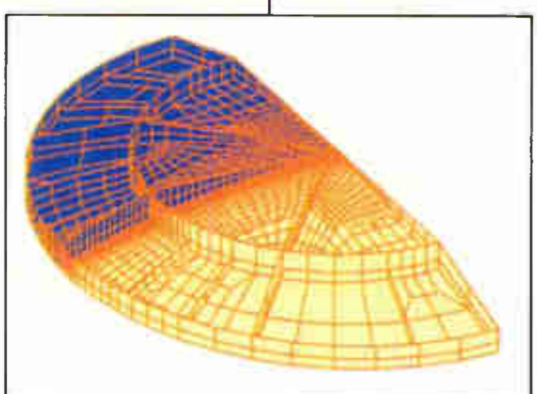
COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers

Headends: Keeping up with the future



Antenna anti-icing

February 1988

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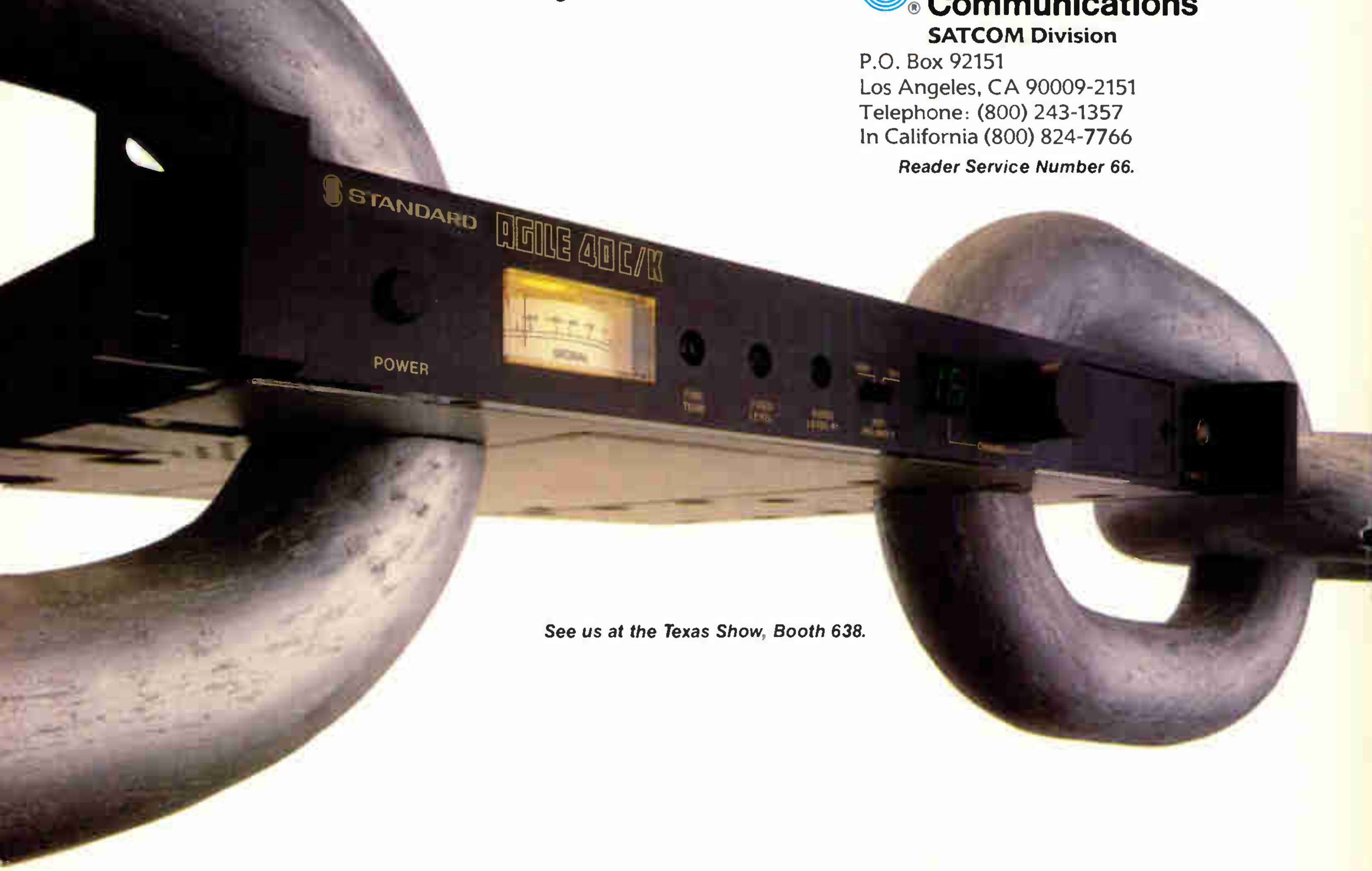

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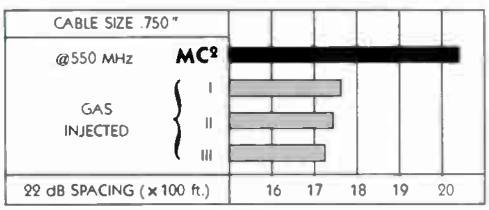

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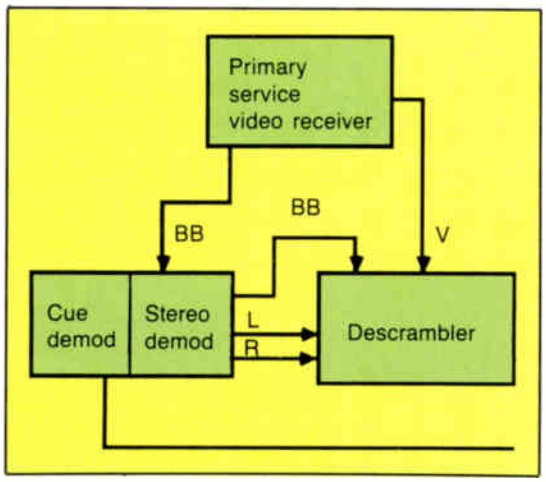

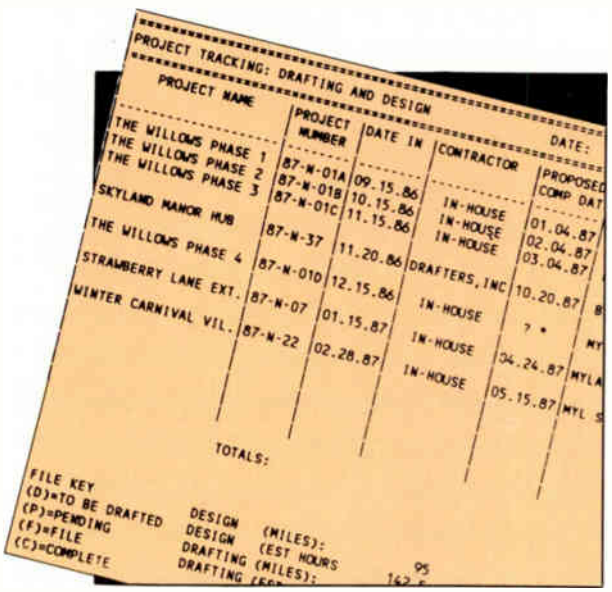

Features

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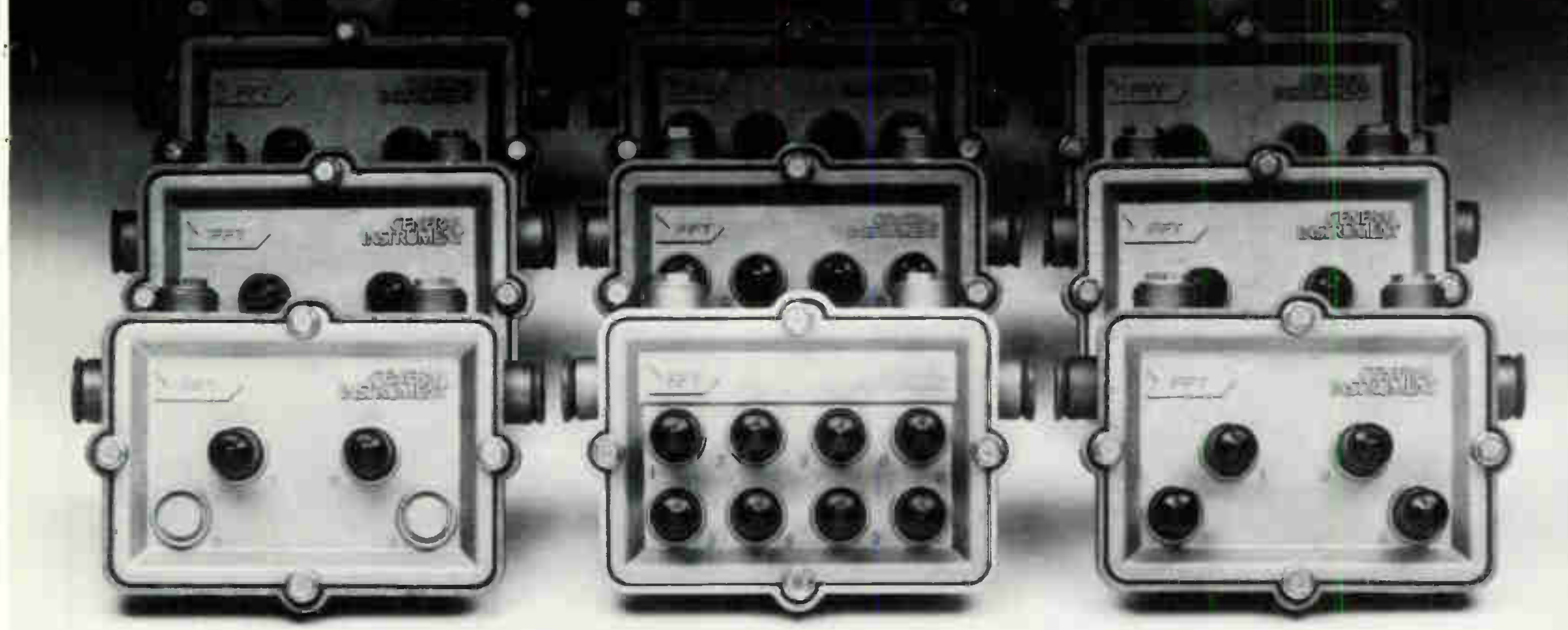

Thanks to our greatly expanded production capacity, Jerrold can offer you excellent delivery on our complete line of 2, 4, and 8-way taps!

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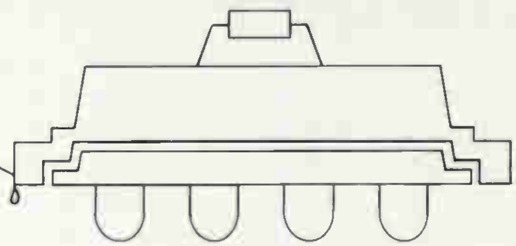

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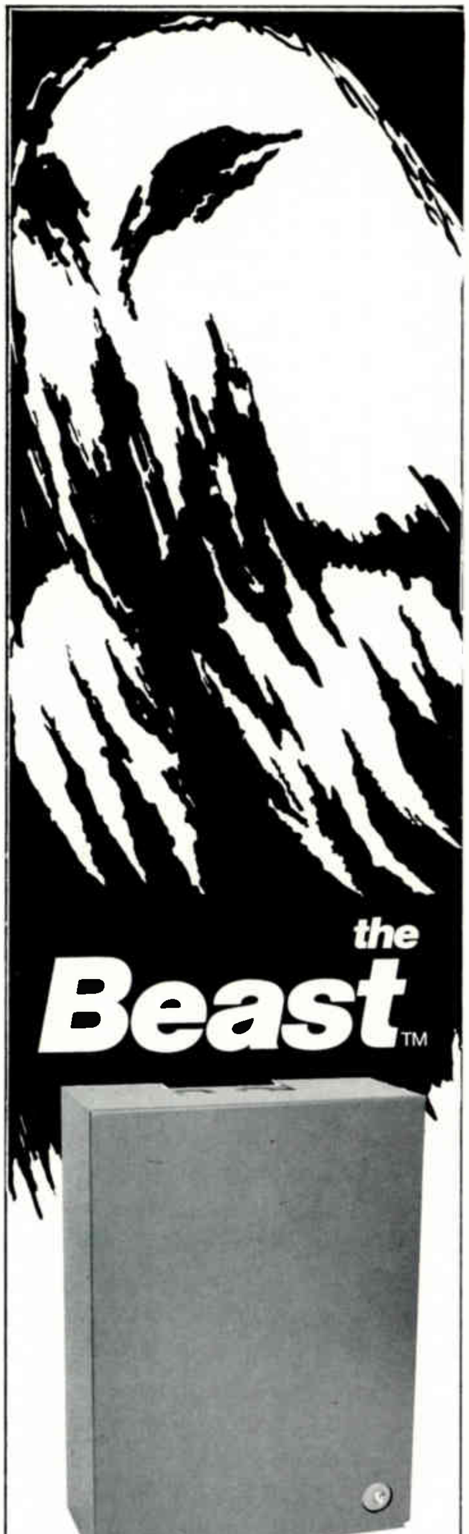


PUBLISHER'S LETTER

Fiber-optic fever

With the recent news items that more cable systems are planning to use fiber-optic cable in new-builds or rebuilds, you might think that there would be the need for a national seminar on the subject. And you'd be right. On Jan. 18-20, the Florida Chapter of the Society of Cable Television Engineers co-sponsored its first fiber-optic seminar in Orlando, Fla.

It was estimated that about 150 people in the industry would be interested in workshops and discussions with some non-cable companies (BellSouth, AMP, AT&T and Stromberg-Carlson) currently involved in fiber-optic design, production and use. As it turned out, the attendance was 412, almost triple the original expectations. Congratulations and thanks go to the SCTE Florida Chapter for its hard work in putting together the seminar, as well as for its dedication to the continuing education of the cable engineering community.

The SCTE is also planning some exciting seminars for this month's Texas Show. Topics include "Management skills for the engineer," with Wendell Bailey, National Cable Television Association; "Signal leakage," with Robert Dickinson, Dovetail Systems; "BTSC stereo," with Steve Fox, Wegener Communications; and "Headend maintenance," with Paul Beeman of Viacom Networks and Ron Hranac of Jones Intercable. There's also an afternoon set aside for BCT/E testing.

Speaking of which, Leslie Reed of Sammons Communications was the first to successfully complete the BCT/E Certification Program at the engineering level; Dave Large of Gill Cable came in second. Also, James Goins of Florida Cablevision, Kevin McNichol of Continental Cablevision and Todd Acker of Jones Intercable recently fulfilled the requirements for certification at the technician level. Congratulations to all!

Leave it to the SCTE to be in the vanguard of CATV training. And this year's Annual Engineering Conference and Cable-Tec Expo, to take place June 16-19 at the San Francisco Hilton, promises to be another winner. Topics almost certain to be covered include high-definition television, BTSC stereo, signal leakage and (of course) fiber optics. I am proud to be on this year's expo Program Committee. Anyway, watch for more information on the expo coming in future issues of *CT* and *The Interval*.

Lights, camera, action!

It's time for the second annual *CT*/SCTE contest. Last year we asked for essays on how *CT* and the SCTE benefits the CATV engineering community. You may recall that Dean Owsley of Cardinal Communications wrote the winning entry. However, this year we decided to do something a little different: a photo contest on the topic of "technical trials and tribulations." (I cringe at what that entails.)

Photo entries can be color, black and white, slides or prints. The winner will be selected by a panel of four, consisting of two SCTE representatives and two members of the *CT* staff. If your entry is chosen, you will receive a trip for four to San Francisco, including round-trip airfare, hotel accommodations for four days and four nights and free registration to the Cable-Tec Expo for the winner. Deadline for entries is May 2. For more information, see page 61.

Closed-circuit to SCTE national members: You should have already received your election packet for nominating new directors. Please mail it as soon as possible. If you haven't received yours, or if you have questions, call Bill Riker at the SCTE, (215) 363-6888. Next month you will be receiving your expo registration materials and information.

Meeting minutes

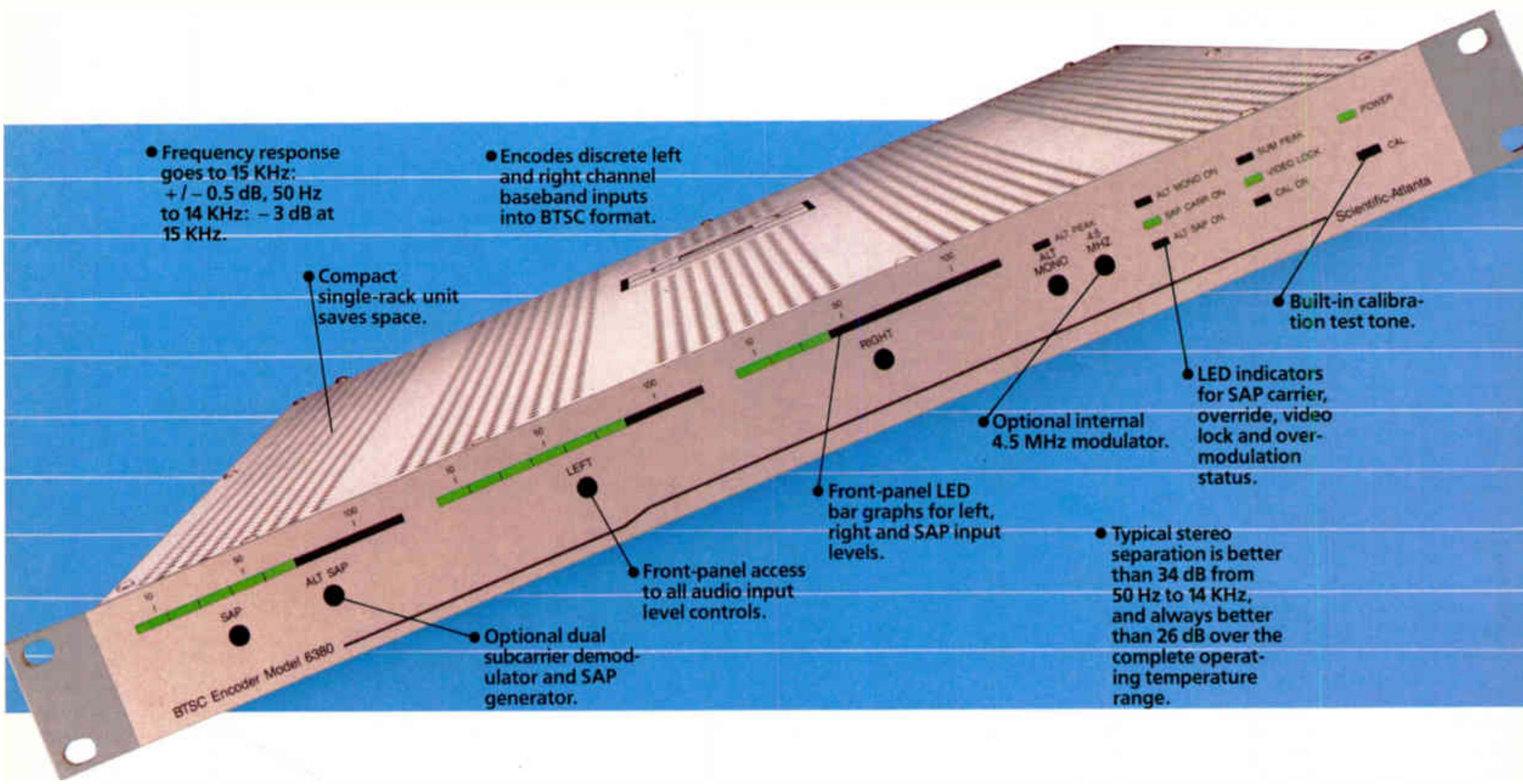
In this month's "News" section are the minutes of the NCTA Engineering Committee's bimonthly meetings. The latest session occurred in Englewood, Colo., last December. Our thanks to Wendell Bailey, Brian James and Katherine Rutkowski for sharing this information with our readers. And stay tuned for the latest details on the National Show, only two months away.

Finally, take some time to look through the first of this year's *CT* card decks, to be mailed to all readers the end of this month.

See you in San Antonio!

Paul R. Levine

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



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BPA

Texas Show to host technical panels

SAN ANTONIO, Texas—The Society of Cable Television Engineers will coordinate the technical program for the 28th annual Texas Cable TV Association Convention and Trade Show, to be held here Feb. 17-19. This event marks the fourth consecutive year SCTE has served in this capacity for the Texas Show. The agenda for the technical panels is as follows:

Wednesday, Feb. 17

Noon-3 p.m.—Administration of BCT/E Certification Program examinations.

Thursday, Feb. 18

9-10:15 a.m.—"Management skills for the engineer" with Wendell Bailey, National Cable Television Association.

10:30-11:45 a.m.—"Signal leakage" with Robert Dickinson, Dovetail Systems.

1:45-3 p.m.—"BTSC stereo" with Steve Fox, Wegener Communications.

3:15-4:30 p.m.—"Headend maintenance" with Paul Beeman, Viacom Networks and Ron Hranac, Jones Intercable.

For further information on the Texas Show, call (512) 474-2082.

Engineering Committee: Improving quality

Beginning with this issue, "CT" will provide a report of the bimonthly meetings of the Engineering Committee of the National Cable Television Association, written by Brian James, NCTA director of engineering.

DENVER—The Engineering Committee held its meeting here Dec. 17-18, 1987, with over 60 engineers from operating, manufacturing and programming present. Improving picture quality and high-definition television (HDTV) were the major topics.

Two pre-meeting sessions were held. The first was at the American Television and Communications labs, where a demonstration of a high-capacity, amplitude-modulated fiber-optic link took place. The development of an AM fiber-optic link would allow cable operators to reduce amplifier cascade lengths and, thereby, improve the noise and distortion performance of their systems. The introduction of HDTV may require improved system performance; fiber optics may be one method of achieving the improvement.

The second session was a demonstration by Yves Faroudja of Faroudja Laboratories on the ability of pre- and post-comb filters to remove many of the artifacts created when an NTSC signal is transmitted. The pre-comb filters process the video signal before it enters the NTSC encoder at the origination site. The post-comb filters would be located in TV sets. The two types of comb filters work independently and both provide some reduction in the normal NTSC artifacts. Maximum signal quality improvements require the use of both types of filters.

The main meeting started with an update of major activities at the Federal Communications Commission, including the adoption of isolation specifications for A/B switches, filing of comments on automatic identification systems for satellite uplinks and a notice of proposed changes for Part 15 rules. In addition, the Court of Appeals for the Washington District struck down the must-carry rules. The Supreme Court agreed to hear the technical deregulation case.

Eric Rosenthal of ABC stated the broadcaster's desire to improve the quality of its affiliate signals carried on cable systems. ABC hopes to accomplish this by working with local cable operators to determine what is necessary to improve the signal received at the headend, including the possibility of direct feeds to the headend. This is an indication that at least one network is beginning to recognize the importance of the cable industry and the ability of a cable operator to provide a higher quality signal than may be available off-air.

