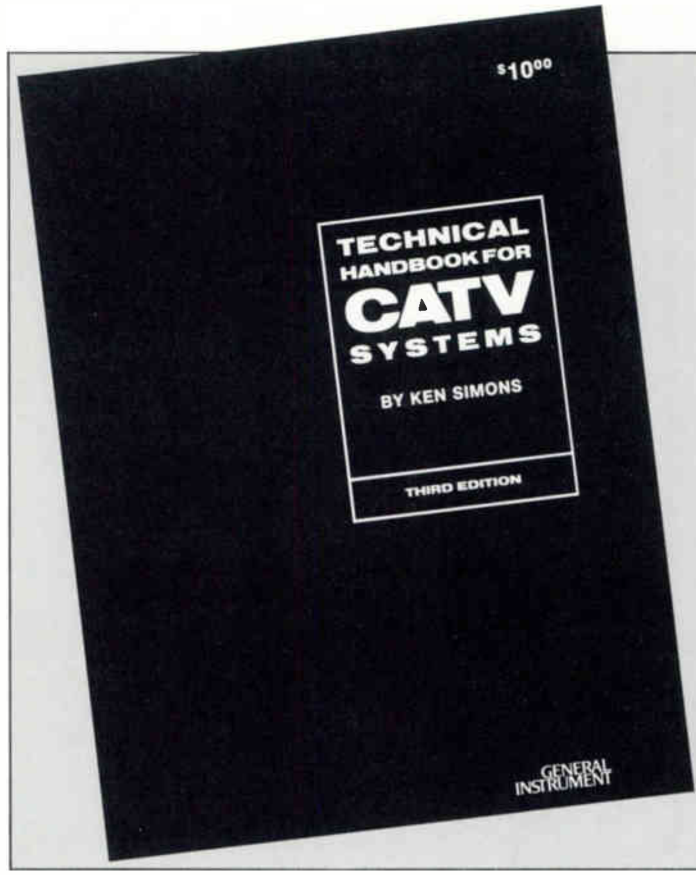


Technical handbook for CATV systems

Chapter II: The combination of voltage, current or power

The following is the second chapter of the Ken Simons technical handbook. Each monthly issue of "Communications Technology" will feature another installment of this excellent technical primer.

By Ken Simons
Cable Television Consultant

To analyze the operation of a CATV system it is essential to understand how electrical quantities combine to produce a final result. The way in which noise and distortion combine in a cascaded amplifier system to produce the net effect at the output of the last amplifier determines the requirements on each amplifier. How the signal "splits" or "divides" in a customer tap or line splitter determines the net effect on system levels.

This understanding is approached by first considering a few simple cases involving the addition of voltage, current or power.

Voltage and current addition—DC

First consider the conditions that exist in the simple DC circuit shown in Figure 5. A constant voltage* DC source maintains a 1-volt drop across a 100-ohm resistive load. The load draws a current of 10 mA and dissipates 10 mW, which is the power output of the source.

Similarly Figure 6 illustrates a constant-current** DC source. This source maintains a current of 10 mA through a 100-ohm load. The voltage drop is 1 volt, and the load dissipates the full output of the source, which also is 10 mW.

Now consider what happens when a second equal voltage source is connected in series with the first (compare Figure 7 with Figure 5). It is not surprising to find that, with twice the voltage, the 100-ohm load draws twice the current, 20 mA. It is perhaps a little surprising, when you think about it, that the power dissipated in the load, which is the same as the power output of the two generators, is 40 mW, four times what it was with only one source. The presence of the second source increases the current flow through the first, so the power output of the first is doubled.

When a third source is connected in series, as indicated in Figure 8, the voltages add to produce 3 volts across the load, resulting in a current of 30 mA and in a power of 90 mW. In summary, as sources having equal voltages are added in series, the power output into a common load increases as the square of the total voltage ($P = \frac{E^2}{R}$).

The situation is similar when two currents are added. When a second current source is added, causing a second 10-mA current to flow in the 100-ohm load (compare Figure 9 with Figure 6), the total current of 20 mA causes a voltage drop of 2 volts, and a dissipation in the load of 40 mW. The presence of the second source increases the power output of the first.

Similarly, when the outputs of three constant-current DC sources are combined to feed a common load as illustrated in Figure 10, the current through the load is three times the current from one source and the power dissipated is nine times the power that would be dissipated with a single source and the same load. ($P = I^2R$).

Voltage and current addition—phased AC

Next, what will happen when the outputs of two sine wave AC sources having identical phase and frequency are added? Figure 11 illustrates the situation: Since the two voltages reach each point in the cycle at the same time, their outputs add directly, and the total voltage is just twice that of either one. Thus the power output of each is doubled by the presence of the other, just as in the DC case.

When AC voltage or current components have identical frequency and phase, as in Figure 11, they are said to be phased. A general rule can be formulated for the addition of phased voltage or current components:

When the AC voltages (or currents) from a number of phased sources are combined, the total rms voltage (or current) is the sum of the individual rms voltages (or currents).

Example: The output currents of six phased AC sources are combined in a 1000-ohm load as shown in Figure 12. What is the total current, what power is dissipated in the load, and how many dB is this power increased over that dissipated by source #1 only?

Solution: Since the sources are phased, the total rms current is simply

**A constant-current source maintains the same output *voltage* regardless of load. The internal resistance of a constant-voltage source is very *low* compared to the load resistance.

**A constant-current source maintains the same output *current* regardless of load. The internal resistance of a constant-current source is very *high* compared to the load resistance.

Figure 5

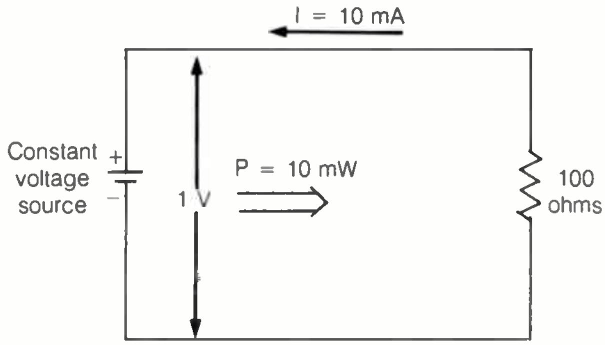


Figure 6

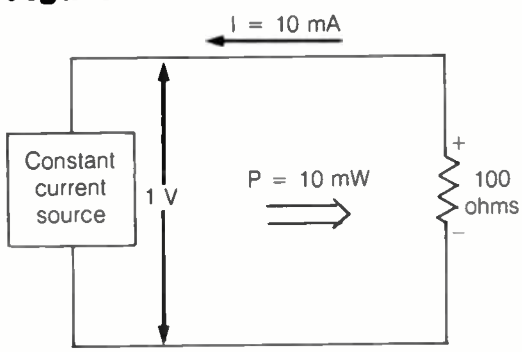


Figure 7

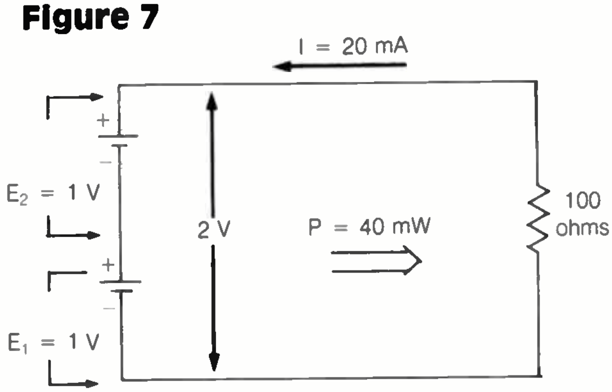


Figure 8

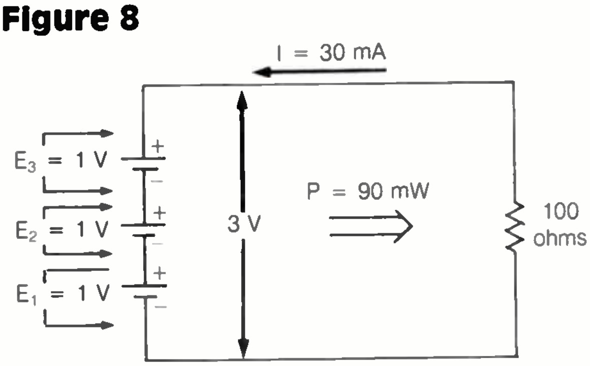


Figure 9

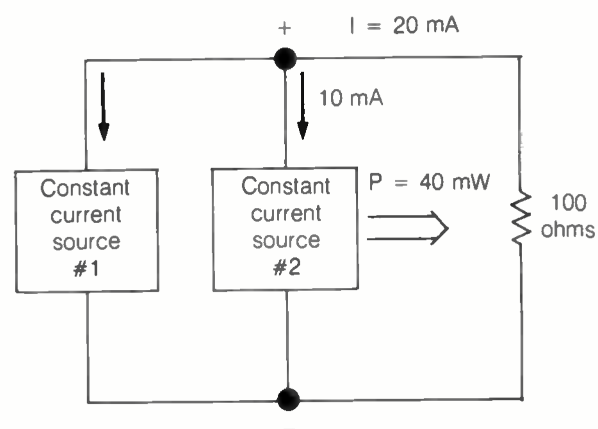
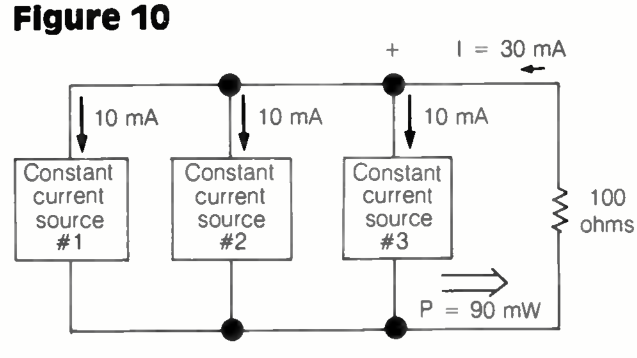


Figure 10



the sum of the given currents: 1 + 4 + 11 + 3 + 6 + 5 = 30 mA. The power dissipation is I^2R = 30/1,000 × 30/1,000 × 1,000 = 0.900 watts. The power dissipation with source #1 alone would be 1 mA through 1,000 ohms, or 1/1,000 × 1/1,000 × 1,000 = 0.001 W.

The power ratio is 0.900 divided by 0.001 or 900. From Table P7 in Chapter XI we find that the dB number for a power ratio of 9 would be 9.54 dB; adding 20 dB corresponding to a power ratio of 100, the solution is 29.54 dB.