The HDTV Subcommittee provided input for the NCTA comments in the FCC advanced television systems docket and will provide input for the reply comments. The committee is beginning to gather data to better define the cable transmission medium and will develop a test plan to obtain data on parameters for which insufficient information exists. The information obtained will be used to analyze proposed HDTV transmission systems and determine the optimal system for cable TV. Tests are expected to take place the first half of this year. The subcommittee also is looking into the feasibility of transmitting a Super-VHS quality signal down the cable system.

The National Electrical Safety Code Committee will review suggested changes for the next revision. Currently, there are no cable operators representing the industry on any of the committees. In order to protect the industry from harmful changes, volunteers are needed for at least the grounding, work rules and clearance committees.

The Satellite Practices Subcommittee is preparing a suggested procedure for program suppliers and cable operators to assist in setting up headend receivers and modulators. A review of ad insertion cue tones and other signaling methods is under way to determine the most reliable method(s). With the increase in ad inser-

tions, the reliability of present methods needs to be reviewed.

The Electronics Industries Association/National Cable Television Association joint committee is progressing in finalizing the multiport specifications. Some TV set manufacturers are now producing sets with the multiport. Unfortunately, decoder manufacturers have delayed making products available to system operators. If TV manufacturers do not see the cable industry supporting the multiport, they will stop production. Hence, the opportunity to improve consumer friendliness will be lost. The manufacturers are reluctant to accept the proposed specs for ingress of cable-compatible TV sets because they have not received complaints of direct pickup (DPU) from customers. A survey of operators will be undertaken to document the incidence of DPU on cable-compatible sets.

The meeting ended with the announcement that Syd Bradfield of the Cable Branch was leaving the FCC. The committee expressed its appreciation for his efforts on behalf of the industry and wished him the best in the future.

Floor space sold out for Cable-Tec Expo

EXTON, Pa.—According to the Society of Cable Television Engineers, there is no remaining exhibit space available for the SCTE's 1988 Cable-Tec Expo, to be held June 16-19 at the Hilton and Towers in San Francisco. Over 85 companies, displaying all types of products, services and equipment used in the operation of cable systems, have rented space for the expo.

Companies wishing to exhibit at the expo can contact SCTE national headquarters to be placed on a waiting list and contacted in the event of an exhibitor's cancellation. For further information, call Bill Riker at (215) 363-6888.

Studies link stereo with better picture

LAS VEGAS, Nev.—In two studies announced here at the Winter Consumer Electronics Show and conducted by the Massachusetts Institute of Technology and Zenith Electronics Corp., "television that sounds good looks good too." Preliminary research by the Advanced Television Research Program of the Media Laboratory at MIT showed that consumers who viewed the same television twice—once with stereo sound and once without—believed the television with stereo sound had a better picture.

These results were consistent with Zenith's own findings. In its study, 93 percent of the consumers surveyed whose television had stereo sound said that they were "very satisfied" with the set's picture quality. According to Bruce Huber, vice president of marketing for Zenith's Consumer Products Group, "Because TV viewers are so visually oriented, a better overall viewing experience from stereo TV is often attributed to the picture instead of the sound."

Jones systems sold to Falcon Cable TV

LOS ANGELES—Falcon Cable TV recently acquired $106 million in cable properties from Jones Intercable. This will make Falcon the 22nd largest MSO in the United States. The acquisition is being made primarily by a new partnership called Falcon Cable Media, owned by Falcon and Boston Ventures, a private investment company. In addition, the Bank of Boston has committed to provide an initial credit line for $80 million to finance the venture.

The 12-system sales includes approximately 60,000 cable subs and passes 112,000 homes in 30 communities.

- Cable Link recently set up repair facilities at its Columbus, Ohio, base to handle both Oak and Jerrold addressable converters.
- Scientific-Atlanta received four orders for its B-MAC equipment totaling $4 million from the United Kingdom, Sweden, Argentina and Brazil. B-MAC provides simultaneous satellite transmission of video, six channels of digital audio or data, teletext and utility data in an encrypted, addressable format. S-A also began shipments in early December 1987 of its Masterworks 8585 integrated impulse pay-per-view system to operators.
- General Instrument's VideoCipher Division was awarded a contract by Hughes Television Network for securing satellite transmission using VideoCipher's IB technology. The system will first be used to scramble Major League Baseball backhaul feeds beginning with the 1988 season.
- Ohio Bell is planning a new installation for North Coast Cable in Cleveland that will utilize approximately 1,100 miles of Trilogy Communications' MC² coaxial cable. The projected build is expected to take three years to complete. Also, Jerry Conn Associates purchased more than $1 million worth of the MC² cable for distribution during the first half of 1988.
- TV Answer filed a Petition for Rulemaking on Dec. 2, 1987, seeking the reservation of one-half MHz in the 216-222 MHz band for cable operators, broadcasters, MMDS/ITFS licensees and others to use for offering viewer response services in education, public information research, special events TV, home shopping, pay-per-view and other applications where viewers are able to select options presented on their TV screens. The deadline for filing to the Federal Communications Commission was Jan. 27.
- RFI Communications of San Jose, Calif., was chosen to design and construct the Communications Network Utility, a dual-cable 450 MHz broadband system supporting data and video to an initial 19 buildings, for Lockheed Missiles and Space Co. The Jerrold Division of General Instrument was selected as the vendor for the project.
- Mitsubishi Electric Sales America changed the name of its Industrial Video Division to Professional Electronics Division, in order to more appropriately identify its growing product lines. The division is headquartered in Piscataway, N.J.
- Pioneer Communications of America began the new year with seven major sales nationwide worth more than $5 million. New customer sales accounted for more than $2 million of the total, while current customers placed follow-up orders worth more than $3 million. The largest new addressable system purchase was made by Times Mirror Cable TV for its Providence, R.I., system.
- Tele-Communications Inc. recently relocated its corporate offices to Regency Plaza One, Suite 600, 4643 S. Ulster St., Denver, Colo. 80237, (303) 721-5500. The mailing address is Terminal Annex, P.O. Box 5630, Denver, Colo. 80217.
- C-COR Electronics announced it will supply distribution electronic equipment for Bay CableVision in Richmond, El Cerrito, Berkeley, Hercules and El Sobrante, Calif. The company also signed a contract with the University of Georgia to provide electronics for two new systems in Athens, Ga.
- Wegener Communications was chosen to supply audio transmission equipment to Jones Intercable for Jones' new Galactic Radio audio services. Wegener will supply the complete uplink as well as the audio demodulators and FM stereo demodulators required to receive and retransmit the audio in the FM band.
- Midwest CATV, a division of Midwest Corp., will be the exclusive U.S. distributor of Syrcuits International's new Matrix System. The product in an outdoor security system that employs addressable technology used in the Syrcuits descrambler.
- Viacom Cable presented its Office of the Chief Executive Award to employees for their outstanding performance and contribution to the company. Two of the recipients were Roger Hooker, construction manager at the Everett, Wash., system; and Dean Pohlkotte, maintenance supervisor at the Dayton, Ohio, system.
- Oak Industries signed an agreement to sell its corporate headquarters building in Rancho Bernardo, Calif., to San Diego-based developer Buie Corp. The 78,000-square-foot facility was built by Oak in 1980.
- M/A-COM MAC was awarded a $2.9 million contract to supply the Bangkok Entertainment Co. of Thailand with microwave radio equipment for expansion of a nationwide TV network.
- Anixter announced an agreement in principle to acquire the assets of Cable Terminal Services, the CATV electronics repair operation with facilities located in Austin, Texas, and Torrance, Calif.
- United Cable Television Corp. has placed an order, valued at more than $1 million, with Hughes Aircraft Co.'s Microwave Products Division for a 60-channel AML system for local signal distribution. The system will interconnect the East Bay, South Bay and Peninsula areas around San Francisco and will eliminate six smaller headends.
- AM Communications received an order for $1.5 million from MCI to construct a fiber-optic telecommunications link in Georgia and Alabama.

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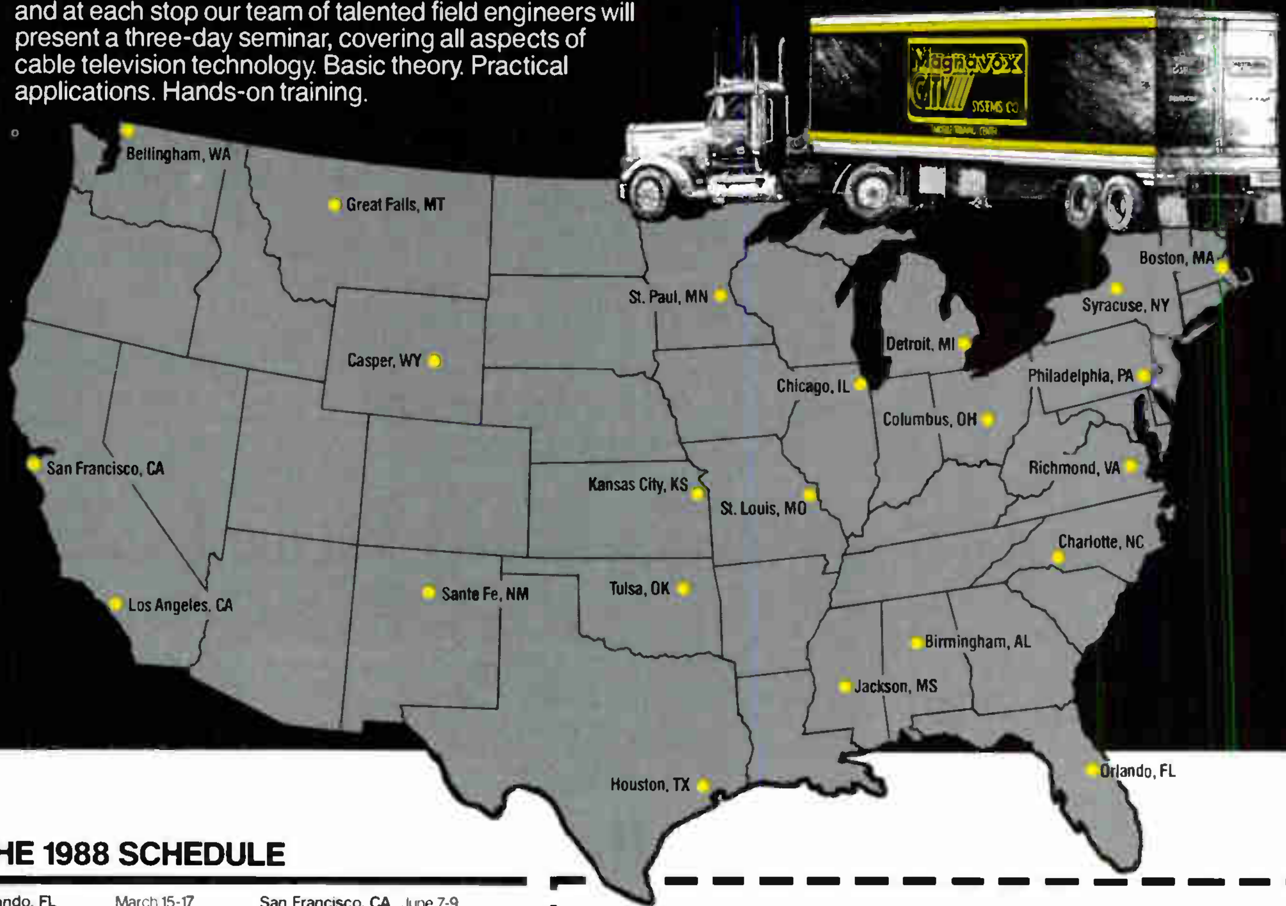

THE 1988 SCHEDULE

Orlando, FL	March 15-17	San Francisco, CA	June 7-9
Birmingham, AL	March 22-24	Columbus, OH	September 13-15
Jackson, MS	March 29-31	Detroit, MI	September 20-22
Houston, TX	April 5-7	Chicago, IL	September 27-29
Tulsa, OK	April 12-14	St. Louis, MO	October 4-6
Santa Fe, NM	April 19-21	Kansas City, KS	October 12-14
Los Angeles, CA	April 26-28	Charlotte, NC	October 18-20
Bellingham, WA	May 10-12	Richmond, VA	October 25-27
Great Falls, MT	May 17-19	Philadelphia, PA	November 1-3
St. Paul, MN	May 25-27	Boston, MA	Nov. 9-11, Nov. 15-17
Casper, WY	June 1-3	Syracuse, NY	November 21-23

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Science at Loch Ness

By Isaac S. Blonder
Chairman, Blonder-Tongue Laboratories Inc.

The average human, from the assumed superior stature as a literate learned judge of nature and human foibles, immediately identifies any departure from familiar objects and normal behavior as fraudulent and hallucinatory. This happened to me on two occasions: when I first advocated pay-per-view (30 years ago) and my excursions to Loch Ness in search of the elusive monster (commencing in 1970). Professor Harold Edgerton—you *must* know of him!—a confirmed Nessie hunter, once said, "If I believed the statistics, I would never have started most of the things I have done."

Of the 3,000 documented sightings of Loch Ness, about 300 have survived the most skeptical evaluations. The first recorded observation concerned St. Columba (in 565 A.D.) who commanded the monster in the name of God to "go back with all speed," and thereby saved the life of one of the heathen Picts. However, no recent reports depict Nessie as a menace to humans. Some mid-century sightings refer to water kelpies (water horses), and an old map dated 1325 carries an inscription concerning "waves without wind, fish without fin, and floating island." A Loch Lomond map (1653) noted that "the fish they speak of as having no fins are a kind of snake and therefore no wonder." Modern sightings of Nessie were facilitated by the construction of a new road in the 1930s on the west shore of Loch Ness.

What was it that convinced the many reputable scientists who have volunteered their time and money pursuing the elusive monster?

1) The multitude, integrity and variety of witnesses who, independently and without collusion, describe similar "beasts"?

2) Still photographs taken by Hugh Gray, F.C. Adams and Lacklen Stuart; underwater flipper, body (?) and head (?) shots by Robert Rines? (The famous 1934 Wilson photo is still involved in controversy over its resemblance to a cormorant.)

3) A movie? Of the known 22 movies the following are impressive: G.E. Taylor, 1938; Tim Dinsdale, 1960, certified by the official British JARIC as depicting an animate object; Richard Raynor, 1967, not only filmed but seen by many credible witnesses.

4) Sonar? Just about every monster hunter, equipped with sonar, has recorded large echoes, indicating the presence of live targets dwarfing the largest recorded fish caught in the Loch. A few examples: In 1968, Professor Tucker of the University of Birmingham, England, observed large objects rising and falling at a rapid rate (5-7 mph) as well as in horizontal motion. In 1969 Robert Love (financed by the Field Foundation) tracked a target for three minutes and 19 seconds, during which it moved at speeds of 2-4 mph in a looping path. Both of these observations were conducted with the objects at depths of 200 to 600 feet. Since the sonar beam must reflect from a density transition such as an air bladder, the animal would have to be very large to return a usable echo at those depths.

In 1969, Canada's submarine *Pisces* picked up a sonar target at a distance of 600 feet while hovering 50 feet off the bottom at a depth of 520 feet. The submarine headed toward the target, which rapidly disappeared from the screen. The *Pisces*' maximum speed—2 knots! In 1970, Marty Klein, Academy of Applied Science (AAS), towed a side-scan sonar 100 feet under the surface for the entire length of Loch Ness, recording large moving targets, abundant fish and a bathtub-shaped bottom. In 1972, Robert Rines of the AAS took an underwater photo of a flipper (or tail); at the same time the sonar recorded large objects passing by. I was in an adjacent boat at the time recording with hydrophones—no luck on my part!

Over the years many groups have scoured the waters of Loch Ness with diverse scientific apparatus, most of the time with insufficient funds. To name a few out of the many: University of Chicago Professor Roy Mackal, the BBC, *The New York Times*, *National Geographic*, David James of the Loch Ness Phenomena Investigation Bureau, World Book (Field Foundation), the AAS (Rines), NBC and the Japanese. Two of these teams I can personally vouch for. My nephew Jeffrey volunteered to serve with the World Book team of Bob Love and Professor Mackal in 1970. As a member of the AAS, I have spent more than 12 summers at Loch Ness. Come up and hear my hydrophone stereo recordings some time!

"Why, then, has Nessie eluded the best-laid plans of many of the world's best scientists?"

Best-laid plans

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Finally, in 1979, a really great idea died—literally—before its time. The AAS located a trainer with a pair of dolphins named Susie and Sammy. Professor Harold Edgerton, in his MIT lab, turned out a miniature strobe and 35mm camera harness rig. For weeks in Florida the trainer taught the dolphins to pick up the harness, search out any large object in the area, approach within 40 feet, actuate the mouth switch (whereupon the camera takes 30 pictures and sets off a buzzer) and return to the base for reloading.

From Florida the dolphins were flown to Boston for cold-water conditioning. All went well until suddenly one of the dolphins died. End of experiment! It seems that no more dolphins could be caught for performances in the United States due to an act of Congress passed with pressure from concerned environmentalists. Nessie, your secret is safe, until we can get dolphins from Europe who are not subject to the act!

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Reader Service Number 13.

Distributed headends

By James D. Hood, Ph.D.
President, Catel Telecommunications Inc

The traditional architecture of the single-headend CATV system is changing. Due to the requirements for increased channel capacity and improved picture quality, single-headend architecture followed by an extensive tree and branch distribution system will no longer provide the quality of service required by today's cable TV customers and has no hope of providing the signal characteristics required by high-definition television (HDTV) receivers. Even though the technical specifications for HDTV have not yet materialized, HDTV products are beginning to appear at consumer electronics shows. Consumer demand is being created and the cable industry must be ready to meet it.

Distributed architecture for headends promises to provide this improved performance, and the equipment necessary to accomplish its cost-effective implementation is becoming available. A "distributed headend" normally consists of one master control location and numerous hubs located throughout the service area. Any hub can serve as an interface to the tree and branch distribution system; in the case of a bidirectional hub it can serve as a point of signal origination. The hubs may be interconnected in a variety of star, ring or other patterns, and all are controlled at the master location.

The hub is considered to be part of the headend, rather than part of the distribution system, because the signals are delivered using high quality "transparent" transmission techniques. The signals delivered to the tree and branch distribution system from the hub would be at least equivalent to RS250B long-haul specifications. In many cases, it is advantageous to generate signals at a hub for transmission back to the master control location and/or for distribution throughout the cable system. It is thus highly desirable for the transmission medium used between the master control location and the hubs, and between the hubs as well, to be capable of bidirectional communication.

To quantify the performance requirements of the various components of a cable system, a simple mathematical model is used[1]. Table 1 shows the primary contributors to noise in a cable system and provides the results of a simple noise summation. In this model, the carrier-to-noise ratios (C/N) of satellite receiver, headend processing equipment, hub trunking and conversion equipment and set-top converter are held constant at 54 dB, 57 dB, 58 dB and 47 dB, respectively. The C/N of the tree and branch distribution system is varied in Cases 1 through 4 to show the effect on overall picture quality delivered to the subscriber.

Table 2 shows the results of a similar set of calculations for HDTV. It is assumed that more bandwidth on the satellite will be used for HDTV distribution, resulting in 57 dB C/N. It is further assumed that an HDTV receiver will have 55 dB C/N and that a 49 dB C/N signal will be required at the HDTV receiver to provide satisfactory service. The implication is that a tree and branch distribution system with 55 dB C/N performance will be required to provide satisfactory HDTV service.

Table 1

	Case 1 C/N dB	Case 2 C/N dB	Case 3 C/N dB	Case 4 C/N dB
Satellite receiver (SR)	54.00	54.00	54.00	54.00
Headend signal processing (HE)	57.00	57.00	57.00	57.00
SR and HE	52.24	52.24	52.24	52.24
Hub carrier/noise (HB)	60.00	60.00	60.00	60.00
SR, HE and HB	51.56	51.56	51.56	51.56
Distribution system (DS)	40.00	43.00	46.00	49.00
SR, HE, HB and DS	39.71	42.43	44.94	47.09
Set-top converters (SC)	47.00	47.00	47.00	47.00
SR, HE, HB, DS and SC	38.96	41.13	42.84	44.03

Table 2

	Case 1 C/N dB	Case 2 C/N dB	Case 3 C/N dB	Case 4 C/N dB
Satellite receiver (SR)	57.00	57.00	57.00	57.00
Headend signal processing (HE)	57.00	57.00	57.00	57.00
SR and HE	53.99	53.99	53.99	53.99
Hub carrier/noise (HB)	58.00	58.00	58.00	58.00
SR, HE and HB	52.54	52.54	52.54	52.54
Distribution system (DS)	46.00	49.00	52.00	55.00
SR, HE, HB and DS	45.13	47.41	49.25	50.59
HDTV receiver (HDTV)	55.00	55.00	55.00	55.00
SR, HE, HB, DS and HDTV	44.70	46.71	48.23	49.24

Table 3

	Case 1 C/N dB	Case 2 C/N dB	Case 3 C/N dB	Case 4 C/N dB
Satellite receiver (SR)	57.00	57.00	57.00	57.00
Headend signal processing (HE)	57.00	57.00	57.00	57.00
SR and HE	53.99	53.99	53.99	53.99
Hub carrier/noise (HB)	50.00	53.00	56.00	60.00
SR, HE and HB	48.54	50.46	51.87	53.02
Distribution system (DS)	52.00	52.00	52.00	52.00
SR, HE, HB and DS	46.93	48.15	48.92	49.47
HDTV receiver (HDTV)	55.00	55.00	55.00	55.00
SR, HE, HB, DS and HDTV	46.30	47.33	47.97	48.40

Transmitting technologies

Three existing technologies can be used to transmit signals to a hub: coaxial cable, microwave and fiber optics.

Coaxial cable is the least desirable due to its inherent high attenuation. Amplifiers are required to attain any reasonable transmission distance, and the resulting noise figure makes it impractical to achieve the 60 dB C/N specification at the hub. A processing gain can be achieved using frequency or digital modulation to improve the end signal C/N, but requires signal processing equipment (and probably multiple cables due to the bandwidth limitations of the cable and the amplifiers) to transport the large number of channels typical of some of today's cable systems.

Microwave radio systems have frequently been used to implement hub systems. These radios operate in the 12.7 to 13.2 GHz frequency range and typically transport signals in the VSB-AM (vestigial sideband-amplitude modulated) format, making them directly compatible with the cable distribution system. Whereas microwave transmission equipment is quite expensive, hub site costs vary from $15,000 to $40,000, depending on the performance requirements. Line-of-sight must exist between the transmitter antenna site and the antenna on the hub receiver. Thus, the location of the hub has geographic restrictions in most cable system installations. Further, microwave transmission is subject to fade due to atmospheric attenuation (primarily precipitation).

The transmission quality of microwave systems is typically 53 to 56 dB C/N. Table 3 takes Case 4 shown in Table 2 (i.e., 55 dB C/N specifications for the distribution system) and varies the C/N

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at the hub from 50 to 60 dB. As can be seen, the 53 to 56 C/N of the microwave system results in a C/N below the 49 dB required for an HDTV signal. It would therefore appear that microwave transmission systems will have difficulty handling the HDTV format, even with no fade, and would appear to be quite unsatisfactory when the inevitable fade conditions do occur.