One step in the calculation of the dB expression could be eliminated by simply using the current ratio. The total current is 30 mA, an increase of 30 times over 1 mA from source #1. From Table V6 we get that a current ratio of 30 corresponds to 29.54 dB.

General rule for finding the dB increase for a combination of phased sources:

To find the dB increase when the outputs of phased voltage or current sources are combined, add the voltages (or currents) and use the voltage-dB table to find dB corresponding to the ratio of the total to the original voltage or current. This kind of combination is called "voltage (or current) addition."

Equal contributions

When a common output is obtained by combining the current or voltage outputs of a number of phased sources, and each source contributes equally to that output, the dB increase in output for any given number of sources can be easily tabulated. The dB increase is simply the voltage or current ratio expressed in decibels, and since the ratio is equal to the number of sources, this is simply that number expressed in dB.

For example; two equal phased sources in series generate an output 6.02 dB above a single source, since $20 \log_{10}2 = 6.02$.

Table F has been prepared to show these dB ratios for numbers of equal contributions from one to 50 sources.

Example: By how much will the output of a system increase when 45 equal, phased sources in series are used as compared with the output of one such source?

Solution: Since voltage addition is applicable in this case, Table F can be used; so the dB increase corresponding to 45 contributions is found opposite number 45 in the table, 33.06 dB.

Figure 11: Two sinewave AC sources, same frequency, same phase

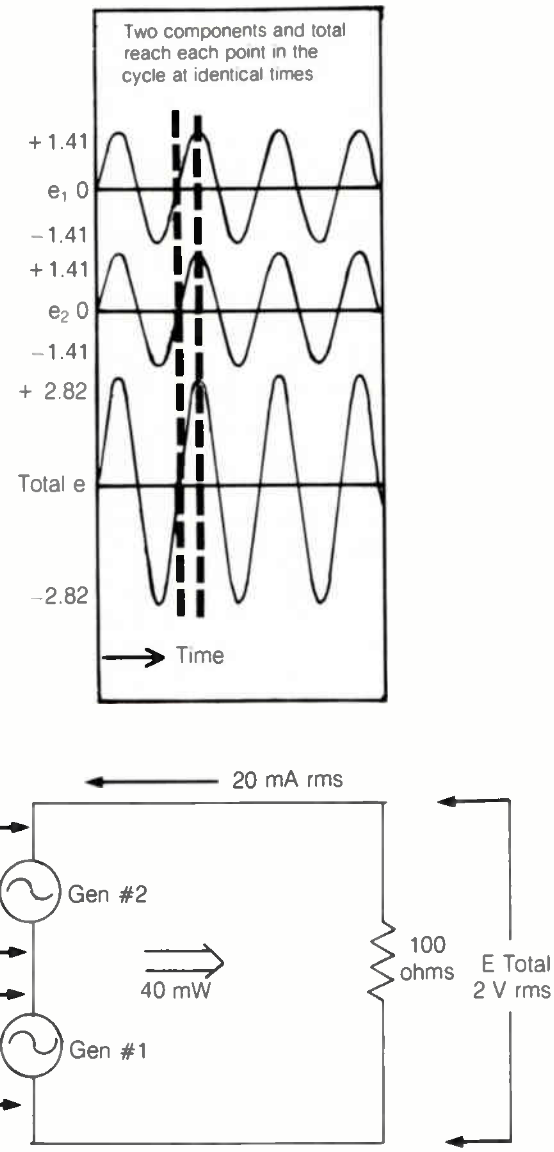


Figure 12: Addition of phased currents

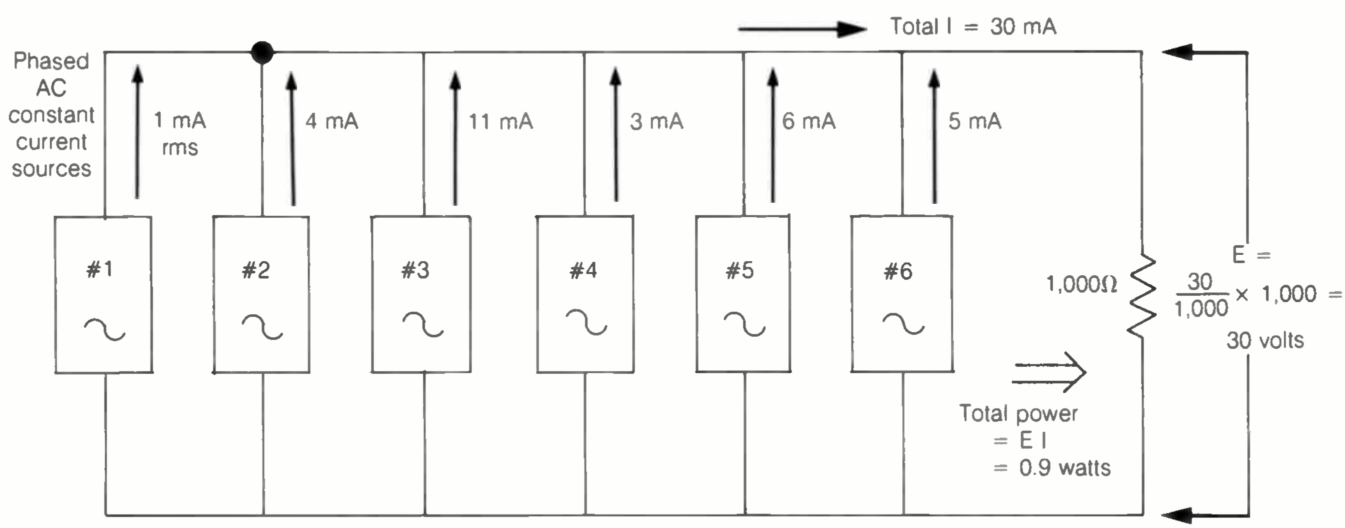
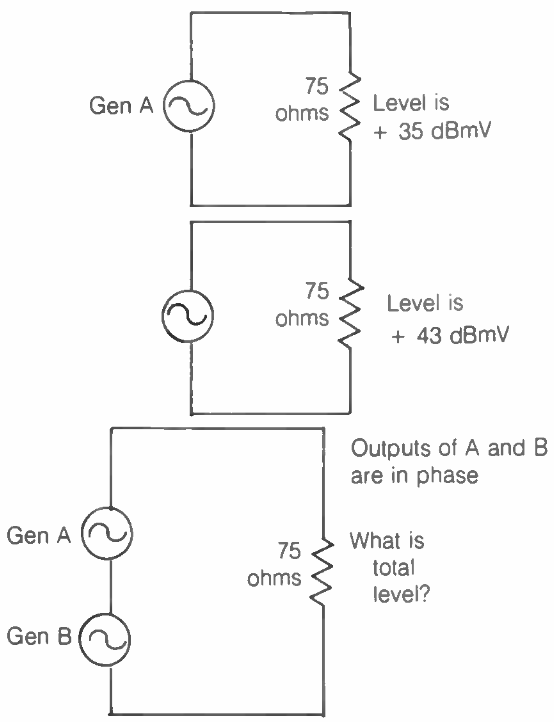


Figure 13



Voltage addition—two unequal contributions

Consider a case where the outputs of two unequal voltage or current sources are phased so that they add directly on a voltage basis. If the levels of the two are given in dBmV, and the total is wanted in dBmV, one way to find the answer would be to convert each level to an equivalent rms voltage, add the two voltages, and convert the total back to dBmV.

Example: Two phased generators supply a 75-ohm load. The first alone develops a level of +35 dBmV, the second alone develops +43 dBmV. What is the level with both connected? (Figure 13.)

Solution: From the dBmV-voltage Table V7 find the rms voltages corresponding to the two levels: +35 dBmV corresponds to 56.23 mV; +43 dBmV corresponds to 141.3 mV. The total voltage is 56.23 + 141.3 = 197.53 mV. In Table V6 we find the corresponding level is about +45.9 dBmV.

This calculation can be simplified by the use of a table that allows making the calculation in dB language without converting to voltage. The table relates the difference in dB between the higher level and the lower to the difference between the total and the higher. The preparation of the table can be understood from the following:

Let:

L_s represent the lower level in dBmV, e_s the corresponding voltage in millivolts.

Table F

Voltage or current addition, phased sources, equal contribution from each source

Number of equal contributions	dB corresponding to this ratio	Number of equal contributions	dB corresponding to this ratio
1	0	26	28.30
2	6.02	27	28.62
3	9.54	28	28.94
4	12.04	29	29.24
5	14.00	30	29.54
6	15.56	31	29.82
7	16.90	32	30.10
8	18.06	33	30.36
9	19.09	34	30.62
10	20.00	35	30.88
11	20.82	36	31.12
12	21.58	37	31.36
13	22.28	38	31.60
14	22.86	39	31.82
15	23.52	40	32.04
16	24.08	41	32.26
17	24.60	42	32.46
18	25.10	43	32.66
19	25.58	44	32.86
20	26.02	45	33.06
21	26.44	46	33.26
22	26.84	47	33.44
23	27.24	48	33.62
24	27.60	49	33.80
25	27.96	50	34.00

L_h represent the higher level in dBmV, e_h the corresponding voltage in millivolts.
L_t represent the total level in dBmV, e_t the corresponding voltage in millivolts.

We want a table arranged so that, when given $L_h - L_s$ we can find $L_t - L_h$.

By definition: $L_h = 20 \log_{10} e_h$ and $L_s = 20 \log_{10} e_s$;
hence: $L_h - L_s = 20 \log_{10} e_h - 20 \log_{10} e_s =$

$$-20 \log_{10} \frac{e_s}{e_h},$$

so given $L_h - L_s$ we can find $\frac{e_s}{e_h}$;

Now, since: $e_t = e_s + e_h$ and $L_t = 20 \log_{10} (e_s + e_h)$;
hence: $L_t - L_h = 20 \log_{10} (e_s + e_h) - 20 \log_{10} e_h$

$$= 20 \log_{10} \left(\frac{e_s + e_h}{e_h}\right) = 20 \log_{10} \left(\frac{e_s}{e_h} + 1\right)$$

Thus knowing $\frac{e_s}{e_h}$, we can simply add 1 to that number and then find the corresponding number of dB, representing $L_t - L_h$.

Example: let $L_h - L_s$ be 8 dB, then $\frac{e_s}{e_h} = 0.398$ and $\frac{e_s}{e_h} + 1 = 1.398$; then $L_t - L_h = 20 \log_{10} 1.398 = 2.91$ dB.

With this result the solution for the example in Figure 13 is greatly simplified. Given two sources having levels of +35 and +43 dBmV, and assuming voltage addition, the difference in level between the higher and the lower level is 43-35 = 8 dB. The level of the total is found

Table G

Number of equal contributions	dB increase corresponding to this power ratio	Number of equal contributions	dB increase corresponding to this power ratio
1	0	26	14.15
2	3.01	27	14.31
3	4.77	28	14.47
4	6.02	29	14.62
5	7.00	30	14.77
6	7.78	31	14.91
7	8.45	32	15.05
8	9.03	33	15.18
9	9.54	34	15.31
10	10.00	35	15.44
11	10.41	36	15.56
12	10.79	37	15.68
13	11.14	38	15.80
14	11.43	39	15.91
15	11.76	40	16.02
16	12.04	41	16.13
17	12.30	42	16.23
18	12.55	43	16.33
19	12.79	44	16.43
20	13.01	45	16.53
21	13.22	46	16.63
22	13.42	47	16.72
23	13.62	48	16.81
24	13.80	49	16.90
25	13.98	50	17.00

by adding 2.91 dB ($L_t - L_h$ from above) to the higher level. 43 + 2.91 = 45.91 dBmV.

A table has been worked out showing $L_t - L_h$ for the values of $L_h - L_s$ between 0 and 40 dB in 0.1 dB steps. This table is given as Table V8 in Chapter XI; an example will illustrate its use.

Example: A source delivers an output into a 75-ohm load at a level of −12 dBmV. A second source, phased with the first and connected to an equal load, supplies an output at a level of −18 dBmV. What will be the level when both sources are connected to the same load?

Solution: In this case, voltage addition applies, thus Table V8 can be used. The difference in the levels of the two sources is 6 dB. Opposite 6 dB in the table we find 3.53 dB, the increase in the total level as compared with the level of the higher one of the two sources. The higher level is −12 dBmV (it is the smaller number, because both levels are negative). The resulting output level is found by adding 3.53 algebraically −12 + 3.53 = *−8.47 dBmV*.

Voltage addition—effect of phase variation

When two voltage sources have the same frequency, but different phase, their outputs reach various points in the cycle at different times so they do not add directly, and the rms voltage of the total is not equal to the sum of the two rms voltages. This is illustrated in Figure 14, which shows each of two equal voltages and the total, for various phase relations between the two. When the phase angle is 0, the total voltage is twice either one. For small phase angles the total is only slightly reduced. When the second voltage lags the first by 90° the total voltage is 3 dB higher than either one (i.e., it is reduced 3 dB from the in-phase case) and the power output of each source is the same as it would be if the other were not present. When the two sources have opposite phase (180°) they cancel each other, and the output is zero.

When the contributions from a number of sources add, and the relative phases are not known, it is not possible to determine the total. In some cases, when there are a great many contributions, it is reasonable to assume that power addition applies, as described below.

Power addition—different frequencies

When two sine waves have different frequencies, their phase relation changes constantly. This is illustrated by Figure 15, which shows two sinusoidal voltages plotted on the same graph. Voltage e_2 has a lower frequency, so, as time progresses, e_2 lags ¼ cycle (90°) after e_1 has gone through three cycles; 180° after six cycles; and 360° (in other words back in phase again) after 12 cycles. If the time represented is one micro-second, e_1 has a frequency of 12 cycles/micro-second, or 12 MHz; and e_2 has a frequency of 11 MHz. It takes one micro-second for the phase relation between these two to progress through one full cycle, and the corresponding frequency, 1 MHz, is the difference between the two original frequencies (12 − 11 = 1).

When these two sources are connected in series, as illustrated in

Figure 14: Two voltages, same frequency, different phase

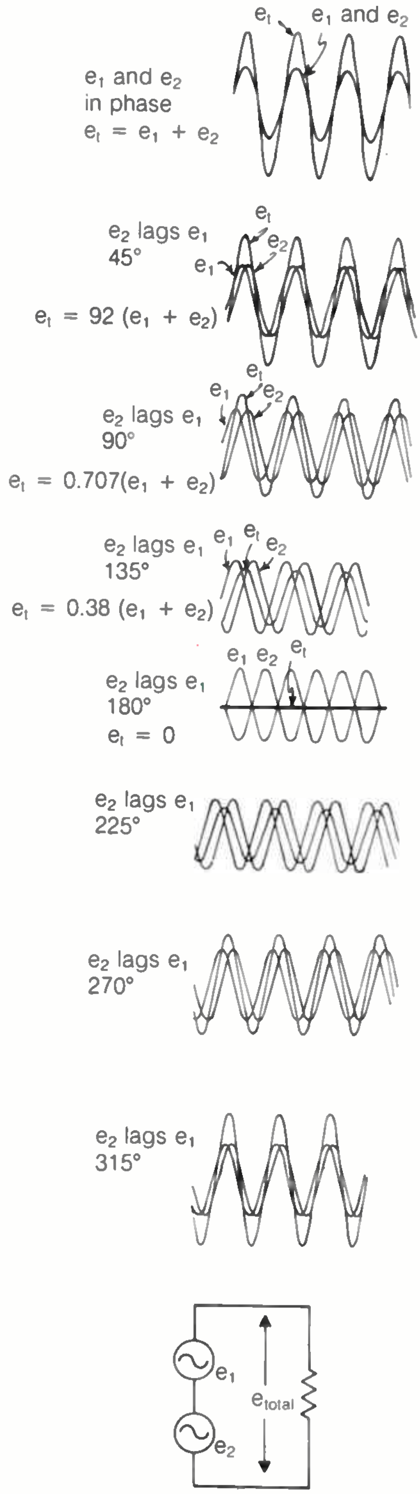


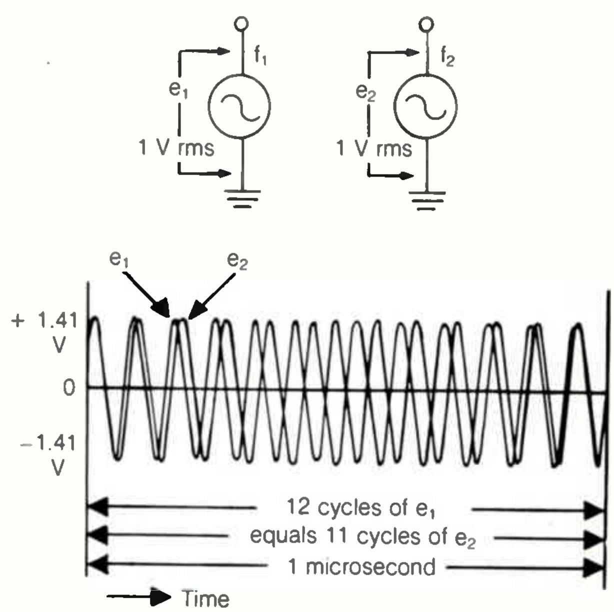
Figure 16, the total voltage varies depending on their relative phase. When they are in phase the total reaches a peak of 2.82 volts (the sum of their peak voltages); as they shift, the total falls, going through zero when they have opposite phase, and back up to maximum when they are in phase again. They are said to "beat" with each other, and their difference frequency (in this case 1 MHz) is called the "beat frequency."

Now consider the power delivered to the 100-ohm load by these two sources. Since each one develops 1 volt rms it would, when connected to a 100-ohm load, deliver a power of 10 milliwatts. When both are connected in series, the power delivered to the load varies, as can be seen from the voltage waveform shown in Figure 16. The power is a maximum when the two voltages are in phase, and zero when they are at 180°. In other words, the power delivered varies as the two sine waves beat with each other.

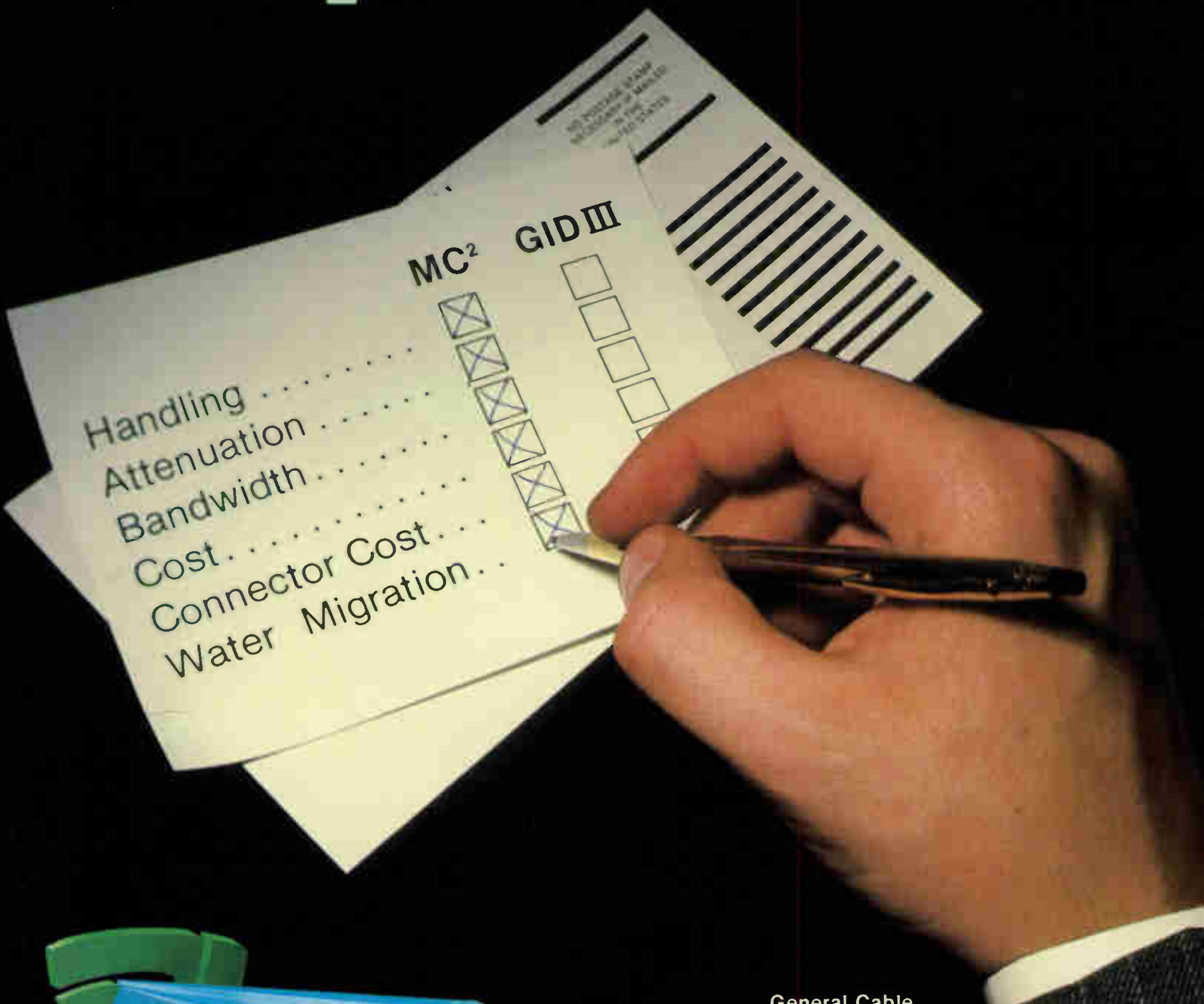
Inspecting the waveform of Figure 16 it can be seen that the rms voltage is going to be less than 2 volts (which it would be if the two voltages were in phase all the time) and more than 1 volt (which it would be with either one alone). Actually it will be 1.41 volts, with a total power of 20 mW delivered to the load. A general rule applies:

When two or more sources supply voltage (or current) of different frequencies to a common load, the power delivered by each source is the same as that which would be delivered if all other sources were removed.