Fiber optics provides optimum transmission for cable TV applications. It is broadband, has linear frequency response and is bidirectional. The glass transmission medium is not subject to the short-term variations that affect delivered signal quality, and no long-term variations in modern fiber optics have been observed. Thus, fade conditions simply do not exist within a fiber system. Service interruptions from "backhoe fades" (i.e., breaks in the fiber) are rare in practice and can be easily avoided by using loop protection techniques.

The bandwidth of single-mode fiber is measured in the hundreds of GHz per mile. For the lengths used in cable systems, the bandwidth of the fiber itself has no practical limitation. The usable bandwidth of today's fiber-optic systems is limited only by its laser transmitters and detectors. If larger bandwidths are required in the future, only transmitters and receivers need be changed—not the fiber itself. Since fiber and installation represent the major capital expense, the usable bandwidth of a system can be increased for a small percentage of the original cost. As HDTV specifications evolve, two requirements become clear: more bandwidth per channel and improved specifications, at least for C/N and differential phase and gain. Fiber is probably the only transmission medium available to the cable industry that can provide the necessary bandwidth and linearity to accommodate HDTV specification requirements.

The primary impediment to a wide application of fiber optics in CATV systems has been the cost of the electronics, including the laser transmitters and optical receivers. In the past, these devices were designed primarily for supertrunking applications, with specifications far in excess of those needed at the hub of a distributed headend system.

Whereas the fiber itself is linear with respect to frequency response, this is not the case for the laser transmitter and optical receiver. The non-linearity and noise characteristics of the devices used in the past required that some "processing gain" be achieved from a modular scheme (usually either digital or frequency modulation) to provide adequate system performance. Recently, lasers have improved significantly, making VSB-AM modulated fiber optics practical in some applications. Further significant reductions in the cost of FM demodulation/AM remodulation equipment also have been achieved.

Optical receivers, FM demodulators, AM modulators, frequency generators and RF combiners/amplifiers used in supertrunking applications cost $4,000 to $5,000 per channel. Equipment has been introduced featuring performance specifications optimized for use in the distributed headend system hub at a price of $1,000 per channel. Advanced versions of this equipment are in development—physically smaller and environmentally ruggedized, with a lower price per channel.

Improved performance

Distributed headend architecture has been implemented in numerous systems in the past, but typically with a small (less than 10) number. Substantive improvement in cable system performance can be achieved by using more hubs to take the distributed headend much deeper into the distribution system. In fact, this type of architecture will most likely be necessary to meet the performance requirements of HDTV. Fiber optics appears to be the only way to realize a practical system with the number of hubs (at least one hub per 1,000 subscribers) required to provide significant improvement in cable system performance. Recent state-of-the-art advances for lasers, optical receivers and FM processing equipment are bringing the costs of a fiber-based, distributed architecture headend system into a price range competitive with alternative implementation techniques. In fact, all indications are that in less than one year this configuration for fiber-optic systems will become the least expensive alternative to building or rebuilding a cable system—and the performance improvement will be substantial.

References

[1]Switzer, Israel, "Video transport systems for optimizing CATV systems," *CED*, December 1987.

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Reader Service Number 16.

Monitoring headend performance

By William T. Homiller
Engineering Manager, Jerrold Division, General Instrument Corp.

The complexity of headend systems is such that even average installations can have 75 to 100 major pieces of electronic signal processing equipment. Output signals may be processed by three or four separate units. Antenna splitting, program switching and output combining networks may contain hundreds of contacts, cables, connectors and passive devices whose performance affects outgoing signal quality. As always the risk from equipment malfunction is high because the entire system and all of the subscribers are affected. Such a system demands a preventive maintenance (PM) program based on performance monitoring as the means to minimize unexpected failures.

The basis for any such PM program is the measurement and logging of significant performance parameters on a regular basis. The log becomes a data base that can reveal undesirable trends, show correlation between related parameters and provide a reference for evaluating current data.

Test equipment selection

Perhaps the greatest difficulty with any such program is in getting the appropriate personnel to perform the measurements regularly and correctly. The prospects here can be improved if the equipment for monitoring the headend is dedicated to the headend facility and actually be kept in the headend. The assurance that the equipment is always available and the knowledge that it will always be the same will make this task more comfortable.

The minimum equipment for essential RF and baseband signal monitoring is a quality TV receiver/monitor with appropriate converter/descrambler, a signal level meter and an oscilloscope. However, the ease and speed with which the tests can be run will strongly influence whether and how well they are performed. Because of this, a spectrum analyzer seems well worth the additional cost. As a headend RF output monitor, for example, an analyzer can simultaneously display all or many picture and sound carriers. An individual signal that is abnormal will be immediately apparent by visual comparison with its neighbors. When compared with carrier-by-carrier meter measurements, this sort of "appeal" is a real incentive to perform the monitoring task. The analyzer provides fringe benefits by measuring other parameters such as modulation levels, spurious signals and noise levels at the same time. Recent firmware-driven analyzer products even automate many of the standard CATV measurements.

Another good example of such measurement enhancement is the use of a TV waveform monitor in place of an oscilloscope. This monitor automatically synchronizes and displays the fields, lines and other specialized elements of the baseband TV signal. Specialized graticules that greatly simplify waveform measurements are available. Most of these tests are possible with a good oscilloscope, but they are a lot more appealing with the waveform monitor.

Obviously, a compromise between the ease of not monitoring anything and the burden of monitoring everything is necessary. Potential characteristics to be monitored should be prioritized by considering two factors: First, what is the experienced probability of performance change or failure? Second, how important is the parameter in question to subjective signal quality or regulatory requirements?

Nothing in the headend relates more closely to subscriber subjective signal quality than the headend output subjective signal quality. Therefore, picture and sound quality observations should be on the top of everyone's list and should be made daily. Headend picture carrier output levels have a direct effect on distribution system performance and therefore have a high monitoring priority. An example of a lower priority parameter would be output picture carrier frequency. FCC regulations must be met, but quality equipment does not normally exhibit a significant rate of frequency drift, so monthly or quarterly measurement is usually sufficient.

Under certain circumstances it is reasonable to anticipate a higher than usual likelihood of faults. In these cases, the normal rules for test selection and interval should be altered. Such a circumstance occurs whenever a headend is newly installed or when new equipment has just been added to the system. We are reminded of this by the general failure rate vs. time characteristic for any equipment: It begins high in its infancy, declines to its "normal" minimum value, then eventually increases as the equipment nears the end of its useful lifetime. The fault probability may increase if equipment is repaired, modified, relocated or handled in any way that introduces new possibilities for failure. Manufacturing and repair operations minimize the infancy phenomenon by incorporating burn-in or other stressing methods into their test processes, but it is unrealistic to expect the effect to be eliminated altogether. It only takes one undetected loose screw, cold solder joint or marginal component.

Another problem affecting stability is temporary or permanent change in the equipment's environment. Such change can be imposed purposely, accidentally or naturally. Examples are the addition of changes to forced ventilation or air-conditioning equipment, exposure to high temperatures due to air-conditioning failure, and potential damage from lightning strike or earthquake.

"Picture and sound quality observations should be on the top of everyone's list and should be made daily."

In such cases critical parameters should be monitored more frequently until there is confidence that normal stability exists or that problem units have been weeded out. A rather obvious example applies to frequency accuracy. The frequency of picture carriers that fall into the aircraft or navigation bands is critical because of the small tolerance allowed by FCC Regulation 76.612. For newly installed processors or modulators, these frequencies should be measured on a weekly basis. The drift characteristics can be easily visualized by plotting the logged frequency data. The frequency counter should have a time base stability at least an order of magnitude greater than the device being measured. Most units will have very high stability from the onset and will remain that way; a small number may show initial minor drift that never disappears. Once the latter type are corrected and all units are showing high stability, reliability theory suggests the probability of subsequent problems is very low (infancy is over, the hardware is mature). The monitoring interval can now be increased to normal.

It must always be remembered that the real reason for performing preventive maintenance is to reduce the likelihood of catastrophic failures and emergency repairs and improve the efficiency of troubleshooting when necessary. The selection of parameters to monitor and the logging of data should be based not only on providing a basis for failure prediction but also on supporting the troubleshooting process. An operator who typically troubleshoots equipment to the module level should log parameters such as IF levels, video and audio levels, internal power supply voltages and AGC voltages using built-in or added test points. These need not be measured as often as the primary parameters, but "normal" readings need to be available for diagnosing the source of the problem.

The decision to go troubleshooting is usually triggered by an abnormal result from the regular subjective observations or key performance measurements. One such scenario begins with the routine picture carrier level measurement. It is noticed that the level at Channel 6 is about 2 dB too low. A check of the associated modulator's RF output level shows that it is also low when compared with the previously logged value. In addition, the log shows that the RF output level has been trimmed upward on three other recent occasions, suggesting that performance is continuously deteriorating. You decide to correct the cause rather than continue to compensate for the problem. This modulator is connected with an IF scrambler so that the IF AGC is disabled and not a factor. Both the composite

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and the upconverter IF input levels also are found to be low compared to the previous log entry. The picture IF output level (as input to the scrambler) and the modulator power supply voltage are normal. By means of a few measurements and log book references the troubleshooting effort can be quickly focused on the scrambler and scrambler/modulator interface connections.

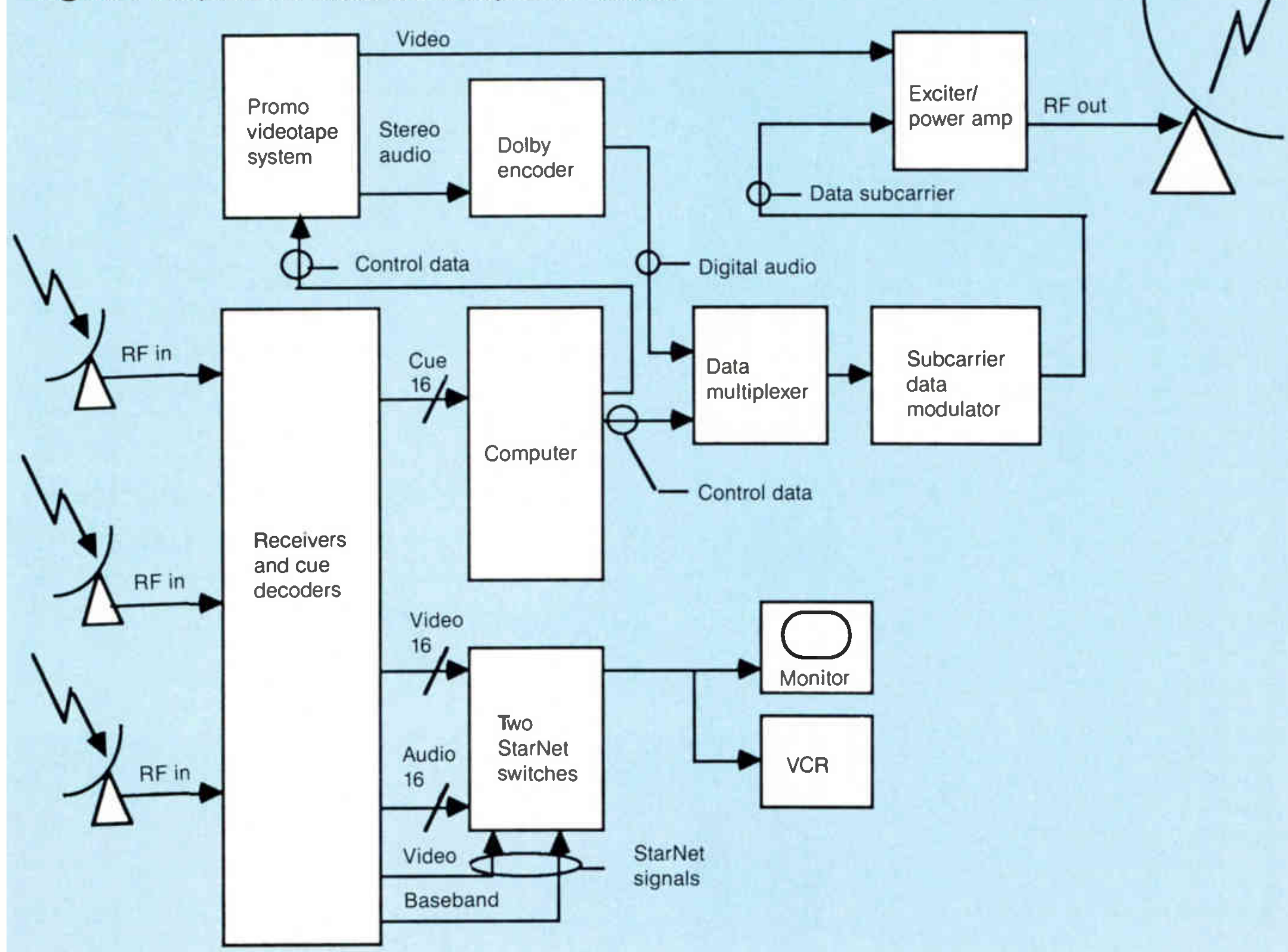
Monitoring schedule

The following is an example of a practical performance monitoring schedule. For simplicity it deals only with major internal headend electronic units. A more realistic comprehensive schedule should cover antenna systems, structures, standby power systems, controllers, microwave equipment and fiber-optic or other special trunk interface units. Each operator must select a schedule of test parameters and intervals that suit the equipment, personnel and preventive maintenance expectations.

Headend combiner output	
Picture quality	daily
Sound quality	daily
Picture carrier level	weekly
Sound carrier level	weekly
Modulators	
RF levels	weekly
Power supply voltages	weekly
Modulation levels	weekly
RF frequency	monthly
IF levels	monthly
Video level	monthly
Audio level	monthly
Frequency response	annually
Carrier-to-noise ratio	annually
Processors	
RF output levels	weekly
RF input levels	weekly
Power supply voltages	weekly
IF levels	monthly
RF output frequency	monthly
Frequency response	annually
Carrier-to-noise ratio	annually
TVRO receivers	
RF input level	weekly
IF level	weekly
Power supply voltages	weekly
Video level	monthly
Audio level	monthly
Signal-to-noise ratio	annually

Many of the weekly or monthly measurement parameters may require more frequent checks if indicated by the results of the daily tests. All parameters, including the annual category, should be measured and logged whenever equipment is newly installed. Other equipment that deserves monitoring includes antennas, preamps, LNAs and LNBs, FM/audio receivers, status monitoring units, standby power supplies, microwave or wideband FM modulators and demodulators, video generators, and optical fiber receivers and transmitters. There is no doubt that operators who avoid the "why waste time measuring things that are working?" syndrome and follow a maintenance monitoring program conscientiously will have fewer unpleasant surprises and headaches from their headend. ■

Figure 1: Uplink for cross-channel promo service



StarNet in the headend

By The Engineering Staff
Wegener Communications

StarNet, a cross-channel tune-in promotion service available May 1, is designed to provide information, previews, etc., to the viewer on a real-time basis. At the uplink, the satellite-delivered video channels are monitored to determine when spots are available for local insertion (Figure 1). Pre-programmed into the uplink computer are the projected times of the available spots, with a matrix screen that indicates what promotional information is scheduled for insertion on each service. The uplink then sends out the promotional material synchronized with each individual avail. The control computer avoids overlap, allows sufficient time between promos and automatically controls all aspects of the promo video signal.

At the headend (Figure 2) promotional programming is inserted on local services as directed by the uplink. The local cable operator programs this switch to allow insertion only on channels currently being received and to insert promotional material only for the services being carried. Also, interfaces with the local ad insertion system allow it to operate normally when the switch is not active. Each cable operator decides the level of promotion insertion frequency to allow on each channel, what promotions to receive and onto what networks these will be inserted. The following is a general sequence of events of the service:

1) The central control computer tells each StarNet switch the next available ad insert time and network and the next promotion it is sending (Figure 3).
2) The uplink central computer commands the local switch to insert the promotion if programmed to receive it.
3) During the last few seconds of a promotion a character generator internal to each switch inserts a local channel number and system logo identifying on which channel the promoted program appears on that cable system.
4) An optional card allows downloading other promotions to an external tape recorder and playing them back under uplink or local control simultaneously with the satellite video.

Uplink and control computer

All 16 services (expandable to 24) on which information can be inserted are received at the uplink. Each service has a cue and control decoder that normally provides controls to the headend local insertion equipment. The information from the decoders is now used to encode the data stream, which controls the insertion of the promo information at the headend.

These signals along with an alarm summary are fed into the control computer, which contains a real-time clock and is pre-programmed for all projected promos on all services monitored. These pre-programmed times are compared with the actual cueing information received from each video receiver and based on a coincidence of these two signals commands are sent to various parts of the encode system to send and monitor the video. There are two general categories of promotion insertions. These are: spots that have accurately defined times and spots that have no specific time defined (such as those that occur during sporting events, concerts, etc.).

The entire system is monitored by using a switch like the one used in each headend, receiving the off-air signals and actually doing the insertion as in a typical headend. The video and audio signals are then switched to a single monitor and VCR well before insertion time so that actual inserts can be watched by the operator. Programming of promotional inserts, as well as downloading of printed and video and audio information, can be addressed to individual headends, groups (such as MSO, regional and other combined groups) and all StarNet users. This addressing is inherent in every data transmission and control signal sent to the headends.

All programming received from the satellite goes through the satellite switch before going to the local insertion system. The insertion cueing signals are routed through the switch before going to the local ad insertion equipment to prevent attempted insertion of both the promo and the local ad.

The service is designed to allow a cable operator to use from one to three chassis that allow insertions on from eight to 24 channels, respectively. The first chassis in a system is the master, containing a full front panel with all controls and indicators. Only the master chassis has the FSK demod and Dolby processor, the modem and the ability to add in the printer, terminal and remote tape control option board. The slave chassis have simplified front panels that give alarm and communications bus status only. The master receives switching commands and sends the necessary switching information to any attached slave units. It also has a telco input that allows the internal phone modem to be tied in for remotely reconfiguring the switch. This modem also is used to remotely obtain status of the switch including switch settings and switching history.

The switch has a bypass position that is a manual override of all insertions from the switch. An alarm light indicates if the switch is in the manual override position. Any switch alarm causes the video and audio to be passed through the chassis with no insertions allowed.

With such a service, the immediate concern to the headend tech will be how to connect it and what ramifications it will have in day-to-day operation. While each headend is truly different, each can be generalized for implementation. As is the case many times, the most complex part of implementation will be the audio—and not the video. Assume that all services are available in stereo and that you will carry them on the system in stereo, either BTSC, FM or both. This is the worst case and you should be able to extrapolate to the less complex cases. Likewise, assume that the programming is coming to you scrambled; extrapolation to the simpler case should be easy.

If you are going to insert promotions on channels not being used for local avails, the interconnect is rather simple; Figure 4 illustrates this case. Primary video and audio are derived from the descrambler and sent to the switch. The stereo demod shown is only used when the satellite service broadcasts in the clear. The satellite receiver provides filtered video and baseband video to the switch. The baseband signal is used to decode the data subcarrier, which contains the digital stereo audio as well as all control signals for the switch. The audio and video signals emerge from the switch and are fed to the stereo encoder and FM band modulator.

Figures 5 and 6 illustrate switch interconnect on channels that are also under the control of automated local ad insertion equipment. The basic difference between the two diagrams is how the audio is routed. In the case of Figure 5, both the program audio and the commercial audio are stereo. While probably not too common today, it must be planned for and will become more common in the future. In this case, stereo program audio is routed through the ad insertion switch. The stereo audio output from the insertion device simply drives the stereo encoder and FM modulator.

Note that the "control" signal is routed through the switch to the ad insertion equipment. This allows the switch to either pass through or stop the command signal that the commercial insertion equipment is looking for. This control signal is usually in the form of DTMF (dual tone multifrequency) tones or a contact closure. Thus, if the switch is "taking" the