Figure 15: Two voltages having different frequencies



How do you shop for cable?



Note that in this case the power output of each generator is unaffected by the presence of the other. Compare this with the situation illustrated in Figure 11 where the two have the same frequency.

To derive the total power, when frequencies are different, we calculate the power developed by each source with the given load, and add the powers. This case is called "power addition."

Example: Assume six current sources, each having a different frequency, feeding a common load as illustrated in Figure 17 (note the similarity to Figure 12). What is the total power, the total rms current, and the dB ratio between No. 1 current and the total.

Solution:

1. Calculate the power output of each source (pretending the others aren't there) and add to find the total power.

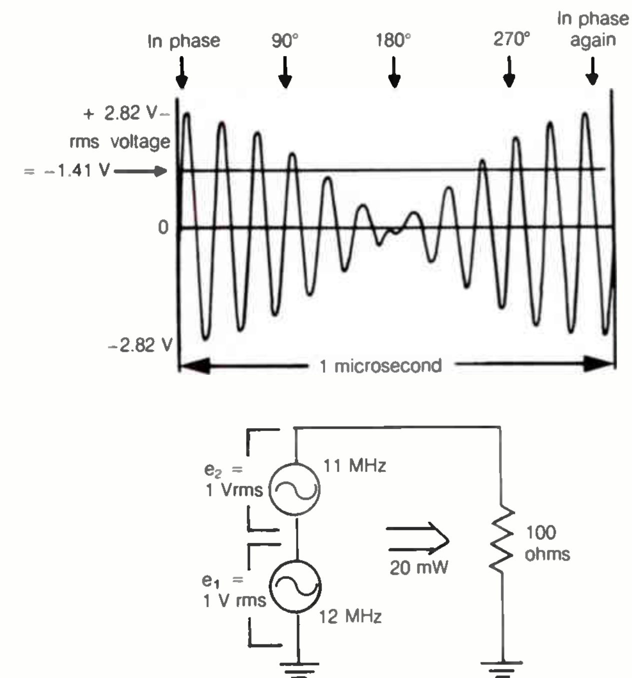
Source No.	Output current into 1,000 ohms	Power = I^2R
1	1 mA rms	1 mW
2	4	16
3	11	121
4	3	9
5	6	36
6	5	25
		Total power 208 mW

2. Since (total current)^2 times 1000 = 208 mW, the total current is

$$\sqrt{\frac{0.208}{1000}} = 14.4 \text{ mA rms.}$$

3. The dB ratio can be calculated by taking the ratio of No. 1 current to the total (14.4) and looking up the corresponding number of dB in the current ratio-dB Table V6 (23.2 dB). Alternatively take the ratio of the power output of No. 1 source (1 mW) to the total power (208 mW) and find the corresponding dB in the power-dB Chart P7. The power ratio would be 208. Divide by 100 to find dB corresponding to 2.08 (3.201) and add 20 dB (because you had to divide by 100) getting 23.2 dB.

Figure 16: Sum of two voltages of different frequency



Power addition—equal contributions

When the outputs of a number of equal sources are to be combined, and the conditions indicate power addition, the calculation can be simplified by using a table. The table is prepared by noting that the power ratio is equal to the number of sources. Thus the dB ratio of the output level is 10 $\log_{10}$ times the number of sources. Using this relationship, Table G has been prepared to show the increase in output level for 1 to 50 equal sources combining on a power basis.

Example: 32 sources all having equal outputs and different frequencies combine in a common load. How much is the total output increased over that which would be supplied by a single source? Table G opposite 32 sources shows an increase of *15.05 dB*.

Power addition—two unequal contributions

Just as it was possible to simplify calculations by preparing a table for two unequal contributions in the case of voltage addition, a table can be developed for the case of power addition relating total level to input levels with two unequal contributions. The preparation of the table can be understood from the following:

Let L_s represent the lower level in dBmV, P_s the corresponding power ratio.

Let L_h represent the higher level in dBmV, P_h the corresponding power ratio.

Let L_t represent the total level in dBmV, P_t the corresponding power ratio.

We want a table arranged so that, when given $L_h - L_s$, we can find $L_t - L_h$.

By definition: $L_h = 10 \log_{10} P_h$ and $L_s = 10 \log_{10} P_s$,

hence: $L_h - L_s = 10 \log_{10} P_h - 10 \log_{10} P_s =$

$$-10 \log_{10}\left(\frac{P_s}{P_h}\right);$$

so given $L_h - L_s$ we can find $\frac{P_s}{P_h}$

Now, since: $P_t = P_s + P_h$ and $L_t = 10 \log_{10} (P_s + P_h)$,
hence: $L_t - L_h = 10 \log_{10} (P_s + P_h) - 10 \log_{10} P_h$

$$= 10 \log_{10}\left(\frac{P_s + P_h}{P_h}\right) = 10 \log_{10}\left(\frac{P_s}{P_h} + 1\right);$$

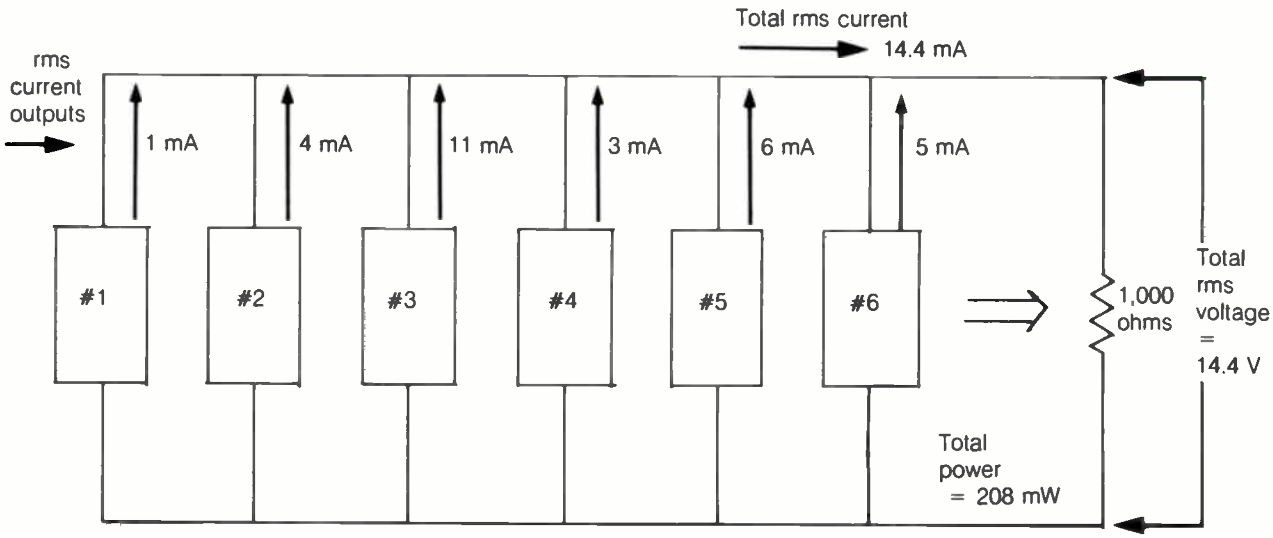
Thus knowing $\frac{P_s}{P_h}$, we can simply add 1 to that number and then find the corresponding number of dB, representing $L_t - L_h$.

Example: let $L_h - L_s$ be 12 dB, then $\frac{P_s}{P_h} = 0.063$ and $\frac{P_s}{P_h} + 1 = 1.063$; then

$L_t - L_h = 10 \log_{10} 1.063 = 0.265$ dB.

Based on the above, a table has been worked out showing, for the case of power addition, $L_t - L_h$ for values of $L_h - L_s$ between 0 and 20 dB in 0.1 dB steps. This table is given as Table P9 in Chapter XI. An example will illustrate its use.

Figure 17: Addition of current of different frequencies



Example: The output of a channel 6 strip amplifier is combined with the output of a channel 10 amplifier in a common load. Channel 6 level is +54 dBmV, channel 10 level is +64 dBmV. What is the total power output?

Solution: The level difference is 11 dB, so the amount to be added to the higher level (from Table P9) is 0.33 dB. The combined output level is +64.33 dB or about 36 milliwatts.

Power splitting relationships

In the analysis of CATV systems a situation is frequently encountered, particularly with regard to taps and splitters, where the power from a given source divides unequally between two loads. Given the dB ratio between the power from the source and the power in one load, we want to find the dB ratio between the source power and the power in the other load. This is another case of power addition, but the relationship is a bit different from that described above, and another table is needed. Its preparation can be understood from the following:

Let L_s be the level of the lower one of the outputs, and P_s the corresponding power ratio

L_h be the level of the higher one of the outputs, and P_h the corresponding power ratio

L_t be the level of the input, and P_t the corresponding power ratio

We want a table arranged so that, when given $L_t - L_s$, we can find $L_t - L_h$.

By definition: $L_h = 10 \log_{10} P_h$ and $L_s = 10 \log_{10} P_s$
and since: $P_t = P_h + P_s$, $L_t = 10 \log_{10} (P_h + P_s)$,
hence: $L_t - L_s = 10 \log_{10} P_h + P_s - 10 \log_{10} P_s =$

$$= 10 \log_{10}\left(\frac{P_h + P_s}{P_s}\right) = 10 \log_{10}\left(\frac{P_h}{P_s} + 1\right)$$

Thus given $L_t - L_s$ we can find $\frac{P_h}{P_s}$;

but since $L_t - L_h = 10 \log_{10} (P_s + P_h) - 10 \log_{10} P_h =$

$$= 10 \log_{10}\left(\frac{P_s + P_h}{P_h}\right) = 10 \log_{10}\left(\frac{P_s}{P_h} + 1\right)$$

we first have to find $\frac{P_h}{P_s} - 1$, then invert to $\frac{P_s}{P_h}$, add 1, and find the corresponding number of dB, representing $L_t - L_h$.

Example: let $L_t - L_s$ be 16 dB, then $\frac{P_h}{P_s} + 1 = 39.81$ and $\frac{P_h}{P_s} = 38.81$; inverted $\frac{P_s}{P_h} = 0.026$ and $\frac{P_s}{P_h} + 1 = 1.026$;

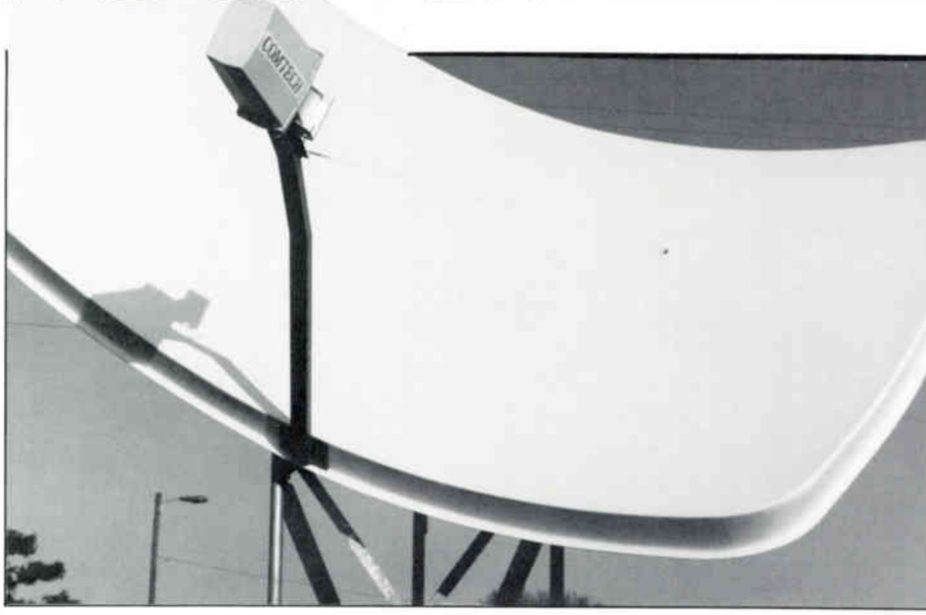
then $L_t - L_h = 10 \log_{10} 1.026 = 0.1104$ dB.

A table (P10) in Chapter XI has been prepared for the case of power splitting relationships. An example will illustrate its use:

Example: A directional coupler divides energy between two output terminals. Assuming it has no internal power loss, and the loss to the tap output is 18 dB, what is the line loss?

Solution: In the table opposite 18 dB ($L_t - L_s$) we find 0.069 dB ($L_t - L_h$). So the line loss is *0.069* dB.

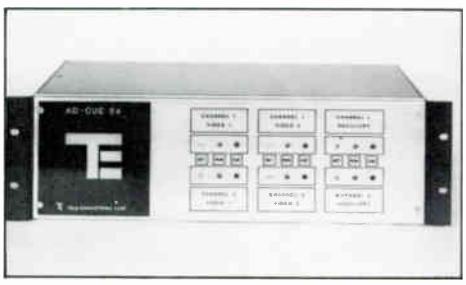
This chapter of the "Technical Handbook for CATV Systems" is being reprinted courtesy of the General Instrument Corp.'s Jerrold Division. To obtain a complete copy of the "Technical Handbook," send $10 plus $1.50 for postage and handling to: Technical Handbook Order, Customer Service Department, General Instrument/Jerrold Division, 2200 Byberry Rd., Hatboro, Pa. 19040. Jerrold customers may place orders with their customer service rep. (Make checks payable to General Instrument/Jerrold Division.)



Antenna for 2° spacing

Comtech Antenna Corp. has introduced the OFFSAT™ antenna system. According to the company, this unique one-piece design with innovative full offset feed makes the OFFSAT the only antenna in its size category capable of exceeding all the 1983 FCC specifications for 2° spacing. The reflector is 5.5 meters in the plane of the orbital arc and just 8 feet high. The OFFSAT, manufactured to Ku-band tolerances, is available in both C- and Ku-band receive or transmit configurations, and is offered in El/Az, polar and transportable versions.

For complete specs, contact Comtech Antenna Corp., 3100 Communications Rd., P.O. Box 428, St. Cloud, Fla. 32769, (305) 892-6111.



Commercial inserter

Tele-Engineering Corp. recently unveiled a new addition to its line of automatic commercial insert equipment for cable television, the AD CUE 84™ programmable insertion system. The new system contains logging, switching and random access capabilities in one unit, and inserts local messages into two channels of advertiser-supported cable programming.

The AD CUE 84™ system cues up prerecorded commercial or system announcements in any order and runs them whenever a satellite network DTMF cue tone signals the start of a local commercial availability. Commercials can be placed on an ROS (run of schedule) basis, a fixed position basis (to run at a given hour), or a combination of the two. Up to two minutes of commercials will be run automatically during each availability. The unit controls two video cassette players and one character generator—or other auxiliary video source—per channel. The operator can program the sequence of ads remotely using any standard CRT terminal and modem. The hand-held Commander™ microterminal (included) provides on-site programming.

Verification log numbers record spot identification and time of insertion. These log numbers can be retrieved remotely via telephone line for CRT display or fed into IBM-compatible software such as Tele-Engineering's COBIAS I™ cable advertising package for automatic printing of affidavits and invoices.

For further information, contact Jeff O'Brien, PVS Product Manager, (800) 832-8353; in Massachusetts, (617) 877-6494.

Energy management

Scientific-Atlanta Inc. has introduced its Model CBM-1270 cable modulator and Model CRI-1271 cable receiver/signal inserter. The cable modulator and receiver/inserter operate in conjunction with S-A's hotel/motel (HMS-1201) or commercial (CES-1202) energy management system and operate through a standard cable television system to provide a communications link for load management of a large number of buildings. Use of the new equipment with existing cable allows cost-effective energy management for numerous locations that are otherwise inaccessible, according to the company. This type of energy management system may be placed in condominiums, resorts, schools, government buildings or any properties in an area covered by cable television.

Using the cable modulator and receiver/inserter, the master control unit of the energy management system sends energy management commands over the cable at normal frequencies. As these signals are received at the remote building, they are decoded and inserted onto the building electrical wiring where they are transmitted via power carrier to the loads to be controlled.

Special software is not required. Only the cable modulator and receiver/inserter are needed to expand the standard Scientific-Atlanta HMS/CES energy management system to allow energy management via cable. Systems are available for a cable operating frequency between 88 and 175 MHz (50 kHz bandwidth).

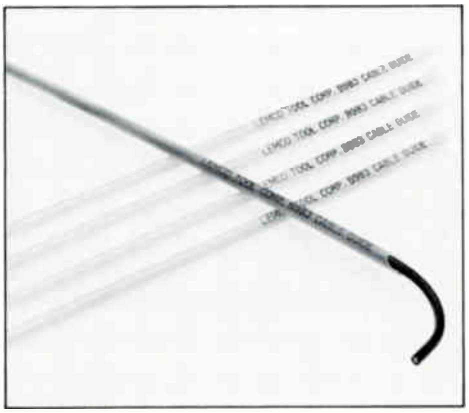
For complete details, contact James Massara, Marketing Manager, Scientific-Atlanta Energy Management Division, (404) 449-2093.

Security system

CableBus Systems Corp. announced additional configuration features to its Micro-2 automatic alarm controller for cable-based residential and commercial security. The Micro-2 alarm controller is a sophisticated alarm polling and display device that permits monitoring of customers via cable plant. Used in conjunction with a CableBus Mod-1 headend modem at the cable headend site and with a CableBus home terminal at each subscriber location, the Micro-2 responds to alarms by simultaneously printing and displaying a plain-English alarm message along with a customer code and time of day. The Micro-2 is programmed to expect a response from each home terminal polled and reports out-of-service units within seconds.

The enhancements to the Micro-2 system allow the unit to be upgraded by adding plug in circuit cards to increase subscriber accounts. These increases are in increments of 2,000 subscribers at a time, up to a total of 5,000 subscribers. A second enhancement for the Micro-2 is the availability of a demographics custom software package. Operating on a modified IBM PC color computer, the system plugs into the existing RS 232 port available on the Micro-2. The software package displays any occuring alarm message with customer demographics and all pending alarms. Rapid alarm handling, alarm processing and dispatching are possible with this software package.

For more specs, contact CableBus Systems Corp., 7869 S.W. Nimbus Ave., Beaverton, Ore. 97005, (503) 643-3329.



Cable guide

Lemco Tool Corp. is now offering a new drop cable guide, Model B983, designed to facilitate the installation of the service wire through a wall. After drilling a ⅜" hole, the guide can be easily inserted through the wall. The tapered end aids in locating the hole on the opposite side; the flared end prevents the guide from pulling through the wall. A slit is provided on the guide to remove it from the wire once it has been fed through.

For additional information, contact Lemco Tool Corp., R.D. #2 Box 330A, Cogan Station, Pa. 17728, (800) 233-8713 or (717) 494-0620.

Audio amplifier

Channelmatic Inc. recently unveiled its all new UAA-6A universal audio amplifier. The UAA-6A contains six separate broadcast quality transformerless audio amplifiers in a single 1.75 by 19-inch rack mounting frame. Each amplifier accepts a balanced or unbalanced high impedance input and provides an adjustable level 600 ohm balanced (or 150 ohm unbalanced) broadcast standard output. The UAA-6A is designed to adapt low-cost audio equipment and videocassette machines for use in professional broadcast facilities. The unit offers a frequency response of 20 Hz to 20 KHz ±0.1 dBm, and a THD less than 0.05 percent (at a +24 dBm output).

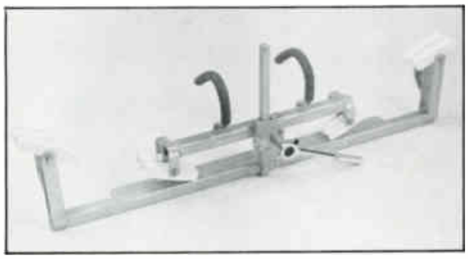
For more information, contact Channelmatic Inc., 821 Tavern Rd., Alpine, Calif. 92001, (619) 445-2691.