Figure 2: Headend for cross-channel promo service

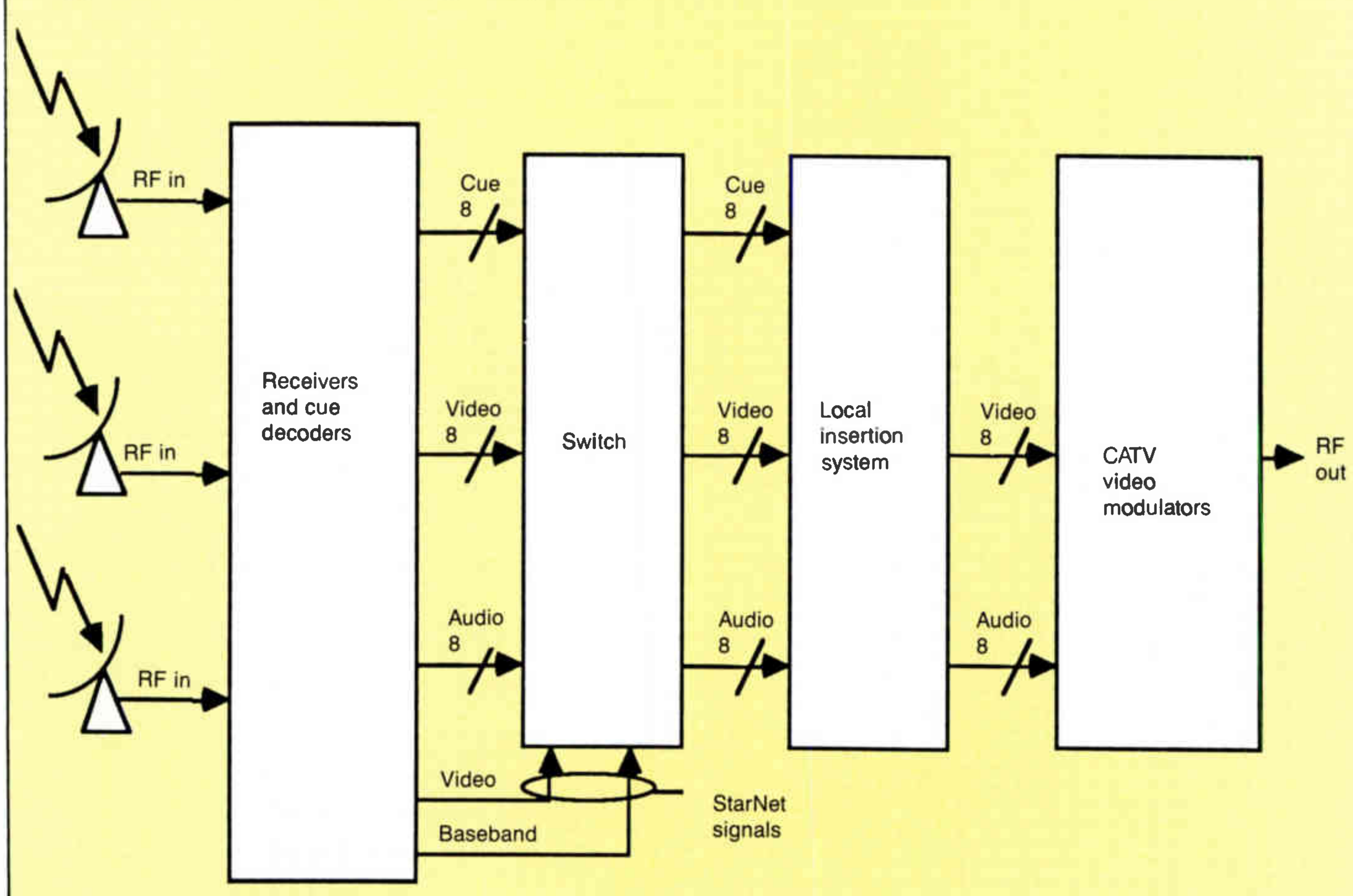
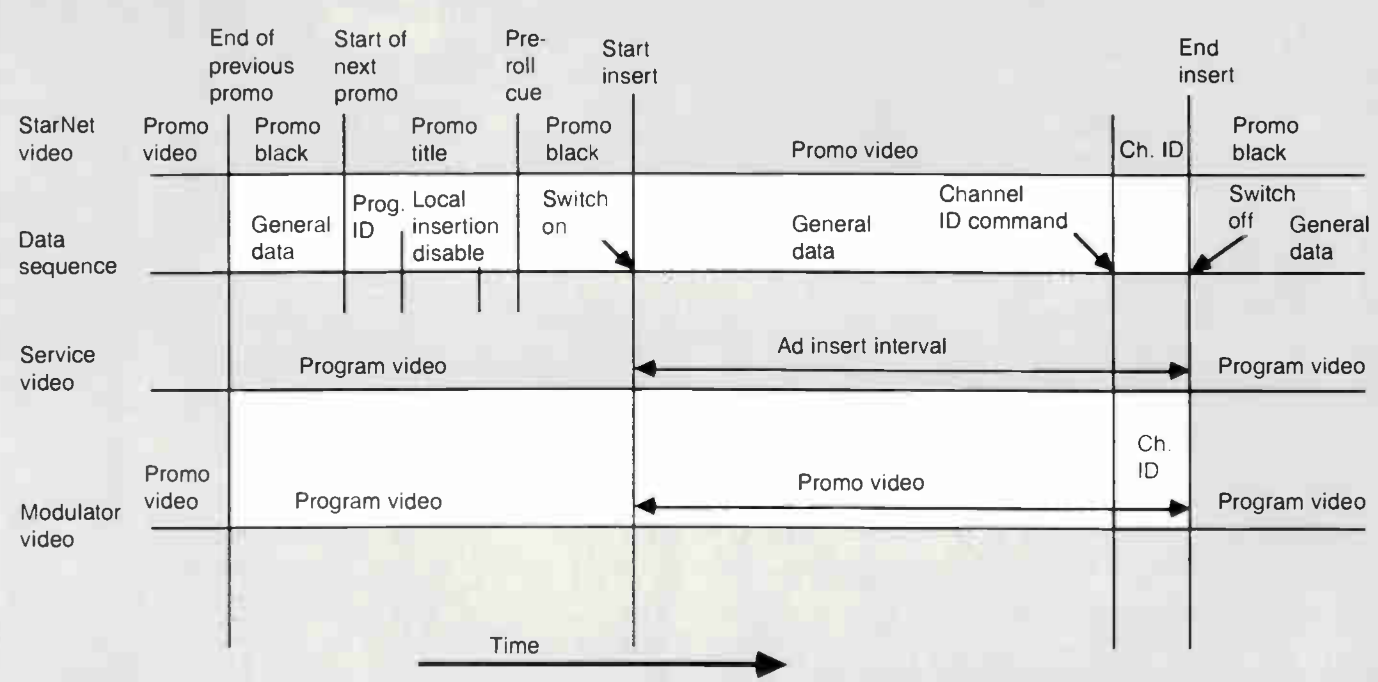


Figure 3: Switch timing



next local avail, it will not allow the command signal to pass through it on the next break.

Figure 6 illustrates the more common case where the program audio is in stereo, but the ads are in mono. In this case, the connection is a little more tricky, since the local ad insertion equipment may not be capable of switching the stereo program audio. In this case, we rely on the fact that most commercially available BTSC stereo encoders have two sets of audio inputs. Main program audio is fed to the main input and the ad audio is fed to the alternate input. A contact closure provided by the local ad insertion equipment does the actual audio switch. The FM modulator also is shown with this feature as it is commonly available. The biggest problem in implementing any of these systems will more than likely be audio level matching, which can only be done by the headend tech using "real world" program and ad audio sources.

When you consider the number of channels that may be under control of the switch, this one box will easily win hands down the award for the most number of wires connected to a single device in the headend. It will be imperative that the tech carefully label all leads and use good engineering practices to avoid problems such as crosstalk and hum. The switch itself is designed to be removed from service totally and allow all connections to pass through as if the box were not there. This feature should ensure fail-safe operation if all connections are made properly.

The Wegener team contributing to this article include Ron Cordell, Ned Mountain, Bill Tetens, Ron Wallace and Heinz Wegener.

Figure 4: Scrambled signal (no ad insertion, with BTSC and FM stereo)

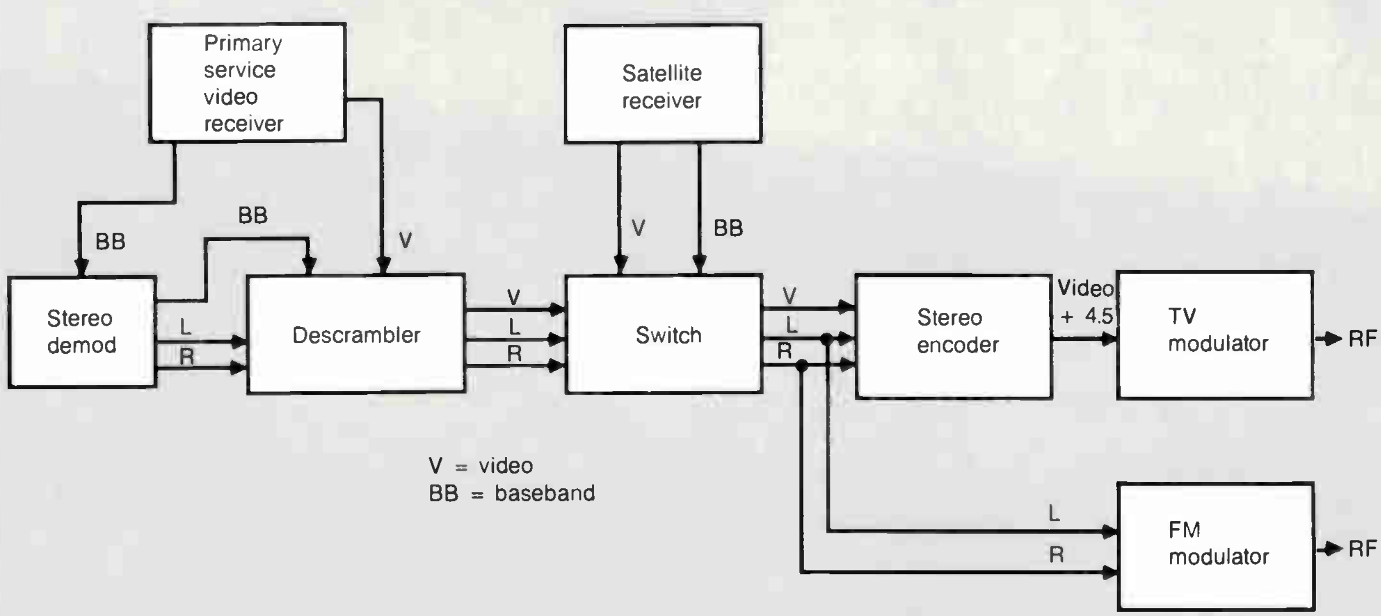


Figure 5: Scrambled signal (local inserts, BTSC, FM stereo and stereo ads)

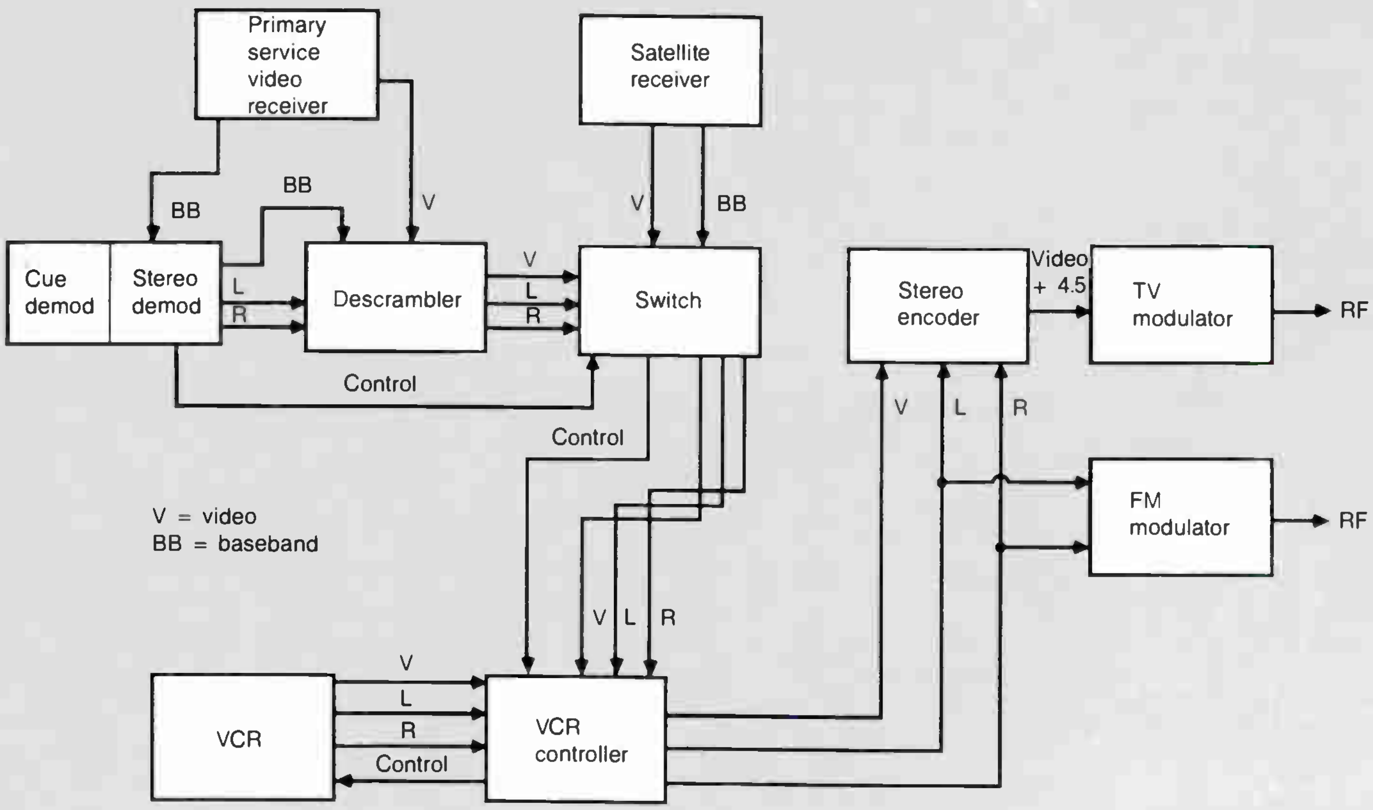
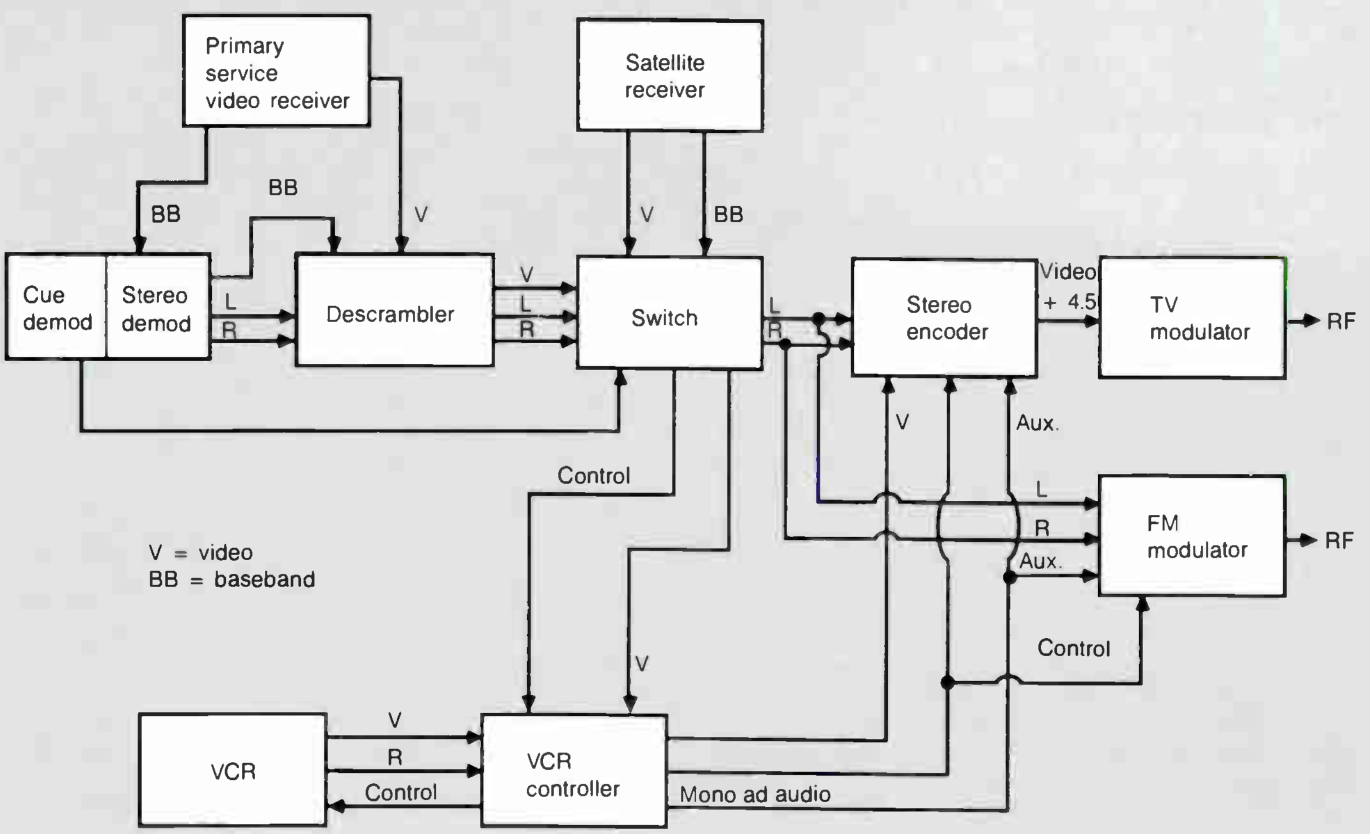


Figure 6: Scrambled signal (local inserts, BTSC, FM stereo and mono ads)



Rebuilding a headend

By Peter Friedman
President, Analytical Cable Consultants

A good system begins with a good headend. A good headend begins with good system design. Recognizing the following six good reasons to rebuild a headend can help keep a cable company ahead of the game:

1) *Proper operation.* Correct levels from modulators and processors provide optimum signal-to-noise ratio throughout a cable plant. Rebuilding a headend should result in consolidation of equipment, optimum use of space and proper equipment placement, allowing adequate air circulation.

2) *Tangled wiring.* A rat's-nest effect (doubtless your predecessor's fault, not yours) can complicate wire tracing and additions. A rebuild/upgrade can help improve demand as well as prevent maintenance problems. If the need for a headend that reflects an engineer's professionalism and pride is impressed on all who work there, the wiring will look better and last longer.

3) *More space.* Even the smoothest operating, best maintained system may have to rebuild a headend to meet the demands of expansion; in fact, such a system may be the most likely to expand.

4) *Technological advances.* Consider, for example, stereo sound. While it was introduced early in the '80s, only a few years ago was stereo available in the BTSC format. It might be prudent to incorporate space for it in your new design—even if you don't expect to install it right away. Similarly, it may pay to plan for ad insertion equipment. Many companies find the benefits well worth the capital investment. Another advance to consider when designing is a VideoCipher for each scrambled satellite service.

5) *More channels.* A system going from 35 to 54 channels may find it needs another 40 or more pieces of equipment and an upgraded headend to accommodate it all.

6) *Deterioration.* Sometimes a rebuild is a good preventive maintenance procedure. Wires and connectors do get old and worn out—even faster than do engineers.

Capital spent on a headend rebuild/upgrade ensures better signal quality and reduces service calls. But whatever the reason for rebuilding, a reasonable plan and the proper equipment for doing the job are absolutely essential.

Equipment

First you need good, sturdy metal racks with more than enough rack screws. Try to standardize as much as possible. Keep all screws the same—either all Phillips or all flathead. This will make things much easier the next time you have to change equipment. When buying new racks, consider the kind already wired to terminal strips. Don't reuse homemade wooden racks. They can make common grounding a problem.

Make sure you have plenty of headend cable and fittings. Headend cable is an extra-shielded cable with a low-loss center conductor; construction may vary with manufacturers. Some types of cable have additional shielding around the conductor. The fittings used on this cable are not always of standard size, so be sure of your order. Forcing on standard fittings can cause future problems.

Consider acquiring an extra combining network or two. Even if you don't use it now, it can be good to have a spare for future use or repair, because a splitter has some of the properties of a combiner. Some people use them interchangeably, but that could mean not getting a linear loss on all channels.

You'll need a wide variety of pads. All equipment manufacturers have set output levels at which modulators and processors work best with greatest signal-to-noise ratio. These are the levels at which to set the equipment; then make adjustments with the pads. Once all levels are set, an amplifier can be used to compensate system out-


Bert Berelli
Albert Harper
Al Tomkins
Sharon Albert

put levels and make minor corrections to the tilt.

Have terminal strips on hand for both audio and video signals. These can be mounted on the back of the rack and facilitate channel changing. They also let you bring all wires back to a central point. This will help keep the headend looking neat. Audio terminal strips can be ordered from a supply company or bought at an electronics shop; video terminal strips can be made by drilling out a spacer and inserting p-81s.

Have plenty of different sized spacers available. Different types of equipment require different ambient air flow. Most requirements are listed in the specs; if not, use at least a 1¾" spacer. In some cases, add fans to the rack.

Obtain a large supply of ty-wraps and labels. You also should have something to keep the cable from being exposed. Plastic trough-type devices work well since you can lay the cable into it rather than pull the cable through it (as with a conduit). This protects the cable's integrity and simplifies adding or replacing cables later.

Even when you have everything you need it may not be prudent to start stripping wires. Rebuilding can mean taking many channels off the air. Try to do as much of this as possible when the programmer is off the air or when viewership is at its lowest. For most systems, the logical time is between midnight and 5:30 a.m. Allow at least four workhours for each rack. Processors will probably be faster, VideoCiphers slower.

Map out what you are going to do on paper and set up a schedule so the new system can be incorporated with the old at many points. Don't expect to complete this in one night. On the map keep all the same things together: VideoCiphers in one rack, receivers in another. It helps to group receivers by what birds they get and by polarity. It is better to arrange processors and modulators in numerical order; that way you'll be better able to find lost channels or other problems.

Leave spaces for all channels that are approved for your location; they may be needed in the future. Trunking cables and wires between racks can be run and left until needed. They should be installed before old wires are removed. This can be done without interrupting service.

In setting a headend design, it is better to be logical than fancy. Installing little tricks for this or that may be nice now, but they may fail later—especially if someone else who doesn't understand them tries to use them.

When rebuilding a headend, limit the number of people involved to no more than three at any one time. Arrange the projects so one person knows what everyone is doing and can manage easily. With too many people working in the confined space of a headend, productivity will drop as they get in one another's way and the chances of mistakes increase.

Avoiding trouble

In all headends there are devices that should not be taken down for any length of time. One such device in an addressable system is the addressable controller. Its downtime may not have an immediate effect on the system, but it must be returned to operation quickly. It should be checked at the end of each night's work, as should all channels and devices.

Wire in all the test points you might need. Even if you use one only once a year, this can save many hours of demand maintenance if a problem arises. Mark all wires in plain language. Abbreviations or your own shorthand can make them difficult for others to work with when you're not there.

Consider future accessibility when placing cables. Leave plenty of room for more wires and space to replace them. When running cables, keep things simple. Leave slack when bundling cables with ty-wraps. This will make it easier to trace and exchange in the future.

Double-check all connections and check your power requirements for each rack to make sure they are not overloaded. Check your air conditioning to make sure it is large enough for your new needs. While most equipment will work over a large temperature range, it is best to keep the temperature constant in the 68° -72° F range.

Once a headend rebuild is finished, draw an accurate map of wire and equipment placement. This will help with future modifications and is a good training tool for your staff. Do a proof-of-performance test to inform you of any problems that need correction and serve as a base line for all future tests and expansions. Log all test points. A well-planned and maintained headend can last for years with few problems. The time spent in good design with industry trends in mind, and enough ingenuity to enable versatility can save much time and money in the future. There are many reasons to rebuild a headend—but only one way to do it right.

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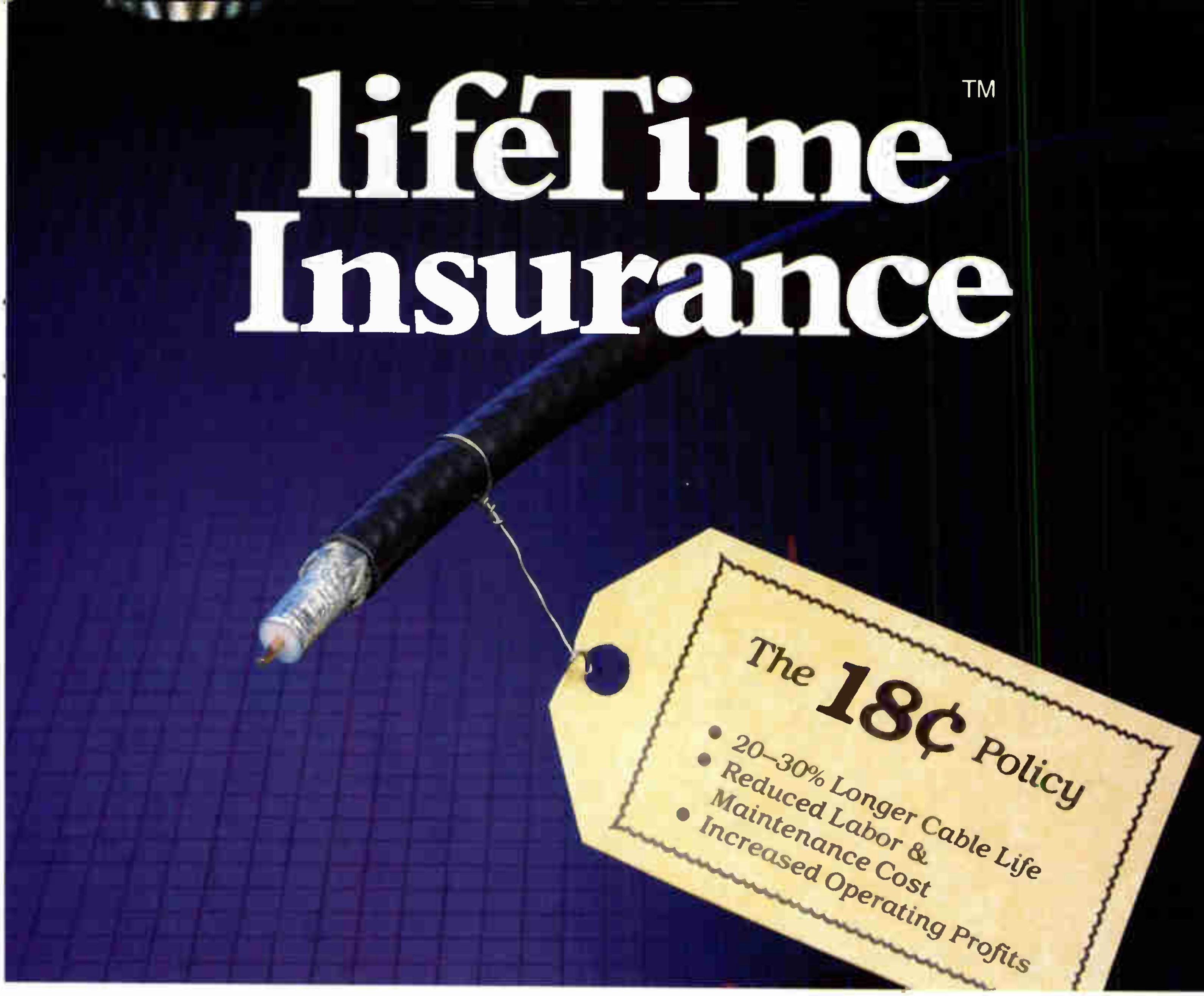

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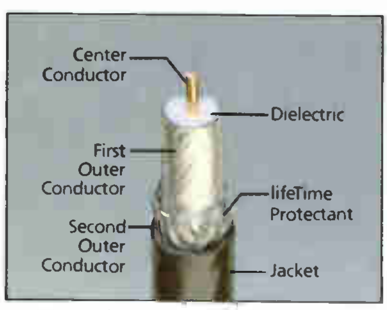

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Reader Service Number 22.