Teletext system

A unique teletext decoding system developed by Zenith will provide cable subscribers with access to 50 times more information on their home TV sets than with conventional teletext systems, according to the company. By using a full cable channel, not just the vertical blanking interval, full-field teletext can provide access to substantially more pages of information. The system combines the major attributes of an advanced pay television system (tiering and addressability) with text capabilities. Tiering will allow cable operators the ability to offer various levels of text service, making it possible to present a wide variety of specialized informational services on one cable channel. A special jack on the back of the teletext decoder will allow con-

sumers to connect a home computer or printer directly to the decoder for newsletter transmission and electronic mail applications. The Zenith Full-field Teletext Decoder, Model TX1000, is based on the World System Teletext format, currently in use in more than 90 percent of all teletext systems in the world, according to Zenith.

For complete details, contact Zenith Radio Corp., 1000 Milwaukee Ave., Glenview, Ill. 60025, (312) 391-8181.



Cable bender

Jackson Tool Systems division of Jackson Enterprises has developed a new mechanical cable bending tool for the CATV construction industry. The new Double 1" Bender, part number 2084, allows construction personnel to form flat-bottom expansion loops in aerial coaxial cable sizes up to and including jacketed 1". The bender is designed to save time while increasing the quality and uniformity of expansion loops in multiple trunk runs. The lightweight unit incorporates the ratchet action and teflon advanages of Jackson's 1084 series benders. The tool forms two identical flat bottom loops as the cables are pulled over low-friction teflon surfaces.

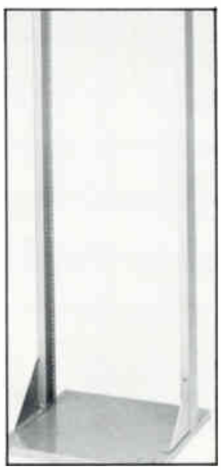
Additional information is available by contacting Jackson Enterprises, P.O. Box 6, Clayton, Ohio 45315, (513) 836-2641.

SMATV polar mount, satellite receiver

Scientific-Atlanta Inc. introduced its Model 9530 satellite receiver designed specifically for SMATV applications. The solid-state, computerized receiver is the latest addition to S-A's mini-cable system product line and offers commercial quality at an economical price, according to the company. The frequency-agile 9530 receiver uses microprocessor-controlled circuitry to select, fine tune or scan any of 24 satellite channels. Soft-touch push buttons on the front panel allow input to the microprocessor. The unit is available in either a rack or table-top model (9530A). Both models work in conjunction with S-A's Model 362 low-noise converter (LNC), allowing use of standard hardware for the antenna-to-receiver connection. The receiver is UL listed and features tuneable audio, volatile memory for set-up instructions, and single and dual LNC selection. Both models are available for immediate delivery.

Scientific-Atlanta also introduced its Series 9000 motorized polar mount for 2.8/3.2-meter earth station antennas, allowing full and continuous equatorial arc coverage after initial antenna alignment. The swing arm design permits viewing of any satellite in the visible equatorial arc from any location in the United States without additional manual adjustment. The Series 9000 motorized polar mount antenna features a low-maintenance DC motor actuator with an automatic reset thermal overload protector. The Model 9130 antenna controller automatically positions the antenna through the use of a microcomputer-equipped keypad, motor drive and cable set for keypad, motor drive and antenna actuator interconnection. The microcomputer has a curve learning function, virtually memorizing the equatorial arc so the antenna can return to any given position at the touch of a button. Adjustments for declination/polar angle are provided with the motorized polar mount and allow easy relocation of the antenna from one site to another while ensuring precise tracking accuracy. The motorized polar mount antenna has been designed to afford simpler set-up than is normally associated with polar mount antennas, according to S-A.

For additional information, contact David Chance, Commercial Markets Manager, Scientific-Atlanta Video Communications Division, (404) 925-5706.



Equipment racks, off-air headends

Macom Industries/OEM Enterprises announced a new open frame 19-inch wide equipment rack series for headend use. Models MOR-61 and MOR-71 are available in 61- and 71-inch heights respectively. The new low-cost racks are made of 12 gauge uprights and 16 gauge base and brackets. The mounting rails provide EIA RS-310C standard holes tapped for 10/32 screws and are finished in a high quality grey hammertone. The racks are available from stock.

Other new Macom offerings are complete off-air headends, fully assembled and wired tested. The headends can provide a clean 65 dB output with 0 dB input on 12 channels.

For complete details, contact Macom Industries, 8230 Haskell Ave., Van Nuys, Calif. 91406, (800) 452-6511 or (818) 786-1335.

Necessity is still the mother of invention

By Toni Barnett

A white pickup truck ambles down a lonely back road in Texas, passing mountains of reels of wrecked-out cable. The driver, Phillip Roddy, retired from the federal government, scratches his head and wonders why the Texas heartland is being marred by all of this trash. Specifically, he wonders why somebody doesn't correct the situation. He's proud of his Lone Star state and the buildup of scrap cable is everywhere.

Taking matters into his own hands, Roddy investigated the problem. "I decided retiring wasn't such a good idea," he said. "I started checking what the cable companies were doing with the scrap cable. The companies didn't have any way of disposing of the cable or the reels," Roddy emphasized, "and there just wasn't any market for them."

Roddy and his wife Clarissa approached different cable operators in 1980 and offered a service they refer to as yard clean-ups. At first, Cable Retrievers (the Roddy's new company) just hauled off the wrecked-out cable and reels, resulting in mountains of scrap. After finding a market for the scrap cable, they then began buying it from the cable operators. "We began to work on a contract basis," said Roddy. "We paid them so much for their used cable and, in turn, we bailed the materials in containers and sent them to Taiwan (the only market then available for wrecked-out cable)."

The scrap problem for cable operators really began to manifest itself when they started to do rebuilds. At this point, Phillip Roddy went to the cable manufacturers to discern exactly what products were in the cable. "We found out that everything in the cable is able to be recycled. The aluminum alloy is about 99.5 percent pure aluminum. We began to look for a machine in the United States," Roddy stressed, "that would strip the cable for us instead of sending everything to Taiwan. We couldn't find anything on the market so we decided to build our own."

Roddy and his people worked on this project for 19 months using the trial-and-error method, until they perfected the equipment (patent pending). "Our cable stripper today will run 135 feet of cable per minute. A jacketed piece of cable has four parts: an outer polyethelyne jacket; the aluminum sheathing; gas-injected polyethelyne next to the center core; and the center core. With the type of equipment we now have," Roddy explained, "the wrecked-out cable goes in one end and it comes out in the four parts I just mentioned."

At this stage, Roddy now sells the recycled parts back to various manufacturers. The aluminum sheathing, for instance, is sold to aluminum manufacturers who in turn sell aluminum tubing to the cable manufacturers. "We have contracts with these manufacturers," said Roddy, "who will buy up to a million and a half pounds of aluminum per month."

'Every 100 miles of wrecked-out cable will build just over one mile of new aerial cable.'

Phillip Roddy

The particulars

Initially, Cable Retrievers contacts various MSOs to purchase their wrecked-out cable. "We try to do this on a contract basis," said Roddy, "so there's no misunderstandings. We give them a proposal. We will buy the cable either with steel strand intact or without if it's wrecked-out cable. If we purchase it with the steel strand it's one price. If we buy it without the steel," Roddy explained, "it's another price." The company also will purchase partials or reel ends, as well as the reels.

Some of the MSOs who already have contracts with Cable Retrievers include Warner Amex, Cox Cable, Group W and Sammons Communications.

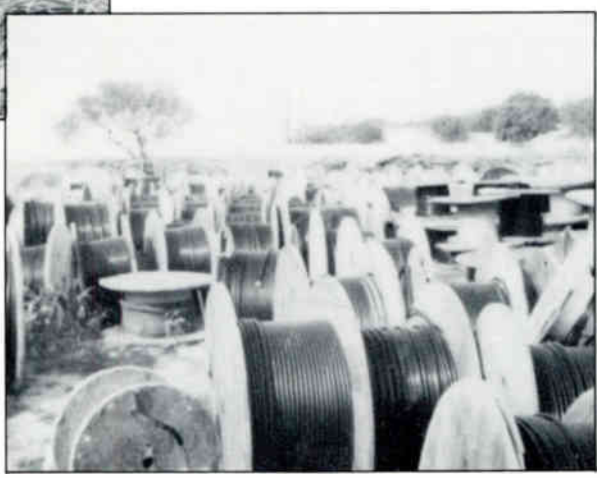
After the contract is worked out, all materials are shipped to Cable Retrievers' base of operations in Ft. Worth, Texas. "We've moved the operation from Houston to the Ft. Worth area in June of '83," explained Roddy, "so that we're in more of a focal point in the shipping lanes." The wrecked-out cable is then run through its machines and packaged in gaylord boxes. The materials are stored until there is a trailer load. The company presently ships about 3,000 pounds of aluminum per day.

All materials purchased from cable operators are bought on a per pound basis. Depending on the type of material, the quantity and location, the price will vary from 4 cents/pound to 10 cents/pound. "On an average," Roddy figured, "every 100 miles of wrecked-out cable will build just over one mile of new aerial cable."

Cable Retrievers has evolved from a hip pocket mom-and-pop situation to a nationwide operation. The company now has eight full-time employees, three officers of the corporation and a great deal of part-time help.

"We've joined the Texas cable association," Roddy added, "and we exhibit at the Texas, Eastern, Western and National shows."

To date, Roddy's company has purchased approximately 30,000-35,000 miles of wrecked-out cable. "The beautiful part of this is that over the next two-and-one-half years, 80 percent of construction will be rebuilds," declared Roddy. "The potential is there and we want our fair share of the market."



James Faust has been named president, Cable Products, a division of **Zenith Radio Corp.** He was executive director and general manager of the division since January 1983. Faust, a 17-year Zenith veteran, was chosen to launch the company's pay TV decoder business group in 1979, when he was named director, sales and marketing, cable and subscription television products. In 1981, he became general manager of CATV/STV/videotex operations. Contact: 1000 Milwaukee Ave., Glenview, Ill. 60025, (312) 391-8181.


Walter

Phil Walter has been named an account representative for **Magnavox CATV Systems Inc.,** responsible for promoting and selling Magnavox CATV products and services in the North Central region. Before joining Magnavox, Walter was sales representative for John Weeks/Comsea Sales Inc. Contact: 3213 E. 13th St., Des Moines, Iowa 50316, (515) 266-0415.

The Drop Shop Ltd. announced two recent staff additions. **Dennis Sarantapoulas** was added to its in-house sales staff, while **Ric Charel** was appointed to the newly created post of special accounts manager. Sarantapoulas, who has eight years of experience with cable TV equipment and operations, has held positions with UA-Columbia Cablevision, US Cable Corp. and RMS Electronics. In his new position, Sarantapoulas will service existing and new accounts throughout the United States. Charel brings with him 20 years of sales and sales management experience, including sales of coaxial cable, electronic components and tools to the electronic and cable TV industries. Contact: P.O. Box 284, Roselle, N.J. 07203, (800) 526-4100 or (201) 241-9300.