Anti-icing earth station antennas

By Joe Lemaire
Broadband Application Manager, Raychem

The Ku-band is here for nationwide cable TV, and a new generation of C-band antennas is coming as well. Throughout the United States, Canada and Europe, the preferred transmission means is shifting from the traditional large dish C-band (3-5 GHz) to smaller C-band antennas and to the Ku-band (12-14 GHz). The shift represents an important move to relieve problems in locating new headends in areas of congested microwave traffic. An important benefit of the Ku-band is the reduced antenna size required for excellent reception; 3+ meter antennas provide comparable gain with the 5+ meter antennas used for C-band.

Higher power C-band satellite transponders also have made possible the use of smaller (3-meter) antennas for CATV reception. Smaller antennas mean rapid installation and simple site preparation. The new 3-meter antennas in the C-band enable inexpensive earth stations to be dedicated to individual satellites.

The problem addressed in this article is the interference with signal reception caused by snow and ice attenuation of the satellite signal. Snow outages of the larger C-band earth stations have been common problems in the past. Newer C-band antennas may have less gain margin than the earlier models. The Ku-band offers greater gain per unit area of antenna surface, but increased moisture attenuation poses more serious challenges and calls for reliable and effective anti-icing solutions.

Why deice?

All satellite communications can be impaired by weather conditions. Attenuation of microwave signals due to rain is well-known, and margins are provided for the most common rainstorm conditions. Data is readily available on the relative attenuation of signals from atmospheric moisture and oxygen for frequencies of interest.[1] More difficult to predict are the effects of snow and ice accumulation. The degree of attenuation of the signal will depend on: the attenuation and relative concentrations of ice/water mixtures, the depth of accumulation or rate of snowfall, the density of snow, and the weather conditions that prevail after snowfall. Snow and ice attenuation measurements have been obtained from several sources [2,3,4] and are illustrated for 11.7 GHz in Figure 1.

In addition to direct attenuation, the weight burden of snow or ice can serve to distort the shape of the antenna, particularly in a large antenna, requiring additional structural design effort. Signal reflections also can occur from the surface of a snow/ice accumulation.

In the past, snow removal has been possible by earth station attendants mechanically pulling away the snow cover. Retrofit kits for deicing have been available, along with installation services by contractors. If weather has posed a sufficiently serious problem during the initial years of operation of these stations, retrofitting the systems has been a practical, although costly, course of action for later years. The need, therefore, exists for some fraction of each nationwide network to be deiced by an automatic, reliable and relatively low-cost means.

Excellent weather data is available from the U.S. Geologic Service[5], the Department of Commerce[6], the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)[7], and weather almanacs[8,9]. Of primary interest to the network designer are the periods of moist snowfall and ice glazing. Useful maps are available for frequency of significant snowfall and for frequency of freezing rain. The *ASHRAE Handbook* cites snowfall and freezing temperature data for 30 cities in the United States. This data can be used to obtain a comparison of weather risk among these cities. Although the availability of satellite communication systems should be higher than the predicted risk level, deicing equipment can assure that weather interruptions are reduced to a minor consideration.

The moisture content of snow not only affects signal attenuation but determines the stick/slide-off characteristics of precipitation on relatively vertical antenna surfaces. Since weather conditions change dramatically during the course of

Figure 1: Snow attenuation at 11.7 GHz during storm

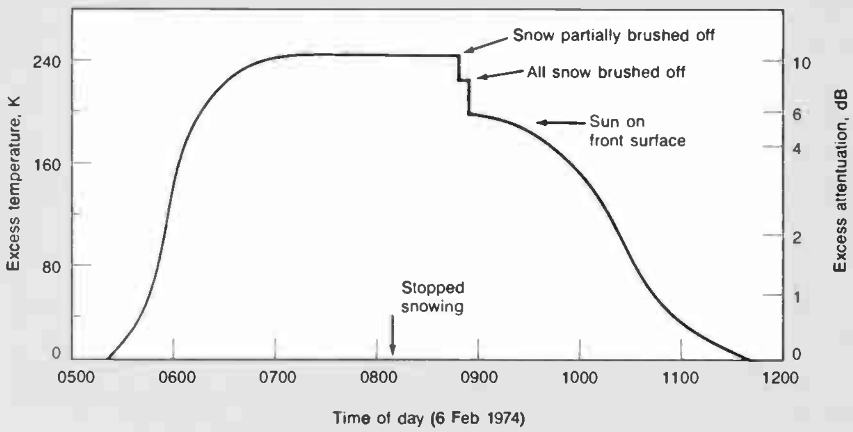


Table 1: Summary of heat losses

Heat loss component	Wind: / Snowfall: / Temperature:	Environmental condition — Moderate		Extreme	
	Wind:	20 mph	30 mph	20 mph	30 mph
	Snowfall:	1.3 in./hr.	1.3 in./hr.	2.0 in./hr.	2.0 in./hr.
	Temperature:	26°F	26°F	10°F	10°F
Convection (losses to the air)		16.3	22.2	45.5	63.1
Evaporation (losses in moisture)		8.2	12.0	15.5	23.4
Sensible heat (raise temperature of ice)		1.8	1.8	2.0	2.0
Latent heat (melting)		26.9	26.9	24.5	24.5
Total		53.2	62.9	87.5	113.0

All data in watts/square foot.

a typical snow storm, the wet snow may cover the surface of an antenna, then freeze in place as temperatures drop and drier snow prevails during the balance of the storm. A snow cover must not be allowed to develop, because subsequent thaw and refreeze cycles will permit significant amounts of retained moisture to attenuate signals.

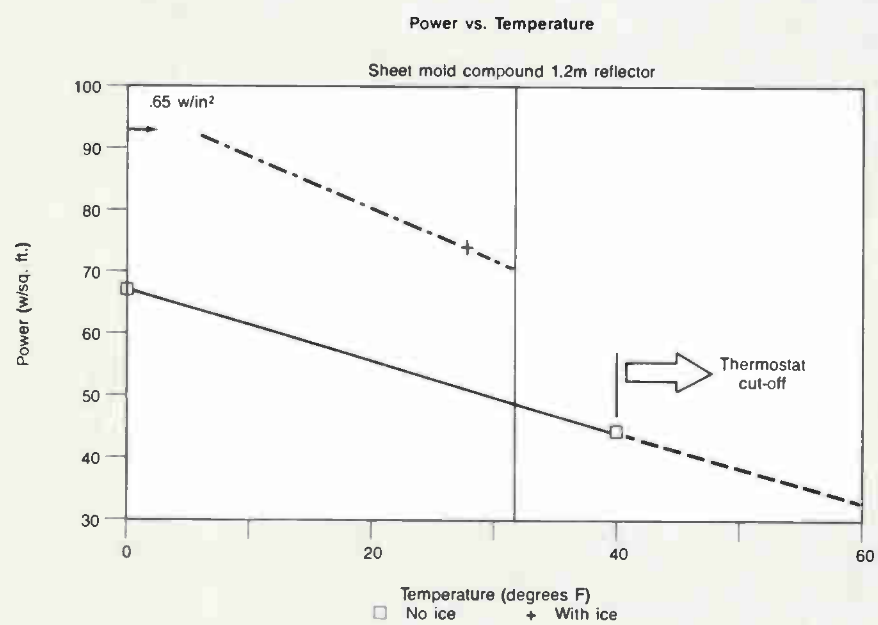
Deicing fundamentals

A range of choices is available to improve the tendency for antenna surfaces to shed water. Because even thin films of water "sheeting" the surface of an antenna will result in measurable degradation of antenna performance, coatings that reduce sheeting tendencies can be beneficial. Antenna manufacturers have utilized epoxy paint coatings with low surface energy characteristics to assist in water runoff. Several manufacturers use special hydrophobic coatings to create even lower surface energy characteristics. These coatings can be demonstrated to be effective in eliminating water sheeting when new. Manufacturers of these coatings recommend that they be maintained on a periodic basis to assure that water-repelling properties are retained. Low surface energy coatings also may serve to reduce the buildup of wet snow, which might more easily slide off due to the action of the coating against the high moisture content of wet snow. The majority of snow and freezing rain conditions do not contain sufficient surface moisture to assure the coatings will always be effective as a means of deicing. Under some freezing rain simulations, relatively thick ice crusts have been built up due to the freezing of relatively high-profile water beads that result from these coatings. In addition, tests by the U.S. Army Cold Regions Research Laboratory[10,11] have shown several versions of these coatings to be of limited effectiveness without the simultaneous application of heat.

Active prevention or elimination of snow or ice accumulations is achieved by directly heating the antenna. A system designed to maintain the surface temperature of the antenna at temperatures above freezing is referred to as an *anti-icing system*. Energized before the beginning of precipitation, snow is melted upon contact with the reflector surface by heaters, and rain that would otherwise freeze upon contact with the antenna does not do so. Power requirements for anti-icing systems vary depending on the weather conditions (wind, temperature and

Figure 2: Selected anti-icing heat flux values

Figure 3: Power/temperature relationship for self-regulating heater



snowfall rate) stated in the design basis. However, these power requirements are generally less than those required for the elimination of snow accumulations that occur prior to energizing the heater system. A system designed for this latter case is referred to as a *deicing system*. Obviously, an anti-icing system designed for extreme weather conditions also will serve as a deicing system under less extreme conditions.

There is no single standard for heat flux concentrations to achieve either anti-icing or deicing. Calculations have been performed for the heat required to achieve snow melting. The heat budget must allow for the heat losses from the surface due to free convection and forced convection by winds. Allowances must be made for increasing the antenna surface temperature to a level above freezing, for increasing the temperature of incident snow to the melting point and for the enthalpy of melting. Estimates of these heat requirements for a useful range of weather conditions are shown in Table 1.

The *ASHRAE Handbook* contains heat flux concentrations for anti-icing of non-critical and critical service surfaces. These vary, as one might expect, depending on the location of the system and the local weather of that location. Figure 2 illustrates these commonly chosen heat flux values. Although this data is eclectic, it serves to illustrate common practices and can be used

SCTE 1988 AWARDS PROGRAM

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NOMINATION/APPLICATION FORMS

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CRITERIA: The awards committee will evaluate the applicants and nominees to ensure the recognition of Awardees from the fullest possible scope of job categories and responsibilities. Multiple Awards are planned, based upon demonstrated individual personal achievements.

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1) Applicants may file the "Application For Award Form" directly, noting the required listing of two individual references. **The "Reference Form," as provided, should be submitted with the Application Form, if possible. Both must be received by the Deadline Date of *May 1, 1988.***

2) "Nomination Forms" may be submitted directly in behalf of Nominees, or may be directed to Nominee for enclosure with Nominee's "Application Form." It is obvious that the use of this form will provide the necessary information for the Committee's use in consideration of the Nomination.

3) All entries are to be mailed to:
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4) The forms as published in *Communications Technology* are to be used for entries.or may be copied as required.

5) Please call the SCTE office at (215) 363-6888 for further information.

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Phone ____________
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____
____

Submitted by
Name ____________
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Please provide brief outline of your reasons for support of the nominee such as the following:
Years known, work habits or dedication, advancement protential, customer/employer relations, achievements on job, or involvement in outside activities.
(Use additional sheets if necessary)

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Reader Service Number 25.

APPLICATION/REFERENCE FORM FOR 1988 SCTE ACHIEVEMENT AWARD

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__ System Construction __ Foreman
__ System Tech __ Service Manager
__ Chief Tech __ Chief Eng'r
__ Regional __ Corporate/Eng'r
__ Corporate Management

Equipment/Services Supplier
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__ Field Sales Rep
__ Equipment/System Designer
__ System Const. __ Foreman __ Mng'r
__ Chief Engineer
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2) What contributions have you made to improve the service provided by your company?

3) What do you wish to achieve in career future?

4) What do you feel the SCTE can provide to improve yourself and/or your work activity?

5) List two references below, one of whom should be a SCTE member.

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Address ______
SCTE Member ☐ Yes ☐ No

Name ______
Phone (____) ______
Address ______
SCTE Member ☐ Yes ☐ No

Figure 4: Heat flux distribution for self-regulating heater

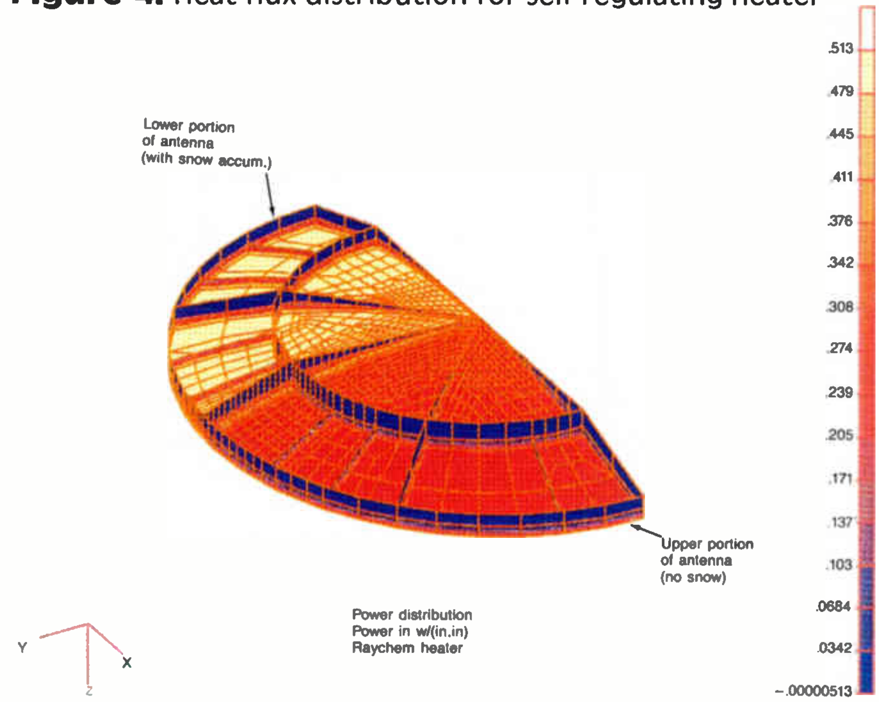
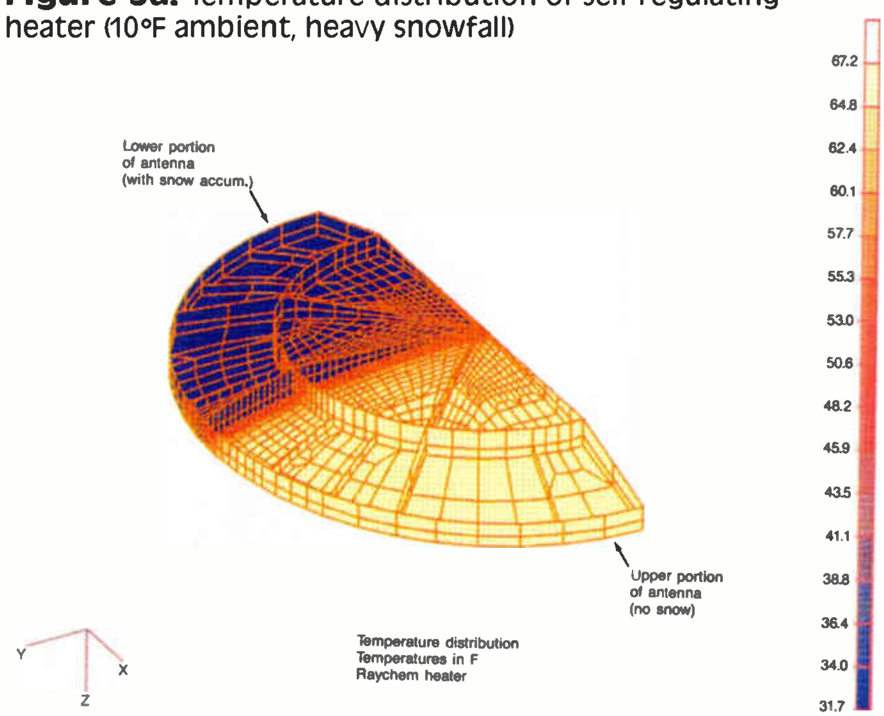


Figure 5a: Temperature distribution of self-regulating heater (10°F ambient, heavy snowfall)



with the weather maps to make judgments on the selection of deicing systems and their design.

For antenna systems a close tradeoff between desired heat flux and antenna thermal distortion must be carefully examined. Differential thermal expansions from the temperature differences across the antenna during snowfall or from the variations between reflector surface and rib structure must be minimized. Higher heat fluxes generally result in higher surface temperatures and aggravate this problem.

Active deicing methods

Three approaches have been used for antenna anti-icing or deicing system design. Shrouds can be mounted on the rear of the antenna and hot air circulated on the rear surface of the reflector. Resistance heaters producing a constant heat flux can be mounted on the rear surface of the antenna or embedded in the antenna material. Finally, resistance heaters with a variable heat flux can be mounted on the rear

(Continued on page 52)

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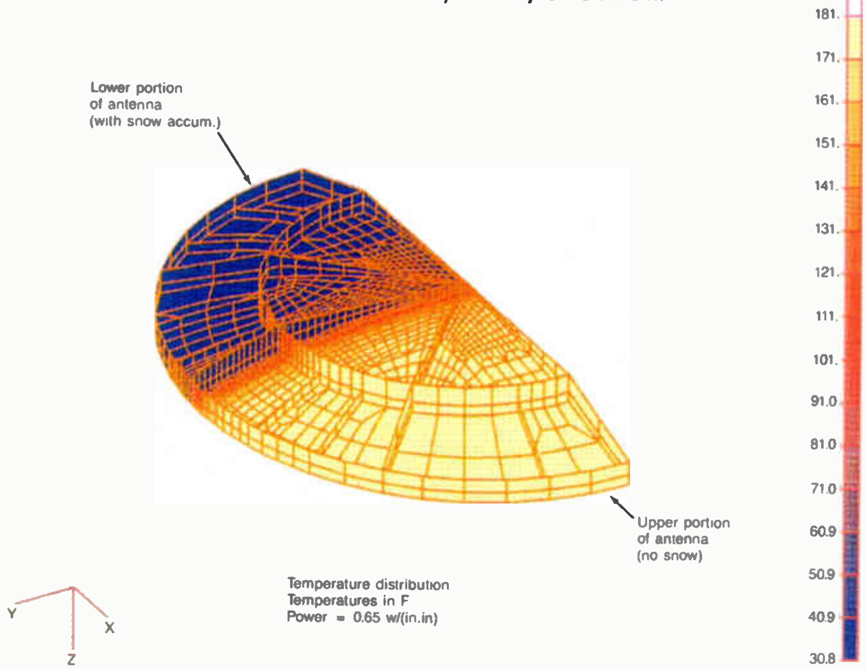


Figure 5b: Temperature distribution of constant wattage heater at .65 W/in² (10°F ambient, heavy snowfall)

(Continued from page 37)
of the antenna. The advantages of each system will be discussed.

Blown air systems:

Systems are available for heating an enclosed air space behind the antenna, utilizing continuously circulated air heated to temperatures sufficiently high to permit heat transfer through the reflective surface. Usually a baffle or ducting arrangement is employed to achieve improved circulation of heated air. Thermodynamics dictate that high temperature resistance heaters or gas burners be used, since the convection of heat by air is inefficient relative to heat induction.

Such systems have been used for antennas of all sizes. In some cases an array of sensors is used to detect surface temperature (both exterior and interior). These sensors determine whether the system is turned on or off to maintain a desired reflector temperature. If the shroud encloses the rib structure and is insulative, then relatively uniform temperatures are achieved in the antenna structure and on the reflector surface when snow is not present.