Hancock

Dick Hancock has been named vice president of sales and marketing for **Anixter Microsat**. Hancock had been national sales manager for the Anixter Communications' unit since 1981. In his new position Hancock will be responsible for overseeing Anixter Microsat's sales to the cable television industry in Canada. Contact: 830 Brock Rd. S., Pickering, Ontario, L1W 1Z8, (416) 839-5182.


Morse

General Instrument Corp. recently announced several new appointments. **Robert Cromack** has been named to the newly formed Administration and Far East Broadband Group Operations unit as vice president of operations. Cromack had previously been vice president for quality assurance, Jerrold Subscriber Systems Division. **Paul Morse Jr.** has been named director of planning for GI's Broadband Communications Group. Morse moves over from the Jerrold Subscriber Division where he was marketing manager for addressable systems. Contact: 2200 Byberry Rd., Hatboro, Pa. 19040, (215) 674-4800.

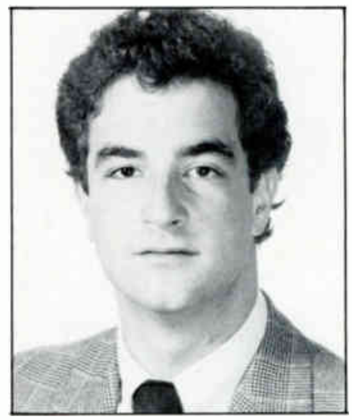
Paula Horne and **Fred Godwin** have joined **Mycro-Tek** as representatives for the Mycro-Vision® Video Display Information System. Horne, who will service customers throughout the Southeastern United States from her Atlanta base, spent the last three years as Eastern regional manager for Scripps-Howard's *TV Watch*. Godwin will be based in Philadelphia and handle accounts throughout the Northeastern United States. Prior to joining Mycro-Tek, he was a sales supervisor for Savin Corp. Contact: P.O. Box 47068, Wichita, Kan. 67201, (800) 835-2055.

Avantek Inc. announced the appointment of **Erik van der Kaay** to the position of senior vice president of the company's Telecommunications Division. Van der Kaay had been with Microwave Associates in Burlington, Massachusetts for the past 14 years, with his last position being president of M/A-COM MVS Inc. Contact: 3175 Bowers Ave., Santa Clara, Calif. 95051, (408) 496-6710.

John Cummings has been promoted to the position of product manager, Cable Security® at **TOCOM Inc.** Cummings joined TOCOM as regional sales manager in 1981 after three years with Cableguard, a TOCOM subsidiary in Dayton, Ohio. While there he served as sales manager and vice president of operations. He most recently served TOCOM as sales manager, Cable Security products. Contact: 3301 Royalty Row, Irving, Texas 75062, (214) 438-7691.

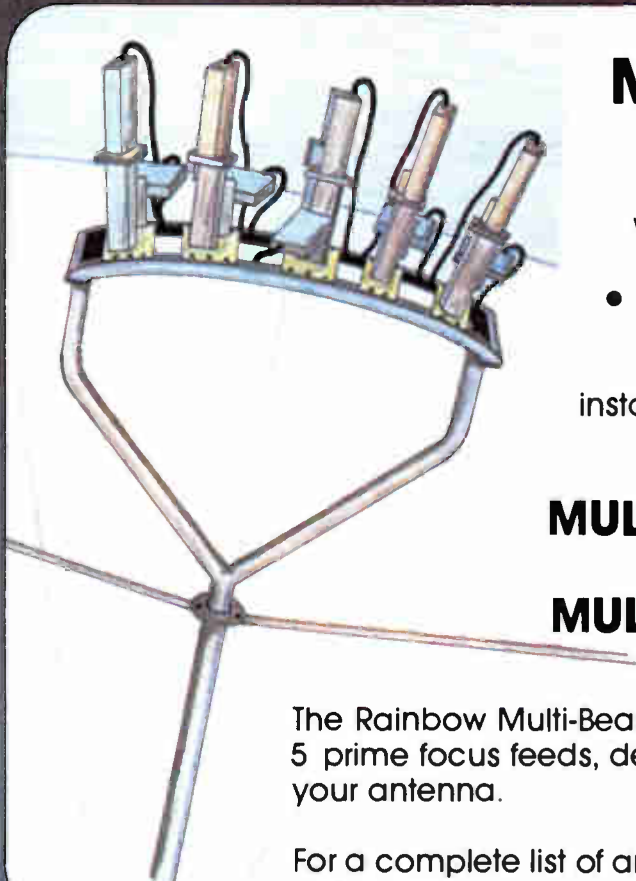
William Earley has been appointed manager of quality control at **Blonder-Tongue Laboratories Inc.** Earley will be responsible for all quality management functions in the company. He joined Blonder-Tongue in 1981 as supervisor of quality assurance.


Bollin


Hoffman

Edgar Ebenbach was recently promoted to vice president and general manager of **Jerrold Canada**. He had been vice president and assistant general manager. Ebenbach previously served as vice president for marketing at the Jerrold Subscriber Systems Division before moving to Jerrold Canada in 1982. Contact: 70 Wingold Ave., Toronto, Ontario M6B 1P5, Canada, (416) 789-7831. Two recent sales personnel announcements also were made by the **Jerrold Division** of General Instrument. **Mark Bollin** has been named as account manager, responsible for sales to Tele-Communications Inc. Bollin comes to Jerrold from AVX Corp., a Myrtle Beach, S.C.-based electronic components manufacturer, where he served as corporate marketing communications manager for five years. **Peter Hoffman** has joined Jerrold as a sales representative for the Northeastern sales region. Contact: 2200 Byberry Rd., Hatboro, Pa. 19040, (215) 674-4800.

5 Star General



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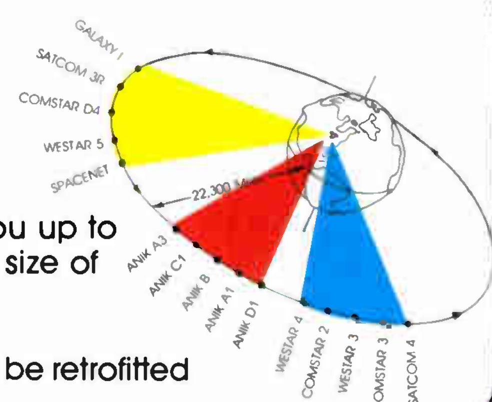

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Answers to FCC true and false quiz

1) True — In addition, there may be other FCC Rule sections that apply to an individual system depending on the particular installation. Such as:
   - Part 17—Tower lighting & painting
   - Part 25—Satellite
   - Part 78—CARS
   - Part 90—Private Land Mobile Radio

2) True — The regulation goes on to say that an operator is expected to be familiar with the Rules governing CATV systems. We recommend that all systems have a copy of the Rules regardless of system size.

3) False — The technical regulations only apply to Class I channels.

4) True

5) False

6) False — If a system is using any frequencies other than the normal off-air TV and FM spectrum, then it would be subject to the Rules pertaining to signal leakage testing. In addition, if a system is using any frequencies in the aeronautical bands then it would be subject to the regular leakage monitoring of the system and maintaining the leakage logs. Actually it is a good idea to do these regardless of system size or frequencies used.

7) True

8) True

9) True

10) True

11) True

12) True — WTBS, WGN and WOR are Class I signals even if received off the satellite.

13) True

14) True

15) True

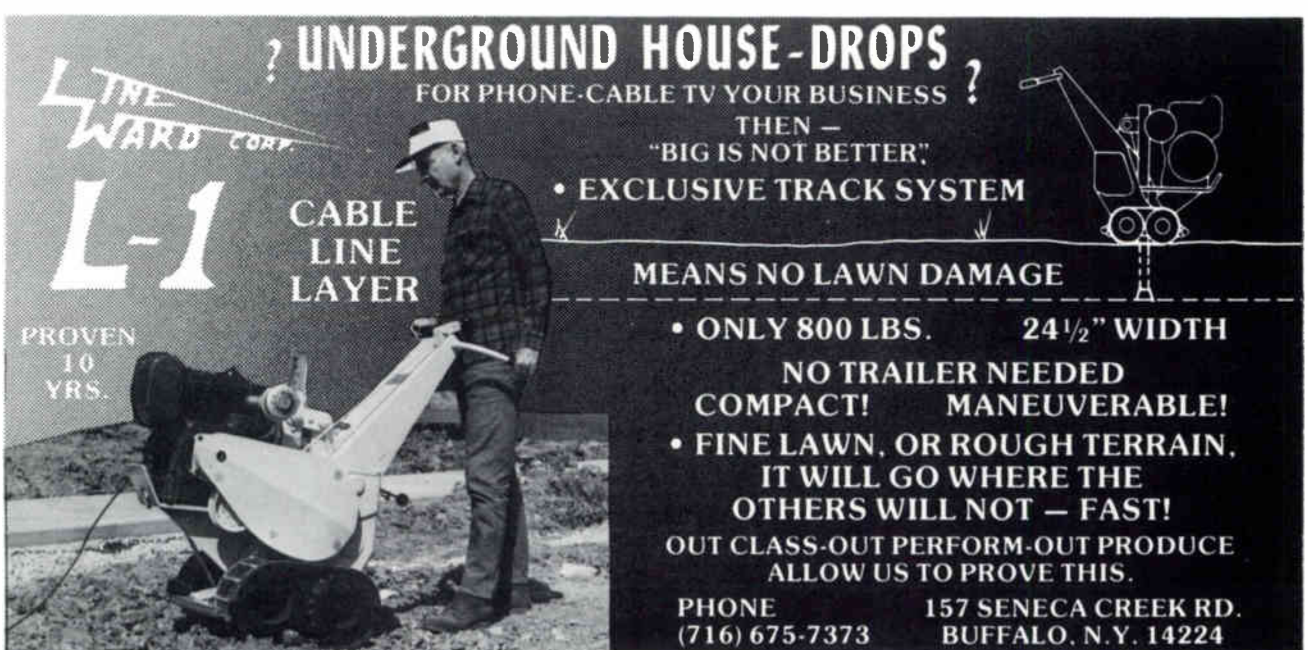
16) False — There are specific instances where this rule applies. They are:
1. When the signal is delivered to any subscriber within the predicted Grade B contour of the station.
2. When the signal is first picked up within the predicted Grade B contour of the station.
3. When the signal is first received from the TV station by direct video feed.

17) True

18) True — A tighter tolerance could be imposed on a system if there is a harmful interference problem.

19) False — Any signal carried on the system within the frequencies 108-136 and 225-400 MHz that has a level greater than 28.75 dBmV, must be coordinated with the FCC prior to its use. This applies no matter what the use of the signal.