Constant wattage resistance heaters:

Relatively inexpensive heaters can be obtained at a variety of heat flux ratings for direct mounting on the rear surface of the antenna. When used in combination with temperature sensors,

Figure 6a: Magnified deflection contours of self-regulating heater

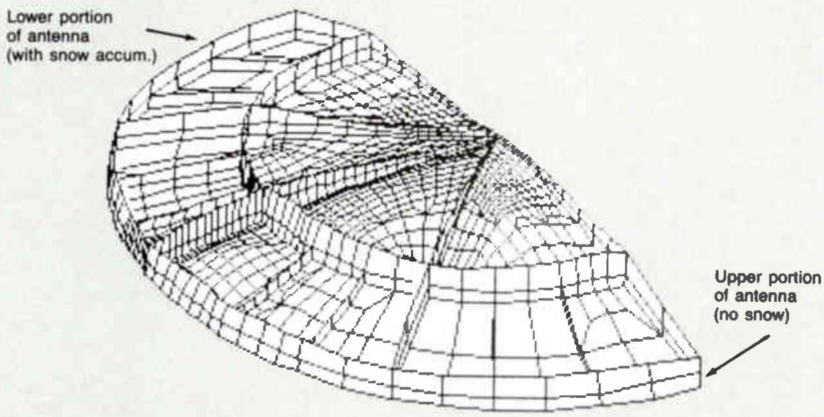
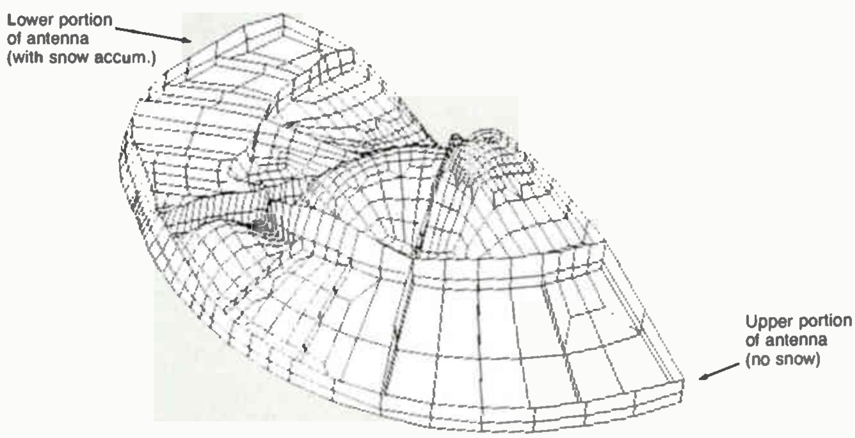


Figure 6b: Magnified deflection contours of constant wattage heater



Deicing conditions for vari

City	Hours snowfall	Winter % hours snowfall	Wir % h abc free
Albuquerque, N.M.	22	0.6	7
Amarillo, Texas	33	0.9	7
Boston	145	4.0	6
Buffalo, N.Y.	240	6.6	4
Cheyenne, Wyo.	138	3.8	4
Chicago	134	3.7	4
Columbus, Ohio	105	2.9	5
Detroit	134	3.7	4
Hartford, Conn.	171	4.7	5
Lincoln, Neb.	91	2.5	4
Memphis, Tenn.	11	0.3	8
Minneapolis	203	5.6	2
New York	76	2.1	5
Oklahoma City	44	1.2	7
Philadelphia	58	1.6	7
Rapid City, S.D.	116	3.2	4
Reno, Nev.	87	2.4	5
Spokane, Wash.	196	5.4	4
St. Louis	33	0.9	6
Washington, D.C.	33	0.9	7

* minimum estimate: assumes all time spent in ambient
** under-average wind, snow and temp conditions; does

especially in any array of heaters and sensors, it is possible to achieve a degree of uniformity in antenna surface temperature performance. High reliability thermostats that tolerate the continuous on/off cycling in moderate temperature conditions can be used, thus preventing overheating of the antenna.

Heaters used in a series resistance fashion must be balanced to achieve even heating. Redundant heater circuits can be used to prevent system failure in the event of an open circuit condition. Constant wattage heaters should be well bonded to the surface being heated to assure that disbonding will not result in hot spots.

Self-regulating resistance heaters:

Self-regulating heaters have been available for the past 15 years for freeze protection of critical piping systems and other structures. Usually these heaters are polymeric in nature and rely on a dispersion of a conductive media in a semicrystalline polymer matrix. At high ambient temperatures the thermal expansion of the semiconductive matrix increases the resistivity of the material many orders of magnitude, assuring that the heater will not achieve temperatures greater than an established level. In conditions favoring heat conduction or at lower ambient temperatures, higher power output is achieved.

Results are shown in Figure 3 for a version of self-regulating heater specifically formulated for use in deicing antenna surfaces. Until recently, the power output of heaters used for deicing has been modest. High overall power output can be achieved through special formulations of the polymeric compound and the use of aluminum fin materials, which also mount the heater to the rear surface. As indicated in Figure 4, the presence of potential icing conditions on the front surface of the reflector increases the power out-

ities

% of time* when no snow or ice risk	Annual % ice-free** avail. if htd. with 44 W/ft³	% ice-free** avail. if htd. with 73 W/ft²
89.52	99.99	100
89.85	99.94	100
85.33	99.90	100
77.83	99.85	100
77.79	99.40	99.99
77.37	99.92	100
83.01	99.95	100
78.04	99.96	100
81.93	99.88	100
77.21	99.78	100
94.70	99.98	100
68.34	99.57	100
81.64	99.95	100
91.30	99.82	100
89.97	99.98	100
77.29	99.66	100
81.77	100.00	100
78.66	99.93	100
87.03	99.97	100
90.84	100.00	100

snow covers reflector surface
ısider extreme wind, snow, temp conditions

put of the heater through the self-regulation principle. Other areas of the antenna surface, where snow would tend not to accumulate due to surface inclination, are heated at somewhat lower fluxes (typically one-half to two-thirds the former level).

The benefit to antenna structural distortion of self-regulating heaters is considerable. A comparison can be made between a self-regulating heater and a heating system that applies a constant heat flux over the entire rear surface of the antenna. Figures 5a and 5b illustrate the temperature profiles associated with a self-regulating heater and constant wattage heater, each producing maximum power at a snow load condition that achieves 32°F over the lower half of the antenna. Because the self-regulating heater reduces its power output in the upper half of the antenna, where snow is not assumed to be accumulating, the surface temperatures are more uniform.

Finite element analyses have been performed to predict the antenna distortion patterns that would result from the thermal patterns in Figures 5a and 5b. The benefit of self-regulating heating is the analytical prediction of a reduction of antenna surface distortion (for composite antenna structures) of 90 percent. The distortions of the surface have been exaggerated for illustration by the computer and are shown in Figures 6a and 6b.

In addition to reliability and minimal distortion, the maximum temperatures that would occur in the antenna if a thermostat was not used or if the thermostat would fail in the "on" position are reasonable. Because power is greatly reduced at high ambient temperatures, the antenna surface is always below critical temperatures, for composite structures. Tests on self-regulating heaters used for anti-icing in small antennas indicate a maximum reflector temperature only 12°C above ambient on very hot days.

Finally, very uniform antenna temperatures are achieved in the structural elements behind the antenna, provided that the system is encapsulated by an insulative backshell. Tests indicate that combined radiant and convective heating in the dead air space behind the reflector allow temperature variations of less than 5°C.

Acknowledgements: The writer wishes to acknowledge the contributions of Terry Kitagawa and Arthur Muller of the Raychem Heater Technology and Corporate R&D groups respectively, who have contributed the analytical and modeling portions of this article and who have provided much input to Raychem's antenna deicing program. The writer also acknowledges the cooperation of M/A-COM and Prodelin Inc. (in particular N. Moldovan) and wishes to express appreciation for their guidance.

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Marketing your services

By Chris Papas
Electrical Engineer, The MITRE Corp.

One area engineers are usually not knowledgeable in is marketing, especially when it comes to marketing themselves to others. The subject has not been an area taught in engineering school, so "trial and error" has been the usual method of learning. This is unfortunate, since marketing techniques can be very useful to engineers when looking for a new job. It can not only improve an engineer's chances at landing the job, but will increase that person's potential worth to the prospective employer, too.

Marketing really doesn't have to be a lengthy or complicated process to be effective. Sometimes just an awareness of it is needed by engineers to take advantage of its benefits. However, the marketing process should be applied from the writing of the resume through the job interview for the greatest benefit. Professional people can and should be marketed just as much as a product being sold by a company. Each person is unique with one's own collection of skills, experiences and achievements. All of these should be identified and properly presented to the prospective new employer to market your services.

Companies interview for positions because they have a problem that needs to be solved. In interviewing people such as yourself, they want to know if your skills can solve their problems. In some job positions competition is stiff, therefore any help in gaining an advantage over the others is critical to being selected for the position.

Preparation

Preparation is the key to properly marketing your services. By determining your skills and a company's needs prior to an interview, you can present your skills in the most favorable light to a future employer. The first step is to prepare a list of your skills, achievements and experiences. It should be a good inventory of your talents and should be as complete and factual as possible. This is an important first step and should not be overlooked.

Companies are more interested in the skills you have attained than the degrees you have. Although a particular degree may be a prerequisite for a job, a prospective employer is looking for specific skills to help solve specific problems. Therefore, it is necessary that you are able to identify all of those skills that a company would want.

The next step is to determine what the company's needs are. Time spent researching the company and the job position will be a great advantage in preparing your resume and at interview time. The simplest way to learn about a position is to ask someone who had the position before or maybe is in it now. That person could provide a great deal of information on both the company and the position.

Additional information can be obtained by calling or writing the personnel department of the company. Most companies usually have material available specifically written toward prospective employees. This information may be a little general for your needs, but it does give good back-

ground information on the company. A phone call to a personnel specialist in the company can give you more specific information about the job position or direct you to someone who has that information.

Other ways to learn about a position or company are: talking to someone who works at the company in a different position; researching library information on the company (such as annual reports and trade journal articles), checking newspaper employment ads for information and reading any other company promotional material.

Resumes

Resumes are a part of the marketing process. It is a form of personal advertising. When properly written, it should emphasize a person's skills for which a future employer is looking. Its wording should be concise, specific, factual and interesting to catch the eye of the potential employer. Some people even have several different resumes each written toward a specific job or industry.

The resume may be a company's first or only contact with you and your skills; therefore, a great deal of effort should be taken to make sure it is well-written. Good resumes may lead to an interview, bad ones will not. It's as simple as that.

There are many good books in the library or bookstores that can help you compose a resume. A few of the more popular ones are:

Better Resumes for Executives and Professionals, Robert F. Wilson and Adele Lewis, Barron's Educational Series Inc. ($9.95).

Resumes that Get Jobs, Jean Reed, Editor, Prentice-Hall Press ($4.95).

The Perfect Resume, Tom Jackson, Anchor Books ($8.95).

How To Write a Better Resume, Adele Lewis, Barron's Educational Series Inc. ($6.95).

In addition, there are also resume writing services that can help you compose a good resume (for a fee). These services have become popular recently and can offer a more personalized approach than reading a book. They can be found listed in the Yellow Pages under the heading of "Resume Service." As an example of their popularity, the Boston Yellow Pages has 50 listings under this title. Either way, it is a small price to pay for good advertising.

Interviewing

When interviewing for a new position, engineers should remember to market their services instead of applying for a job. This involves using the information you prepared for the interview to highlight your skills in a manner that will give the greatest advantage in the interview. For instance, here is an example of two people interviewing for a position. Put yourself on the other side of the interview table and see which person you would hire.

The first person seems to have the qualifications for the job and says, "That sounds like a good job that I can do." The second person seems to have the qualifications for the job and says, "I've done a little checking on the company and the job you are trying to fill and here is how I fill your needs." The second person will probably get the job ahead of the first, even though the two may have the same qualifications. The second also might get a better salary offer, because the company would perceive that person to be worth more.

What was the difference between the two? In a word, preparation. The second person spent the time to learn about the company and the job beforehand. That person was in a better position to understand the company's needs and ultimately to match the skills and experiences to fit those needs.

A prospective employer will be more impressed with a person who is prepared for an interview than one who is not. Having prepared questions concerning the company for the interview based on your research is a good way to show the interviewer your interest. It shows that you not only already know something about the company, but that you are genuinely interested in that company as a future employer. Since there is only a limited amount of time available in an interview, the interviewer just doesn't want to spend that time explaining the company. The interviewer is there to determine if your skills will solve the company's needs, so use the time available wisely.

Marketing techniques used in this manner are a useful way for engineers to present themselves in a positive light to a prospective employer. How much marketing to do is a matter of personal taste, but those who spend the time to use marketing techniques will have an advantage over those who don't.

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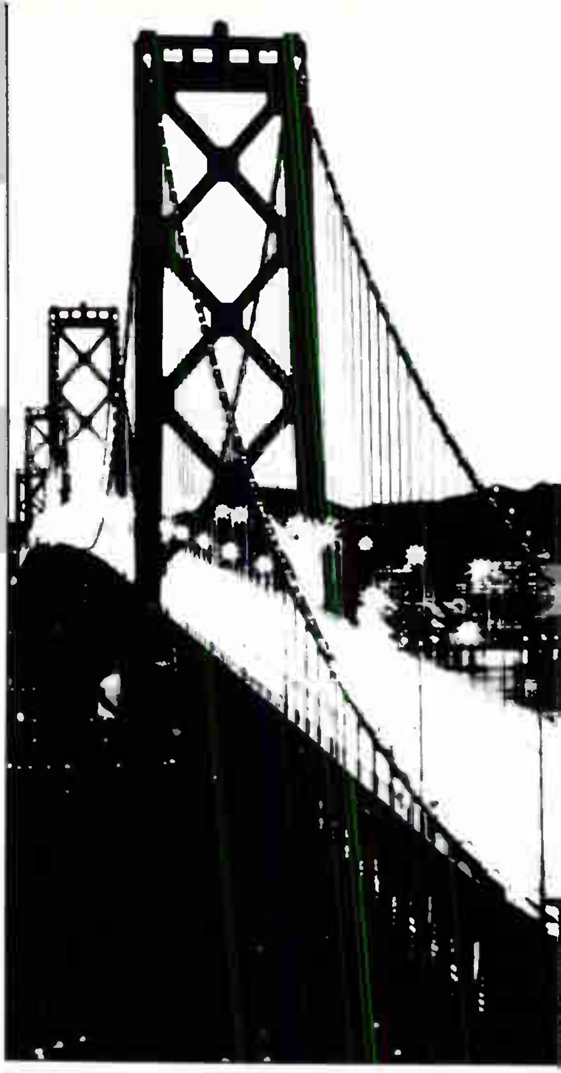

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Photo entries can be color, black & white, slides or prints. Be sure to include your name, company, address and day telephone number. Deadline for entries is May 2, 1988. The winner will be selected by a panel of four, composed of two SCTE representatives and two members of the CT staff.

This contest is open to anyone involved in the cable television industry except CT Publications Corp. and national SCTE employees, directors and their relatives. All entries become the property of CTPC, and may be used at its discretion. **Send entries to CT Photo Contest, P.O. Box 3208, Englewood, Colo. 80155.**

A tracking procedure for drafting and design

By Pam King
Technical Training Coordinator, Jones Intercable Inc

"How long will this project take to accomplish?" "How much will this project cost?" "How much do design and drafting cost our company?" These questions can be equated to: "Can you help me make a realistic goal?", "How much money should I allow for this project in my budget?" and "Is it cost-effective to have an in-house drafting department?" Good business tells management to explore options to reduce overhead. Thus, the need for some kind of drafting and design tracking is established.

The first step in developing a tracking procedure for drafting and design projects is to decide what needs to be tracked. Since Jones Intercable operates more than 60 systems, our corporate drafting department is a support mechanism for numerous types of design and construction projects; we needed to track quite a variety. For anyone who has tried to assign a time frame to as-built drafting, you can see that identifying "black and white" categories is not always easy!

We started with a list based upon the tasks we did most often to establish our tracking categories. Most drafting projects can be categorized as one of the following:

- base drafting (drafting road backgrounds and geographical information)
- strand drafting (includes base drafting plus poles, house counts and footages)
- key maps and map grid
- new design (includes amplifier analysis and bill of materials)

Figure 1: Project tracking spreadsheet

PROJECT TRACKING: DRAFTING AND DESIGN DATE:

PROJECT NAME	PROJECT NUMBER	DATE IN	CONTRACTOR	PROPOSED COMP DAT	MATERIAL NEEDED	DESIGN MILES	DESIGN HOURS	DRAFTMILES STRAND	DRAFTMILES DESIGN	DRAFT HOURS	DATE COMPLETE	DESIGN MI/HR	DRAFT MI/HR	NOTES
THE WILLOWS PHASE 1	87-N-01A	09.15.86	IN-HOUSE	01.04.87	MYLAR/ BL	10.0	15.0	10.0	10.0	40	01.04.87	1.00	1.00	(C)
THE WILLOWS PHASE 2	87-N-01B	10.15.86	IN-HOUSE	02.04.87	MYLAR/ BL	1.0	1.5	1.0	1.0	4	02.04.87	1.20	0.90	(C)
THE WILLOWS PHASE 3	87-N-01C	11.15.86	IN-HOUSE	03.04.87	MYLAR/ BL	7.0	10.5	7.0	7.0	28	03.04.87	1.10	0.95	(C)
							0.0			0				
SKYLAND MANOR HUB	87-N-37	11.20.86	DRAFTERS, INC	10.20.87	BLUELINES	0.0	0.0	500.0	500.0	2000				(D) REDRAFT ONLY
							0.0			0				
THE WILLOWS PHASE 4	87-N-01D	12.15.86	IN-HOUSE	? *	MYLAR/ BL	50.0	75.0	50.0	50.0	200				*(P) ON HOLD PENDING APPROVAL
							0.0			0				
STRAWBERRY LANE EXT.	87-N-07	01.15.87	IN-HOUSE	04.24.87	MYLAR SEPIA	27.0	40.5	0.0	27.0	54				(P) ON HOLD PENDING FIELD WORK
							0.0			0				
WINTER CARNIVAL VIL.	87-N-22	02.28.87	IN-HOUSE	05.15.87	MYL SEP/BL	0.0	0.0	0.0	10.0	20	05.15.87	1.00	1.00	(C) 100 MILES AMP SCHEMATIC
							0.0			0				
							0.0			0				
							0.0			0				
							0.0			0				
							0.0			0				
							0.0			0				
	TOTALS:					95.0	142.5	568.0	605.0	2346		1.08	0.96	

FILE KEY		
(D)=TO BE DRAFTED	DESIGN (MILES):	95
(P)=PENDING	DESIGN (EST HOURS	142.5
(F)=FILE	DRAFTING (MILES):	1173
(C)=COMPLETE	DRAFTING (EST HOURS	2346

Table 1: Sample time tracking chart with cost assigned

Project type	Map scale	Miles per hour	Time per mile (hours)	Cost per mile
Base drafting	(1″ = 100′)	3	0.33	$ 6.67
Strand drafting	(1″ = 100′)	1	1	20
Key maps/map grid	(1″ = 1000′)	10	0.1	2
New design (with bill of materials)		1	1	20
Design drafting	(1″ = 100′)	1	1	20
Amplifier schematic	(1″ = 1000′)	5	0.2	4
As-built drafting	(1″ = 100′)	0.5	2	40

- design drafting
- amplifier schematics or powering schematics
- as-built drafting

Combinations of these categories, as well as partial categories, such as redesign that includes only system powering, are identified on an individual project basis.

The second step is to figure out how much time is associated with each category. To figure out where we were going, we needed to know where we were starting from. Each drafter and designer kept track of the time necessary to do such tasks as gathering the information to start a project, making bluelines of finished maps and mailing the project to the system. This was a long and tedious project for those involved, but the measurement over a period of time was necessary to form an accurate average.

Table 2: Sample project cost chart

Project type	Miles	Cost per mile	Total cost
Strand drafting (includes drafted base)	45	$ 20	$ 900
Key maps/map grid	175	2	350
New design (with bill of materials)	165	20	3,300
Design drafting	175	20	3,500
Amplifier schematic	175	4	700
As-built drafting	N/A (strand only at this time)		
Total drafting and design cost			$ 8,750

Materials	Quantity	Cost apiece	Total
Mylar for new strand maps	10	$ 2.50	$ 25
Mylar sepia for design	70	3.50	245
Bluelines: 10 sets	700	.25	175
Total material cost			445
Total drafting, design and materials			$9,195

Add 10 percent to account for miscellaneous expenses such as shipping costs.

Total project cost **$10,114,50**

The results were worth the time it took. Aside from knowing the average time necessary to complete a project, the drafting associates know where their strengths and weaknesses are. So this project is also an important training and development tool.

A simple project tracking spreadsheet was developed on Lotus 123.

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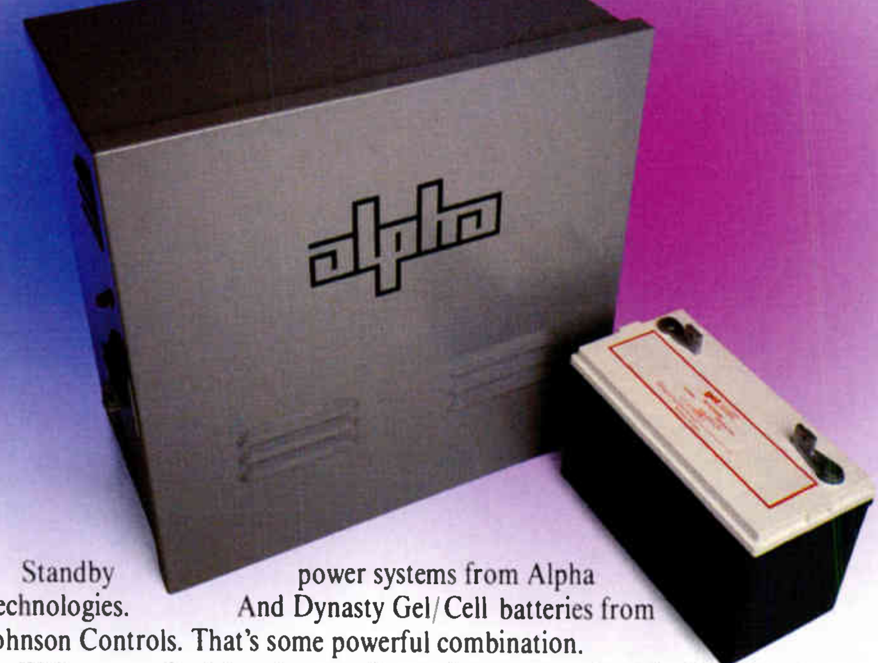

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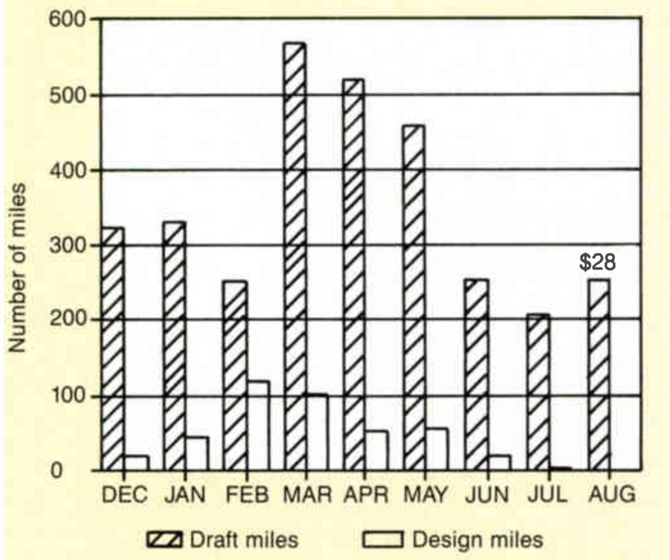
Figure 2: Drafting/design productivity graph



This program will keep track of how many miles of drafting and design are backlogged in the department at any given time, as well as assign hourly figures to the projects. A sample spreadsheet is given in Figure 1.

Estimating the costs

The third step is to assign dollar amounts to the time estimates. This is done by multiplying the average hourly salary of all drafters and designers by two. This hourly cost now includes all overhead, benefits and expendable drafting supplies, such as pens and erasers.

Associates track their individual accomplishments monthly. The results are turned over to the mapping coordinator, who compiles the information through another Lotus 123 spreadsheet. The results are graphed, since this gives any interested persons a clear understanding of the drafting and design productivity at a glance. Specific projects can be researched from the project tracking spreadsheet. As mentioned before, not all these categories are black and white; thus, it is necessary to continue to monitor and revise the tracking process when necessary.

Let's work through an example. *Decide what needs to be tracked*: We will use our basic categories previously described and develop a chart that can be used for tracking the time involved per project.

Figure time associated with each project type: Depending upon the type of projects that pass through your office, it may take a few weeks or months to develop the initial figures. It is important to have enough samples to establish an average. Also, new drafters can use this same chart to establish their own productivity level.

Assign dollar amounts to time estimates: For example, if the average hourly salary of your drafters and designers is $10, the "loaded" salary will be $20. (This will vary, depending upon your company and office location. You may want to research the overhead cost for your office.) Mylars, mylar sepias, paper sepias, vellums and bluelines can be averaged into the numbers in Table 1 or itemized separately.

Now that we have established our starting numbers, let's put them to use in the following three examples:

Example 1: How to assign costs to a drafting/design project

Project assumptions:

1) Total project miles: 175 miles
2) 140 miles redesign
3) 25 miles new extensions. Bluelines for base maps were supplied by the local utility company free of charge.
4) Field work has been completed, as follows: 150 miles of strand maps

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- ☐ 3. Cable TV Program Network
- ☐ 4. SMATV or DBS Operator
- ☐ 5. MDS, STV or LPTV Operator
- ☐ 6. Microwave or Telephone Company
- ☐ 7. Commercial Television Broadcaster
- ☐ 8. Cable TV Component Manufacturer
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- ☐ 10. Financial Institution, Broker, Consultant
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6	20	34	48	62	76	90	104	118	132
7	21	35	49	63	77	91	105	119	133
8	22	36	50	64	78	92	106	120	134
9	23	37	51	65	79	93	107	121	135
10	24	38	52	66	80	94	108	122	136
11	25	39	53	67	81	95	109	123	137
12	26	40	54	68	82	96	110	124	138
13	27	41	55	69	83	97	111	125	139
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15	29	43	57	71	85	99	113	127	141

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verified; 20 miles as-built strand drafting necessary and 25 miles new strand mapping notes complete.

5) Existing strand maps are drafted on mylar; existing design maps are drafted on vellum.

6) Existing strand maps will be used; new mylar sepias will be developed for the design drafting.

After identifying what needs to be done, assign miles to the project types identified previously. Then multiply the miles by the cost per mile. Add material costs to the total. (This is shown in Table 2.)

Example 2: How to use a project tracking spreadsheet

The most important "tool" in tracking projects, especially if you have numerous projects coming to you through many different people, is to have one person track all projects. This person should be able to report on the status of any project at any given time. Scheduling of projects is on a "first in, first out" basis. When prioritizing projects is necessary, outside assistance is sought in order to maintain the flow and to prevent unrushed projects from getting the "back burner" treatment. A sample project tracking spreadsheet is given in Figure 1. (This spreadsheet was developed to meet the needs of our systems at Jones Intercable. Categories can be added or deleted as necessary.)

When miles are input, hours are calculated, based upon the information gathered from your starting point calculations. These hours also account for time to organize projects, fill out time sheets, attend training classes, etc. Thus, an accurate time projection is established. In addition to scheduling projects, these projections can be used to justify the hiring of additional staff.

Example 3: Graph the final results

The easiest way to compile the final results is to have each drafter and designer report the number of miles completed in one month to the mapping coordinator. This person compiles the results and graphs a bar graph driven from a Lotus 123 spreadsheet (Figure 2).

Our program also calculates the cost per mile average for all projects done. Knowing that your staff drafted 500 miles of strand last month is irrelevant if you don't know if your cost was $25 or $125 per mile. In order to get an accurate calculation, the following procedure must be followed. Just averaging the total will not give you a clear picture of your cost per mile.

	Hours to draft		Number of miles drafted		Loaded salary		Individual cost per mile
Drafter 1	(200	/	100)	×	$20	=	$40
Drafter 2	(150	/	150)	×	$20	=	$20

This information is reported by the drafters.

Multiply each drafter's miles by the individual cost per mile and add these totals together. Then divide by the total number of miles of all drafters.

Drafter 1	100	×	$40	=	$4,000
Drafter 2	150	×	$20	=	3,000
Total					7,000

$7,000/250 miles = $28 per mile

This is the average cost for drafting one mile.

Advantages of tracking

Accurate tracking of drafting and design projects has many advantages. Just a few of these include: planning, setting realistic goals, estimating costs for budgets, training and developing employees, justification of employees' salaries and bonuses, identify staffing needs, accountability, future predictions and trends, and project control. Reaching these goals depends on knowing where you are starting.

If you would like a sample copy of the Lotus 123 program for developing a project tracking spreadsheet and productivity graph, send a blank disc and self-addressed return envelope to: Jones Intercable, 9697 E. Mineral Ave., Englewood, Colo. 80112, Attention: Pam King.

Maintenance for the changing headend

By Scott Cooper
Technical Supervisor, Concord TV Cable

The importance of consistent and fastidious headend maintenance has been dogma virtually since the genesis of cable TV. Indeed, it is a proven and accepted fact that the performance of a headend will affect a system not only from a strictly technical aspect, but also has the potential to ultimately influence all other aspects of cable TV, from operating costs and profitability to customer perception and marketability. It is known that one hour of deferred maintenance in the headend can result in scores of hours spent on service calls. Subsequently, over a period of time, customer perception can become negative toward product quality. It is an uphill battle to win customer confidence back.

The purpose of this article, however, is not to rehash but to encourage and remind ourselves that it is time to take a thoughtful look at our maintenance procedures and programs, for the headend environment is radically different from what it was just a few years ago.

In the early '70s it consisted of antennas, processors and an occasional modulator. The cable operator's control over the signal component parameters from a maintenance standpoint was limited to adjusting carrier levels. There was very little that could be done to adjust the various components of the video waveform and, furthermore, very little need to do such. By the late '70s, pay TV via satellite became widespread and cable operators were faced with the necessity to become familiar with baseband video equipment. Also, various methods of signal protection, or scrambling, were introduced, each with its own idiosyncrasies. This required operators to acquaint themselves with the relationship between the integrity of each video component and the operation of their particular system.

In the early '80s, a new generation of converters was introduced that, along with the marketing advantages of addressability, brought the added engineering responsibility of data transmission technology as well as necessitating a more intimate knowledge and use of baseband video technology. Additionally, the interrelationships of these technologies with existing cable technology became even more critical.

Concurrent with all this technological melee was the FCC deregulation of the cable industry. While this decision was seen as a bit of relief in an otherwise increasingly busy engineering arena, it also served to remove some incentive to spend time in our headends. This, combined with constantly challenging activity and growth, has made it more difficult than ever to be consistent with our maintenance programs. It is one of life's ironies that the very factors that demand good headend housekeeping in fact tend to distract from our efforts at regular headend upkeep.

In order to be consistent with our headend maintenance, it is necessary to scrutinize our existing efforts with an eye toward maximizing the time we are realistically able to spend. In many cases, we are finding ourselves with greatly increased workloads for our technical departments, yet because of the insidious nature of the workload increases, we may have the same technical work force as in years past. However, this is not necessarily a disadvantage, since it compels us to be as efficient as possible.

The following are some practical ideas that most anyone may find helpful. It may be noted that there is nothing mystical about these ideas, just common sense and lots of hard work.

Developing a plan

The first step is to develop a headend maintenance plan. In order to achieve this, it is helpful to ask the following questions:

1) What do I want to achieve? Use terms and goals that are measurable and specific. It may help to envision how you would like your headend to perform. (Of course, you must be realistic and stay within the means of your available resources.) An example of a goal for headend maintenance may be "to develop and enlist a routine whereby the following parameters are checked and adjusted as necessary on a weekly basis," and a list of parameters and specifications may follow.

"The very factors that demand good headend housekeeping in fact tend to distract from our efforts at regular headend upkeep."

2) What steps will be necessary to achieve this goal? To continue with the example, the steps may be something like this: to develop hard copy forms of the parameters to be checked, and to fill them out weekly; to schedule, on Wednesday of each week, to be at the headend to perform these tests; and to ensure that necessary equipment will be available as needed (a list of necessary equipment may follow) and to develop a contingency plan in the event that a critical piece of equipment must be sent in for repairs.

In developing these goals and objectives, you will be doing so with your needs balanced against your particular operational boundaries and thereby develop a plan that is uniquely yours. The general idea, however, is to specifically state what you want to achieve, and break these goals into less intimidating, bite-size objectives.

The other side of achieving our goals is having time on a regular basis to spend on objectives. Indeed, this may well be the main problem, as many of us may already have good maintenance programs, but never find time to make them effective. The same principles we have just discussed apply in this case as well.

How many of us in years past, knowing we had to have our proof-of-performance tests done by the end of the year, have waited to start them in November? (One of the reasons for such procrastination is that the size of the job was intimidating to the point that it was never felt there was time to start.) This is where the principle of breaking down a large job into smaller objectives can be effective. Taking the example of proof tests, let us say that at the beginning of the year we have 36 channels to test and document. If this were broken down to monthly objectives, that is only three channels per month! This is clearly achievable and it may even be folded into our headend maintenance program.

It is clear that achieving our goals will require much planning and discipline. Furthermore, it will require patience and perseverance. Also important to consider is that allowances should be made for flexibility, since real-world circumstances tend to favor operating from the seat of the pants, regardless of the amount of discipline and time spent on planning.

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PC software for accurate design

By Barbara L. Lukens
Director of Construction
American Television and Communications Corp

With the increased availability of personal computers (PCs) in the work environment has come the proliferation of PC software for cable TV system design. Such software is available for nearly every brand of PC and purchase prices vary widely. For the local system operator and small MSO, PC design capability can be a real boon. Not only can design accuracy be improved significantly, but a good program also should speed the design process immeasurably.

As always, there are caveats. Accurate design (i.e., correctly calculated signal levels and the resultant selection of directional taps and couplers) does not guarantee design efficiency. Design efficiency occurs when 1) the layout calls for a minimum of materials and equipment (most significant are electronic components) and 2) construction costs are minimized. One *might* sacrifice construction costs that are one time-only costs to gain longer-term savings on system maintenance and power consumption costs, but such tradeoffs should be analyzed.

With the availability of PC design software more operators are doing their own design. They are relying less on design contractors and may be losing design efficiency because of an expectation that the software will make up for a designer's lack of knowledge and experience. Good design still requires a trained and experienced designer!

Considerations

If you have not yet purchased PC design software but are considering it, here are a few things to think about:

1) Does the program track signal levels at more than one frequency or only at the highest frequency you expect to carry? The better programs will track at least two frequencies, usually the highest and lowest, to ensure that the selected equipment will work properly throughout the frequency range.
2) Does the program assume insertion losses are flat, or does it account for the losses accurately over all frequencies being tracked? Most vendors now agree that passive components do not have flat insertion losses.
3) Does the program allow for you to enter the loss factors of your favorite vendor's equipment, or does it contain average losses? The more specific you can make the program, the more accurate and reliable will be the resulting design.
4) Does the program perform accurately? Try it out on a section of plant designed previously and that you are *positive* is designed accurately. Compare its answers to your answers. If they do not agree you should probably look for another source of software (unless, of course, the vendor can convince you that it's your design that's inaccurate).
5) Does the program automatically select the appropriate passive device values? This can be a time saver in the design process.
6) Can you override the program if you have a need to do so? This is an option to be used with great caution but it can be a useful tool for a very experienced designer.
7) Is the program user-friendly? While this is an important consideration you should not sacrifice other criteria for user-friendliness. (Remember, you should be purchasing this as a tool to be used by someone who understands the design process.)

"The more specific you can make the program, the more accurate and reliable will be the resulting design."

The following is a list of many of the auxiliary programs or adjuncts to the design programs that are available today. Take some time to decide which are really needed for your design department's operation. Some are nice to have but certainly not essential:

- Feeder design
- Trunk design
- System powering
- Pad and equalizer selection
- Bill of materials (some even store pricing information for immediate cost evaluation)
- Distortion and/or noise calculations for use in planning
- Graphic representation of the layout
- Capability for hard copy

There's certainly more to obtaining good design than using a computer to aid you. Know what you need and want in a software package and know how to make sure that's what you're getting. There are enough sources in today's marketplace that you do not need to develop your own (besides, who has time?). Look around and see what's best for you from a pricing and functional perspective, and be sure to use an experienced, knowledgeable designer for best results.

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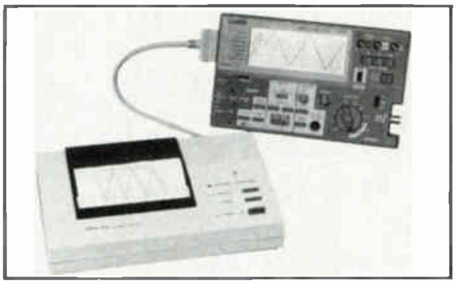


O-scope printer

Now available from Leader Instruments is a companion printer for its combination digital multimeter/storage oscilloscope Model 100P. The printer provides a hard copy of stored waveforms, making it ideal for field service applications as well as laboratory use, according to the company. It also allows evaluation of data at any time and provides documentation of work to satisfy legal requirements.

For more information, contact Leader Instruments Corp., 380 Oser Ave., Hauppauge, N.Y. 11788, (516) 231-6900; or circle #101 on the reader service card.

Software

Available from Software Intelligent Systems, the Protool/Online CICS application generator produces Basic Mapping Support source code and command level CICS Cobol source programs, which are standardized in logical structure and format. This product uses computer-aided software engineering (CASE) technology and has an optional PC feature that provides for definition of the screens and programs without requiring connectivity to the mainframe.

For further information, contact Software Intelligent Systems, 901 Birch Hill St., Thousand Oaks, Calif. 91320, (805) 499-7206; or circle #117 on the reader service card.

Controllers

Zenith recently introduced a new family of cable system controllers that can operate both baseband and RF decoders from the headend. The controllers are built around Zenith's Data Systems Z-248 PC, a PC/AT-compatible desktop computer. According to the company, cable operators can authorize at least five decoders per second in PPV applications.

For more details, contact Zenith Electronics Corp., 1000 Milwaukee Ave., Glenview, Ill. 60025, (312) 391-8181; or circle #114 on the reader service card.

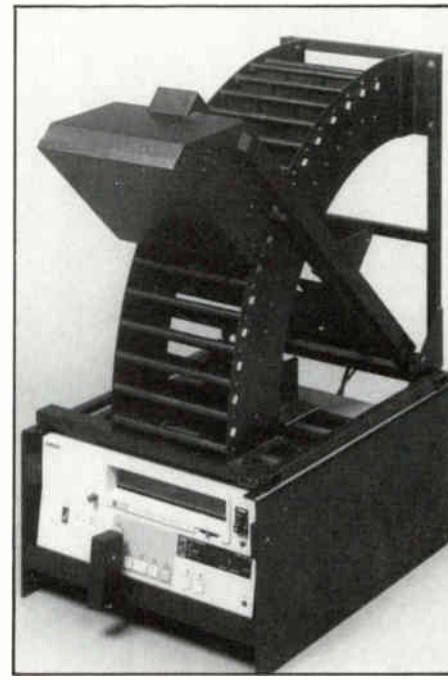
Textbook

GWG Associates has published the second edition of *Cable Television*, a textbook by William Grant. The book is intended as an introductory text for those people with some technical background or training but with no previous experience with coaxial cable transmission. Topics covered in the book include transmission systems, noise, intermodulation distortion, frequency response and equalization, urban and rural system design, headend signal processing, and subscriber terminal equipment.

For more details, contact GWG Associates, P.O. Box 473, Richmondville, N.Y. 12149, (518) 234-7405; or circle #105 on the reader service card.

Upgrade kits

Channelmatic will offer upgrade kits for its Broadcaster I videocassette changers that will include a self-aligning VCR mounting assembly adaptable to Sony Series 5000 and 7000 VCRs. An upgraded clamp and tape guide assembly also are included, as well as software to enable the user to operate the unit as a programmable recording device.



For further information, contact Channelmatic, 821 Tavern Rd., Alpine, Calif. 92001, (619) 445-2691; or circle #113 on the reader service card.

TVRO trap

Microwave Filter Co. introduced the Model 4616UA terrestrial interference trap for IF frequencies between 230 and 700 MHz. The trap is used to suppress terrestrial interference at the final IF stage of TVRO receivers and is designed for cases of mild to heavy interference where the picture is visible under the interference.

This product is factory tuned ±10 MHz from the specified frequency and notch depth is 15 dB, and 3 dB bandwidth is 4 MHz maximum. Impedance is 75 ohms and connectors are type

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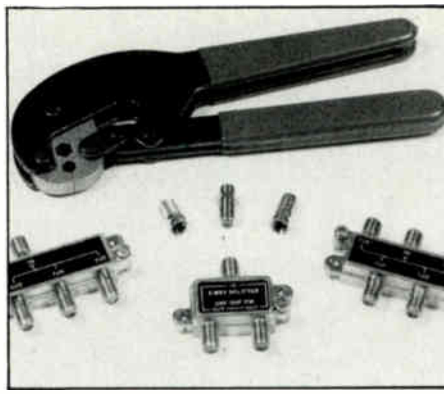
F. The trap is installed between the downconverter and receiver in standard receivers or in the final IF loop at the back of the receiver in block downconverters.

For more details, contact Microwave Filter Co., 6743 Kinne St., East Syracuse, N.Y. 13057, (315) 437-3953; or circle #104 on the reader service card.

Electronic connectors

Cosmic Electrical Products introduced a new line of electronic connectors with precision-machined, nickel-plated brass construction said to preserve high signal strength. Twist-on or one-piece crimp-type male F connectors are available for RG59 and RG6 cable, as well as F-type flush-mount wall plates with a female adaptor, lock nut, washer and mounting screws.

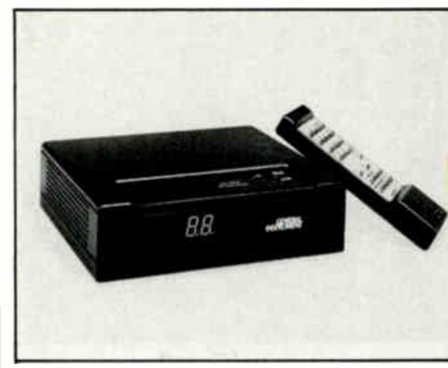


For further details, contact Cosmic Electrical Products, 515 Palmetto Dr., Simpsonville, S.C. 29681, (800) 336-8989; or circle #118 on the reader service card.

Trunk amplifier

The Scientific-Atlanta AT parallel hybrid trunk amplifier is said to deliver 8 dB of distortion improvement (a 2 dB improvement over power-doubling amplifiers). According to the company, the amplifier can be applied in narrow upgrades, providing sufficient channel expansion while maintaining picture quality; and new-builds or rebuilds, cutting overall life cycle costs by reducing power consumption, installation and repair/maintenance expenses. The modules mount in the standard S-A slimline housing and use plug-in equalizers and pads.

For additional information, contact Scientific-Atlanta, 1 Technology Pkwy., Box 105600, Atlanta, Ga. 30348, (404) 441-4000; or circle #107 on the reader service card.



Converter

Jerrold introduced its 550 MHz Model DQN7, a plain converter one-third smaller than its predecessor. Operator features are a non-volatile memory and downloadable parameters using an infrared remote programmer. Subscriber features include last channel recall, favorite channel programming, parental control with electronic override, automatic fine tuning and BTSC stereo transparence.

For more details, contact Jerrold Division, General Instrument Corp., 2200 Byberry Rd., Hatboro, Pa. 19040, (215) 674-4800; or circle #106 on the reader service card.

Modulator

Available from ISS Engineering, the GL2610XT Series II modulator offers the user front panel selection with 0, 12.5 and 25 kHz offsets to meet the new legal frequencies required in the United States and Canada. The offsets do not change the 45.75 MHz IF frequency, allowing for use with standard scramblers. The product features audio and video modulators, an external pre-emphasis select switch and three SAW filters.

For more details, contact ISS Engineering,

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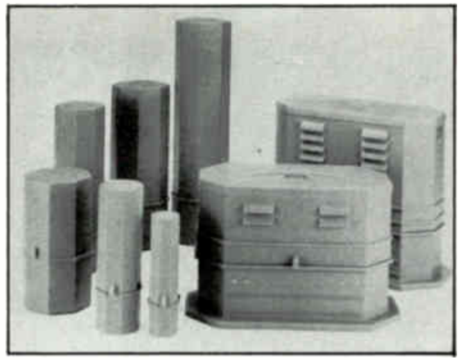
104 Constitution Dr. #4, Menlo Park, Calif. 94025, (800) 351-4477 or (800) 227-6288; or circle #136 on the reader service card.

Pedestals

Federal Telecom recently expanded the Polyped line of buried plant housings for the CATV installation industry. The C124 Series CATV closures has two new heights available for its 10-inch diameter pedestals: the C124-10LP is 17½ inches and the C124-10MP is 27½ inches overall. The C1230 amplifier housing series now includes the C1230 LP at 12½ inches and the C123OX at 25½ inches.

For more details, contact Federal Telecom,



1000 Hart Rd., Barrington, Ill. 60010, (312) 381-8700; or circle #108 on the reader service card.

Electronic marking

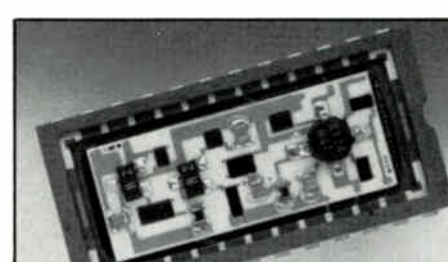
The ScotchMark electronic marker system from 3M is said to provide an accurate, long-term method of marking and locating buried facilities at depths ranging from 2 to 8 feet. The marker locator transmits an RF signal to the buried marker, which reflects the signal back. The location is indicated with both a visual meter reading and an audible tone. The color-coded marker is a passive antenna impervious to minerals, chemicals and temperature extremes. The locator is not affected by metal or conduit pipe, metallic conductors, fences, AC power or electronic markers for other utilities.

For additional information, contact 3M, P.O. Box 2963, Austin, Texas 78769-2963, (512) 834-1800; or circle #115 on the reader service card.

Signal generator

The Model 2022C from Marconi Instruments is a signal generator that can be used as a local oscillator for passive component testing and intermodulation measurements. The product features a 10 kHz to 1 GHz frequency range, +13 dBm output level, auxiliary FM input socket and a memory clear facility. It also includes a 10 Hz resolution to 100 MHz, amplitude, frequency and phase modulation capabilities and an automatic control system.

For additional details, contact Marconi Instruments, 3 Pearl Ct., Allendale, N.J. 07401, (201) 934-9050; or circle #110 on the reader service card.



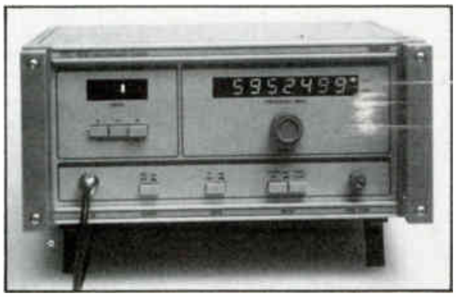
RF amplifier

National Semiconductor's Model LH4200 is a hybrid integrated circuit RF amplifier featuring a GaAs FET front end for high speed, and bipolar second and and third stages for high-power output capability. It can be used in applications ranging from 500 kHz to 1 GHz and has a guaranteed power gain of 14 dB at 500

See us at the Texas Show, Booth 414 & 416. Reader Service Number 60.