20) False



May

May 5-9: EUROCAST '84, **Telsat** and **Satelliten Rundfunk**, Swiss Industrial Fair, Basel, Switzerland. Contact Mark Voss, (713) 463-0502.
May 8-10: Jerrold technical seminar, Boston. Contact Kathy Stangl, (215) 674-4800.
May 9-11: Magnavox CATV training seminar, Rapid City, S.D. Contact Laurie Mancini, (800) 448-5171; in New York, (800) 522-7464.
May 9-11: Community Antenna Television Association advanced technical training seminar, Best Western Monticello Motor Lodge, Bellmawr, N.J. Contact (305) 562-7847.
May 14-16: Magnavox CATV training seminar, Rapid City, S.D. Contact Laurie Mancini, (800) 448-5717; in New York, (800) 522-7464.
May 15-17: C-COR Electronics Inc. technical seminar, San Francisco. Contact Deb Cree, (814) 238-2461.
May 15-18: International exhibition of telecommunications, radio and information technology. **Communications '84**, National Exhibition Centre, Birmingham, England. Contact (201) 652-7070.
May 17-18: TeleStrategies Inc. seminar on "Telephone Bypass Technologies and Economics," Grand Hyatt, New York. Contact (703) 734-7050.
May 31-June 1: "Satellite Communications" seminar, **TeleStrategies Inc.**, Stouffer's National Center, Washington. Contact (703) 734-7050.

June

June 3-6: National Cable Television Association annual convention, Las Vegas (Nev.) Convention Center. Contact (202) 775-3629.
June 10-15: Northeast Cable Television Technical Seminar, **New York State Commission on Cable Television**, Camp Topridge, Saranac Lake, N.Y. Contact Bob Levy, (518) 474-1324.
June 11-14: Canadian Cable Television Association annual convention, Capital Congress Center, Ottawa. Contact (613) 232-2631.
June 13-15: Community Antenna Television Association basic technical training seminar, Best Western Arlington Inn, Arlington Heights, Ill. Contact (305) 562-7847.
June 19-21: Jerrold technical seminar, Kansas City, Mo. Contact Kathy Stangl, (215) 674-4800.

July

July 9-12: National Computer Conference, **American Federation of Information Processing Societies, Association for Computing Machinery, Data Processing Management Association, IEEE Computer Society** and **Society for Computer Simulation**, Las Vegas (Nev.) Convention Center. Contact Ann-Marie Bartels or Marty Byrne, (703) 620-8926.
July 10-12: Jerrold technical seminar, Williamsport, Pa. Contact Kathy Stangl, (215) 674-4800.
July 10-12: Cable '84, **Online Conferences Ltd.**, Wembley Conference Centre, London. Contact Online in England, 01-868-4466.
July 11-13: Magnavox CATV training seminar, Portland, Ore. Contact Laurie Mancini, (800) 448-5171; in New York, (800) 522-7464.
July 12-14: Montana Cable Television Association annual convention, Big Sky, Mont. Contact Tom Glendenning, (406) 586-1837.
July 15-19: Community Antenna Television Association annual convention, CCOS-84, Tan-Tar-A Resort, Lake of the Ozarks, Osage Beach, Mo. Contact Celeste Nelson, (405) 947-7664.
July 16-18: Magnavox CATV training seminar, Portland, Ore. Contact Laurie Mancini, (800) 448-5171; in New York, (800) 522-7464.
July 17-19: C-COR Electronics technical seminar, State College, Pa. Contact Deb Cree, (814) 238-2461.
July 23-25: PC/SMATV workshop, **National Satellite Cable Association** and **Eagan & Associates,** Washington. Contact Larry Hannon, (904) 237-6106.
July 23-27: Annual conference on computer graphics and interactive techniques, ACM SIGGRAPH '84, **Association for Computing Machinery's Special Interest Group on Computer Graphics**, Minneapolis. Contact: (312) 644-6610.
July 30-Aug. 1: New England Cable Television Association annual convention, Sturbridge, Mass. Contact Maureen Murphy, (603) 224-3373.

August

August 8-10: Magnavox CATV training seminar, Chicago. Contact Laurie Mancini, (800) 448-5171; in New York, (800) 522-7464.
August 13-15: Magnavox CATV training seminar, Chicago. Contact Laurie Mancini, (800) 448-5171; in New York, (800) 522-7464.
August 21-23: Jerrold technical seminar, Denver. Contact Kathy Stangl, (215) 674-4800.
August 28-30: Annual Satellite Communications Users Conference, ***Satellite Communications***, Louisiana Superdome, New Orleans. Contact Kathy Kriner or Cheryl Carpinello, (303) 694-1522.

Planning ahead

June 3-6: National Cable Television Association annual convention, Las Vegas (Nev.) Convention Center.
June 11-14: Canadian Cable Television Association annual convention, Capital Congress Center, Ottawa.
July 15-19: Community Antenna Television Association annual convention, CCOS-84, Tan-Tar-A Resort, Osage Beach, Mo.
Sept. 6-8: Southern Cable Television Association annual convention, Eastern Show, Georgia World Congress Center, Atlanta.
Oct. 16-18: Mid-America CATV Association annual convention, Hilton Plaza Inn, Kansas City, Mo.
Oct. 30-Nov. 1: Atlantic Show, Atlantic City (N.J.) Convention Center.
Dec. 5-7: California Cable Television Association annual convention, Western Show, Anaheim (Calif.) Convention Center.

AD INDEX

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Cable industry R&D

By Bob Luff
Vice President, United Artists Cablesystems Corp

Too little or compromised, new revenue-producing research and development could be the Achilles' heel of the cable industry. The cable industry should observe its unique opportunity and aggressively reverse the recent erosion of industry research and development in order to ensure our future transition into a major and full telecommunications entity.

While we have far from squeezed the last drop from cable's classic business of delivery of television entertainment signals, most agree that we have reached a temporary slowed growth plateau. New growth similar to the last decade can come only from the birth or adoption of yet unclear new video or data offerings, as well as extending the existing bounds of our classic services.

Holding the key

The cable TV industry holds the telecommunications equivalent of unimproved waterfront property from Maine to Florida. Our national network of satellites, microwave systems and millions of *in-place* miles of broadband cables *directly* reaching what will soon be the majority of homes and businesses gives us unparalleled telecommunications resources and capability. But, just as the value of waterfront property is limited if left unimproved, so is the future of the cable industry. Only if we carefully develop this vast resource, can we realize its boundless potential. This can only occur with far more coordinated research and development dedicated to opening new, diverse revenue-producing frontiers.

Unfortunately, at a time when we critically need research and development to open new services more than ever, the industry is experiencing a general erosion of R&D as a result of recent industry consolidations triggered by the predictable but nonetheless sobering effects of the end of the franchising era.

Changing times

Additionally, today's deregulated, highly competitive environment has caused many of our hardware and program partners, which we have depended on almost exclusively in the past for new products and services, to develop their own set of independent business goals. These goals may or may not be supportive to cable operators' long-term needs. Manufacturers can and must shift their product lines or move into other related technical fields, as competition requires. But, our cables and business definitions restrict such flexibility. It is likely that as time passes, more and more of our partners today may in fact be in direct conflict to the long-term, overall best interests of the cable industry.

Let's not kid ourselves. Everyone is in it for the money. Stockholders demand a continuing fair return for their investment and growth. If manufacturers can make more money selling millions of DBS dishes rather than a trickle of cable TVROs, can you blame them for shifting their research and development emphasis and aggressively competing in that market? If the program suppliers can make more money by developing alternate ways of delivering their programs directly to viewers, can you blame them for doing so? And, where the money goes, so goes the research and development, leaving the cable operators with a vast piece of unimproved real estate.

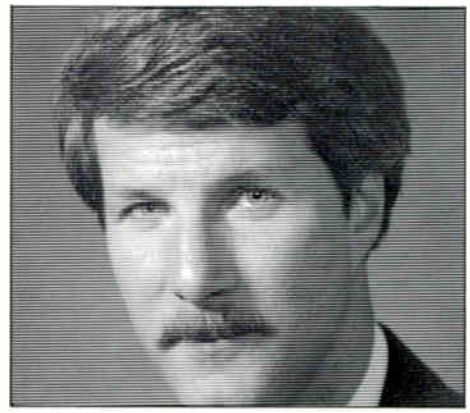
Even without these natural shifts the manufacturer is seeking to expand its profits. Its research and development is directed toward maximizing its profits, not our profits. The two may coincide, but only by chance. There are many examples where manufacturers ignore or postpone development of new products that would be to the advantage of the industry because it may dilute their own manufacturing or engineering effort and jeopardize their individual strength.

Active research and development

It is time that we, the cable operators, become active rather than passive in the research and development responsiblity of our own future. No one else knows our business as well or has so much at stake.

Our timing may be perfect to seize this needed initiative. It may even be that the direction of recent industry consolidations of operators and manufacturers alike mark a natural switch of research and development dynamics from manufacturers to at least the larger MSOs. If there is agreement, there are at least three areas where we can improve our guiding hand over research and development leading to new diverse revenue-producing services.

The first step is to do more internal research and development ourselves. While manufacturers have reduced overall CATV research and development budgets (with several important exceptions), several MSOs have already been expanding their engineering department breadth and instituted internal research and development activities. These activities have resulted in notable achievements on their own (Warner's QUBE, Cox's INDAX, ATC/Zenith's SSAVI, TCI's national addressable system and Manhatten Cable's business data service to name just a few) and



prove the feasibility of this approach industry-wide. Operating companies should continue this trend and place even more emphasis on internal or joint research and development.

Second, operating companies should take more direct interest in other industries and their existing products and research and development activities. It should be noted that very few of today's CATV "break through" technologies came from the CATV industry itself. Government defense, the space program and Silicon Valley properly deserve most of the credit for the pure and applied research that was adopted by our industry. We should expand our reading material and major trade show coverage to these related fields.

The last untapped resource for beneficial CATV research and development that we can directly influence for our own needs are our colleges and universities. In the past, academia seemed only interested in focusing on the social science of marketing research rather than new product or service research and development. It is time to get the hard sciences of the Physics and Electrical Engineering departments of our institutions of higher learning motivated to address the high-tech opportunities of cable. Either collectively through the National Cable Television Association or independently as operators, the industry should encourage university and college level technical research and development programs possibly through grants and scholarships. Such activity would provide a double return in that the industry would benefit from the research itself and we would be simultaneously developing a pool of knowledgeable researchers and students to fill our growing high-tech industry postions.

With proper research and development then, our industry can take advantage of its limitless revenue-producing services and ensure our future position as a major competitor in national and international telecommunications.