MHz. The device has a noise figure of 3 dB in a 50-ohm system and 2 dB in an 800-ohm system and decoupling capacitors that eliminate parasitic oscillations.

For more details, contact National Semiconductor Corp., 2900 Semiconductor Dr., P.O. Box 58090, Santa Clara, Calif. 95052-8090, (408) 749-7421; or circle #116 on the reader service card.



Frequency counter

Texscan's TFC-600 600 MHz tuned frequency counter combines an amplitude modulation stripping circuit that removes the visual carrier modulation, and a frequency counter for precise measurement of the visual carriers and the separation between visual and aural carriers. It features ±1 kHz accuracy for the video frequency measurements and ±10 Hz for intercarrier measurements, eight-digit resolution and 35 dB attenuation on the front panel.

For more information, contact Texscan Instruments, 3169 N. Shadeland Ave., Indianapolis, Ind. 46226, (317) 545-4196; or circle #109 on the reader service card.

Standby power supply

The PowerVision division of C-COR introduced its PS900, a single module standby power supply offered in pole- and pedestal-mount versions. The product is capable of delivering clean uninterrupted power in the event of a power failure, with a transfer time of 16 milliseconds or less. The output waveform is virtually the same in both standby and normal modes.

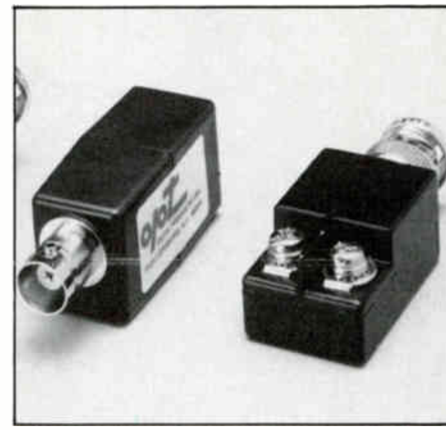
For additional details, contact PowerVision Division, C-COR Electronics, 60 Decibel Rd., State College, Pa. 16801, (814) 238-2461; or circle #112 on the reader service card.

A/V modulator

R.L. Drake Co.'s Model VM2410 frequency agile, audio/video modulator is a vestigial sideband unit with access up to 60 channels, including all standard and cable channels up to 400 MHz. It incorporates IF loop-throughs, permitting operation with various types of descrambling equipment.

The unit features synthesized visual and aural carriers, video low pass filter, IF SAW filter and low intermod output stage. It also accepts standard video inputs (sync negative) of 0.7 to 3 volts peak-to-peak and allows either balanced or unbalanced input without switching.

For additional information, contact R.L. Drake Co., P.O. Box 112, Miamisburg, Ohio 45342, (513) 866-2421; or circle #103 on the reader service card.



Filtered baluns

According to OPT Industries, its new line of filtered coax to twisted pair baluns permits the transmission and receipt of high-speed data (up to 6 Mbps) over inexpensive unshielded twisted pair cable without contamination with unwanted noise. The baluns are available in eight configurations, with either male or female BNCs on the coax side and modular RJ11, RJ45 or two screw terminals on the twisted pair side.

For further details, contact OPT Industries, 300 Red School Lane, Phillipsburg, N.J. 08865, (201) 454-2600; or circle #102 on the reader service card.

Limited Time Sale

Old Convertors Never Die! They're Shelved Because:

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MCC Restoration Kit

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Reader Service Number 62.

Himelrick

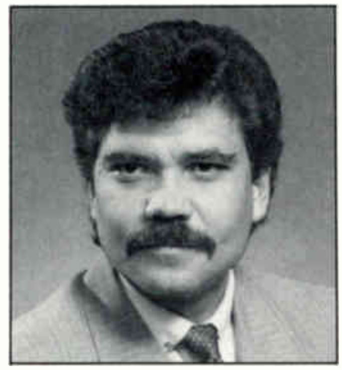
Phoenix Cable appointed **Chuck Himelrick** system manager of its Tennesee and North Carolina properties. He also will serve as regional engineer and purchasing manager for all Phoenix systems. Most recently, he was system manager for Cablevision Industries in Glens Falls, N.Y. Contact: 100 Colony Square, Atlanta, Ga. 30361, (404) 872-2406.

Anixter Bros. recently announced several promotions. **Scott Wilson** was named vice president, marketing services. **Mike Armstrong** was appointed vice president, data systems products. **Marty Ingram** was promoted to vice president, broadband systems products. **Bill McFarland** was named vice president, electrical wire and cable products.

Also, **Paul Sullivan** was appointed Western regional vice president, marketing. **Marlowe Taylor** was promoted to Western regional vice president, operations. **Dan Rubadue** was named Western regional vice president, sales. Contact: 4711 Golf Rd., 1 Concourse Plaza, Skokie, Ill. 60076, (312) 677-2600.

Ruben Lugo joined **RF Superior**, a division of Brad Cable Electronics, as a CAT system specialist. Most recently, he was executive vice president for a cable manufacturing company. Contact: 1023 State St., P.O. Box 739, Schenectady, N.Y. 12301, (518) 382-8000.

Scientific-Atlanta elected **J. Larry Bradner** to vice president of the corporation. He is currently president of the company's Broadband Communications Business Division. Contact: 1 Technology Pkwy., Box 105600, Atlanta, Ga. 30348, (404) 441-4000.



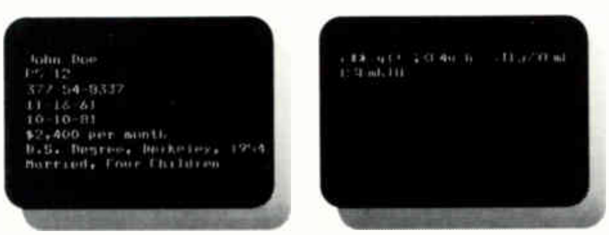
Watson

Michael Watson was named vice president of sales for **Channelmatic**. Previously, he was West Coast regional manager for Video Systems, the former sales arm of Channelmatic. Contact: 821 Tavern Rd., Alpine, Calif. 92001, (619) 445-2691.

American Television and Communications Corp. recently announced the appointment of eight new officers. **James Chiddix** was promoted from vice president to senior vice president of engineering and technology. Elected as corporate vice presidents were **Timothy Evard**, **Thomas Feige**, **John Field**, **Stephen Kniffin**, **Jay Satterfield** and **Jack Stanley**. **H. Jack Roemer** was elected assistant controller. Contact: 160 Inverness Dr. West, Englewood, Colo. 80112, (303) 799-1200.

Sachs Communications appointed **Robert Girard** director of marketing and communications. He most recently spent two years on consultation projects in industrial marketing and advertising-related fields. Contact: 30 W. Service Rd., Champlain, N.Y. 12919-9703, (800) 361-3685.

Panduit Corp. appointed **Howard Weiner** as vice president of its Connector Division. Most recently, he was director of engineering, commercial and industrial products for Allied Amphenol Products. Contact: 17301 Ridgeland Ave., Tinley Park, Ill. 60477, (312) 532-1800.



Voltage addition

By Ron Hranac and Pam King
Jones Intercable Inc.

Combining unlike composite triple beat (CTB) or cross modulation (XMOD) ratios is accomplished using a technique known as voltage addition. For example, determining the final CTB ratio of a 22 amplifier trunk cascade, bridger and line extender would be done using voltage addition. One way to do this is with the following chart; another way is to work through the standard voltage addition formula. Examples of each are shown on the next page.

dB diff.	.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	6.0206	5.9707	5.9212	5.8719	5.8229	5.7742	5.7258	5.6777	5.6298	5.5823
1	5.5350	5.4880	5.4413	5.3949	5.3488	5.3029	5.2574	5.2121	5.1671	5.1225
2	5.0780	5.0339	4.9901	4.9465	4.9032	4.8602	4.8175	4.7751	4.7329	4.6911
3	4.6495	4.6082	4.5671	4.5264	4.4859	4.4457	4.4058	4.3661	4.3268	4.2877
4	4.2489	4.2103	4.1720	4.1340	4.0963	4.0588	4.0216	3.9847	3.9480	3.9116
5	3.8755	3.8397	3.8041	3.7687	3.7337	3.6989	3.6643	3.6300	3.5960	3.5622
6	3.5287	3.4954	3.4624	3.4297	3.3972	3.3650	3.3330	3.3012	3.2697	3.2385
7	3.2075	3.1767	3.1462	3.1159	3.0859	3.0561	3.0266	2.9973	2.9682	2.9394
8	2.9108	2.8825	2.8543	2.8264	2.7988	2.7713	2.7441	2.7172	2.6904	2.6639
9	2.6376	2.6115	2.5857	2.5600	2.5346	2.5094	2.4844	2.4597	2.4351	2.4108
10	2.3866	2.3627	2.3390	2.3155	2.2922	2.2691	2.2462	2.2235	2.2010	2.1788
11	2.1567	2.1348	2.1131	2.0916	2.0703	2.0492	2.0283	2.0075	1.9870	1.9666
12	1.9465	1.9265	1.9067	1.8871	1.8676	1.8484	1.8293	1.8104	1.7917	1.7731
13	1.7547	1.7365	1.7185	1.7006	1.6829	1.6654	1.6480	1.6308	1.6138	1.5969
14	1.5802	1.5636	1.5473	1.5310	1.5149	1.4990	1.4832	1.4676	1.4521	1.4368
15	1.4216	1.4066	1.3917	1.3770	1.3624	1.3480	1.3337	1.3195	1.3055	1.2916
16	1.2778	1.2642	1.2508	1.2374	1.2242	1.2111	1.1982	1.1853	1.1727	1.1601
17	1.1477	1.1353	1.1231	1.1111	1.0991	1.0873	1.0756	1.0640	1.0525	1.0412
18	1.0299	1.0188	1.0078	0.9969	0.9861	0.9754	0.9649	0.9544	0.9441	0.9338
19	0.9237	0.9136	0.9037	0.8939	0.8842	0.8745	0.8650	0.8556	0.8462	0.8370
20	0.8279	0.8188	0.8099	0.8010	0.7922	0.7836	0.7750	0.7665	0.7581	0.7498
21	0.7416	0.7334	0.7254	0.7174	0.7095	0.7017	0.6940	0.6864	0.6788	0.6713
22	0.6639	0.6566	0.6494	0.6422	0.6351	0.6281	0.6212	0.6143	0.6075	0.6008
23	0.5941	0.5876	0.5810	0.5746	0.5682	0.5619	0.5557	0.5496	0.5435	0.5374
24	0.5315	0.5256	0.5197	0.5139	0.5082	0.5026	0.4970	0.4914	0.4860	0.4806
25	0.4752	0.4699	0.4647	0.4595	0.4544	0.4493	0.4443	0.4393	0.4344	0.4296
26	0.4248	0.4200	0.4153	0.4107	0.4061	0.4016	0.3971	0.3926	0.3882	0.3839
27	0.3796	0.3753	0.3711	0.3670	0.3628	0.3588	0.3548	0.3508	0.3468	0.3429
28	0.3391	0.3353	0.3315	0.3278	0.3241	0.3205	0.3169	0.3133	0.3098	0.3063
29	0.3029	0.2994	0.2961	0.2927	0.2894	0.2862	0.2830	0.2798	0.2766	0.2735
30	0.2704	0.2674	0.2644	0.2614	0.2584	0.2555	0.2526	0.2498	0.2470	0.2442

Examples

Problem

What is the combined CTB ratio of a trunk cascade and single bridger amplifier, assuming the following conditions?

Trunk cascade CTB ratio = −68.2
Single bridger amplifier CTB = −66.0

Solution

First, calculate the difference (absolute value) between the two ratios (68.2 − 66.0 = 2.2). Locate "2" in the left column of the chart, and "0.2" in the top row; moving across and down from these numbers, you will find 4.9901. Next, add 4.9901 to the smaller of the two CTB ratios (−66.0 + 4.9901 = −61.0099). The combined CTB ratio of the trunk cascade and bridger amplifier is −61.0.

Problem

What is the total CTB ratio of the above trunk cascade and bridger, plus a line extender whose CTB ratio is −70.0?

Solution

Calculate the difference (absolute value) between the two ratios (70.0 − 61.0 = 9.0). Locate "9" in the left column of the chart, and "0" in the top row; moving across and down from these two numbers you will find 2.6376. Add 2.6376 to the smaller of the two CTB ratios (−61.0 + 2.6376 = −58.3624). The total combined CTB ratio of the trunk cascade, bridger and line extender is −58.4.

Problem

Calculate the total combined CTB ratio of the above trunk cascade, bridger and line extender using the standard voltage addition formula.

Solution

Use the formula

$$CTB_{TOTAL} = 20\log_{10}\left(10^{\frac{CTB_1}{20}} + 10^{\frac{CTB_2}{20}} + 10^{\frac{CTB_3}{20}}\right)$$

$$= 20\log_{10}\left(10^{\frac{-68.2}{20}} + 10^{\frac{-66.0}{20}} + 10^{\frac{-70.0}{20}}\right)$$

$$= 20\log_{10}\left(10^{-3.41} + 10^{-3.30} + 10^{-3.50}\right)$$

$$= 20\log_{10}(0.000389 + 0.000501 + 0.000316)$$

$$= 20\log_{10}(0.001206)$$

$$= 20\,(-2.9185)$$

$$= -58.4$$

CALENDAR

February

Feb. 16-17: Jerrold technical seminar on LAN system technology, Ramada Hotel, Culver City, Calif. Contact Chris Tancredi, (215) 674-4800.

Feb. 17-19: Texas Cable Television Association's Texas Show, Convention Center, San Antonio, Texas. Contact (512) 474-2082.

Feb. 23: SCTE Satellite Tele-Seminar Program on "Balance and alignment equipment for Scientific-Atlanta Series 6500 and 6800 distribution equipment," 12-1 p.m. ET on Transponder 7 of Satcom F3R. Contact (215) 363-6888.

Feb. 24: SCTE Greater Chicago Chapter technical seminar on data communications, Embassy Suites Hotel, Schaumburg, Ill. Contact John Grothendick, (312) 438-4200.

Feb. 24: SCTE North Country Meeting Group BCT/E testing. Contact Douglas Ceballos, (612) 522-5200.

Feb. 24-25: General Instrument's "Cable insights: Taking the mystery out of cable television," Marina del Rey Hotel, Marina del Rey, Calif. Contact Jim Barthold, (215) 674-4800.

Feb. 27: SCTE Rocky Mountain Chapter technical seminar on transportation systems. Contact Steve Johnson, (303) 799-1200.

Feb. 29-March 2: School of Lightning Protection Technology seminar on lightning protection, Orlando, Fla. Contact (815) 943-4005.

March

March 7-9: Center for Professional Development course on fiber-optic communications, Arizona State University, Tempe, Ariz. Contact (602) 965-1740.

March 7-10: Information Gatekeepers' Military and Government Fiber-Optics and Communications Exposition (MFOC '88), Hyatt Crystal City, Washington, D.C. Contact (617) 232-3111.

March 15-17: Magnavox CATV training seminar, Orlando, Fla. Contact Amy Costello, (800) 448-5171.

March 21-23: North Central Cable Television Association annual convention and trade show, Hyatt Hotel, Minneapolis. Contact Mike Martin, (612) 641-0268.

March 22-23: COMBEC '88, Montreal Convention Center, Montreal, Quebec. Contact (416) 536-4621.

March 22-24: Magnavox CATV training seminar, Birmingham, Ala.. Contact Amy Costello, (800) 448-5171.

March 22-24: C-COR Electronics technical seminar, Indianapolis. Contact Shelley Parker, (800) 233-2267.

March 29: SCTE Satellite Tele-Seminar Program on signal leakage detection, 12-1 p.m. ET on Transponder 7 of Satcom F3R. Contact (215) 363-6888.

March 29-31: Magnavox CATV training seminar, Jackson, Miss. Contact Amy Costello, (800) 448-5171.

April

April 5-7: Magnavox CATV training seminar, Houston. Contact Amy Costello, (800) 448-5171.

April 12-14: Magnavox CATV training seminar, Tulsa, Okla. Contact Amy Costello, (800) 448-5171.

April 12-15: Arkansas Cable Television Association and **Louisiana Cable Television Association** joint L'Ark convention, Sheraton Hotel, New Orleans. Contact (501) 372-1756.

April 16: SCTE Rocky Mountain Chapter technical seminar on terminal devices. Contact Steve Johnson, (303) 799-1200.

April 19-21: Magnavox CATV training seminar, Santa Fe, N.M. Contact Amy Costello, (800) 448-5171.

April 26-28: Commwest visual communications exposition and conference, Vancouver Trade and Convention Centre, Vancouver, B.C., Canada. Contact (416) 536-4621.

April 30-May 3: NCTA Show, Convention Center, Los Angeles. Contact (202) 775-3550.

Planning ahead

April 30-May 3: NCTA Show, Convention Center, Los Angeles.

June 16-19: SCTE Cable-Tec Expo, Hilton Hotel, San Francisco.

Sept. 7-9: Eastern Show, Atlanta Merchandise Mart, Atlanta.

Sept. 27-29: Great Lakes Expo, Cobo Hall, Detroit.

AD INDEX

Issues for HDTV, cable

By Walter S. Ciciora, Ph.D.
Vice President of Technology
American Television and Communications Corp.

The Federal Communications Commission issued a notice of inquiry (NOI) on high-definition television (HDTV) in August 1987 with responses due just before Thanksgiving. The responses to the NOI stack up to about a foot of paper. Reading them was a chore (especially with a turkey leg in one hand), but an instructive one. A number of interesting facts, opinions and insights were gained.

Another HDTV definition

The most common definition of HDTV was given in last month's column. An HDTV picture has at least 800 lines of resolution per picture height in the horizontal direction and an aspect ratio of 16-by-nine. The David Sarnoff Research Center (DSRC) filing to the FCC contains an alternative definition that offers some useful insights. It describes the present NTSC system as a "five-picture height" system because it was meant to be viewed from a distance of five times the picture height. That is, it was designed for the relatively small TV screens available at the time of its creation.

Today's larger screen TV receivers and projection sets result in closer viewing distances in normal residences. Super VHS and the DSRC-developed Advanced Compatible TV (ACTV) are described as "three-picture height" systems since they have sufficient definition to be enjoyably viewed from three times the height of the picture. DSRC calls HDTV a "one-picture height" system since it is intended for really large-screen use.

This is a very important point. Most HDTV viewing tests that compare NTSC images to HDTV monitors of less than a 40-inch diagonal measure yield unsatisfying results. Untrained viewers are relatively unimpressed with the definition but like the wider screen. This could tempt us to conclude that a wide-screen NTSC system would be adequate. It is important to realize that truly large-screen TV will arrive at about the same time as HDTV. Compromises based on today's screen sizes could result in embarrassing performance when viewed on tomorrow's HDTV-sized screens.

HDTV issues

After reading the responses to the NOI and visiting with most of the proponents of systems, I've concluded that two of the major issues are: 1) Will HDTV be a new service or an enhancement of NTSC video? 2) Will the international balance of trade influence the course of HDTV events in the United States?

If HDTV is an entirely new service separate from NTSC-delivered video, the question of compatibility is a moot point. On the other hand, if HDTV is meant to enhance NTSC services, compatibility becomes critical. There is a major difference of opinion on this. Japan's NHK, the public broadcasting organization, has decided that Japanese HDTV will be a separate DBS service totally independent of terrestrial broadcast. There are two reasons for this. In its FCC filing, NHK stated that there simply is no spectrum available for allocation to HDTV in Japan. In providing quality NTSC service to nearly all of the Japanese population, an extensive network of more than 12,000 UHF repeaters blanket the island, filling all available spectrum space.

The second reason is only privately stated. Many Japanese TV engineers believe that the problems with multipath, co-channel interference and noise make terrestrial delivery of HDTV extremely difficult. Instead of HDTV, the Japanese broadcasters are working on enhancements for NTSC, which do not include a wider aspect ratio. Standard three-by-four will be the rule for broadcast TV in Japan. HDTV will be available on VCR tapes and on videodiscs. Since Japan has no cable networks like those in the United States, cable delivery of HDTV is not an issue.

The situation in the United States is very different. An extensive system of "UHF taboos" was implemented in the early days of UHF broadcast, motivated by practical circuit considerations of that era. These measures facilitated low-cost UHF tuner designs. The result is that less than half of all available channels are allocated. Most of these design considerations are no longer necessary, making it possible to consider a phase-in of new rules on UHF tuner design that would allow the eventual assignment of most (if not all) UHF frequencies for HDTV purposes. This phase-in would take at least a decade after the last receiver with the older type of UHF tuner was sold. Unlike the situation in Japan, terrestrial HDTV is at least theoretically possible in the United States. However, the multipath questions that privately trouble the Japanese engineers are just as valid a concern for the United States.

The second major HDTV issue is not a technical one. It involves the international balance of trade. Congress may continue its present free-trade policies and do nothing. On the other hand, given the current trade and employment concerns, Congress may take very restrictive action against imports. A continuum of choices exists between these extremes. An analysis of the recent history on these matters would indicate that the do-nothing situation is likely to exist. Congress has been reluctant to take a protectionist stance, but political positions are subject to change. An interesting indicator of the government's mood is that the FCC's HDTV committee has an advisory group on consumer/trade issues.

If Congress takes no action on the trade issue,

"Compromises based on today's screen sizes could result in embarrassing performance when viewed on tomorrow's HDTV-sized screens."

it is likely that the Japanese MUSE HDTV standard will be first out of the starting gate. Since MUSE is well down the development path for introduction as a Japanese DBS standard, TV receivers, tape and disc machines will be available for export. These can be expected to first reach the United States in about 1990. If the U.S. economy is in a boom period and compelling programming is made available on disc and tape, this hardware may find market acceptance. Once a suitable population of equipment is in place, broadcasters, cable and perhaps DBS will want to take advantage of it. Thus, MUSE could become a de facto standard independent of whether other standards are officially adopted.

What kinds of congressional action are possible? Really drastic action might prohibit the sale of any equipment built to any standard other than the standard chosen for the United States. However, this is unlikely. Less drastic action might require that all receivers also work on the "U.S. standard." Perhaps the mildest effective action would simply require baseband video inputs so that external adapters could easily interface to the display.

Cable issues

Some of the respondents to the NOI have argued that there should be only one transmission standard for cable and broadcast. Probably the most important cable issue is that cable must be free to compete with discs, tapes and DBS by whatever technology it can apply. Cable must not have an artificial ceiling imposed on its technical ability to compete.

The second most important cable issue involves "must-carry." While the current must-carry rules have been invalidated by the U.S. Court of Appeals, any similar rules adopted in the future must not require cable systems to involuntarily allocate more than the present 6 MHz to the broadcast signals carried. Of course, cable operators will deliver the signals their subscribers desire in the format they demand; that's just good business practice.

Probably the third most important cable issue is that any enhanced NTSC system adopted for broadcast must be compatible with cable practice. This means that acceptable pictures will be delivered over cable to both existing TV receivers and to new enhanced receivers without significant modification of cable practice or plant. Adapter boxes must be avoided.