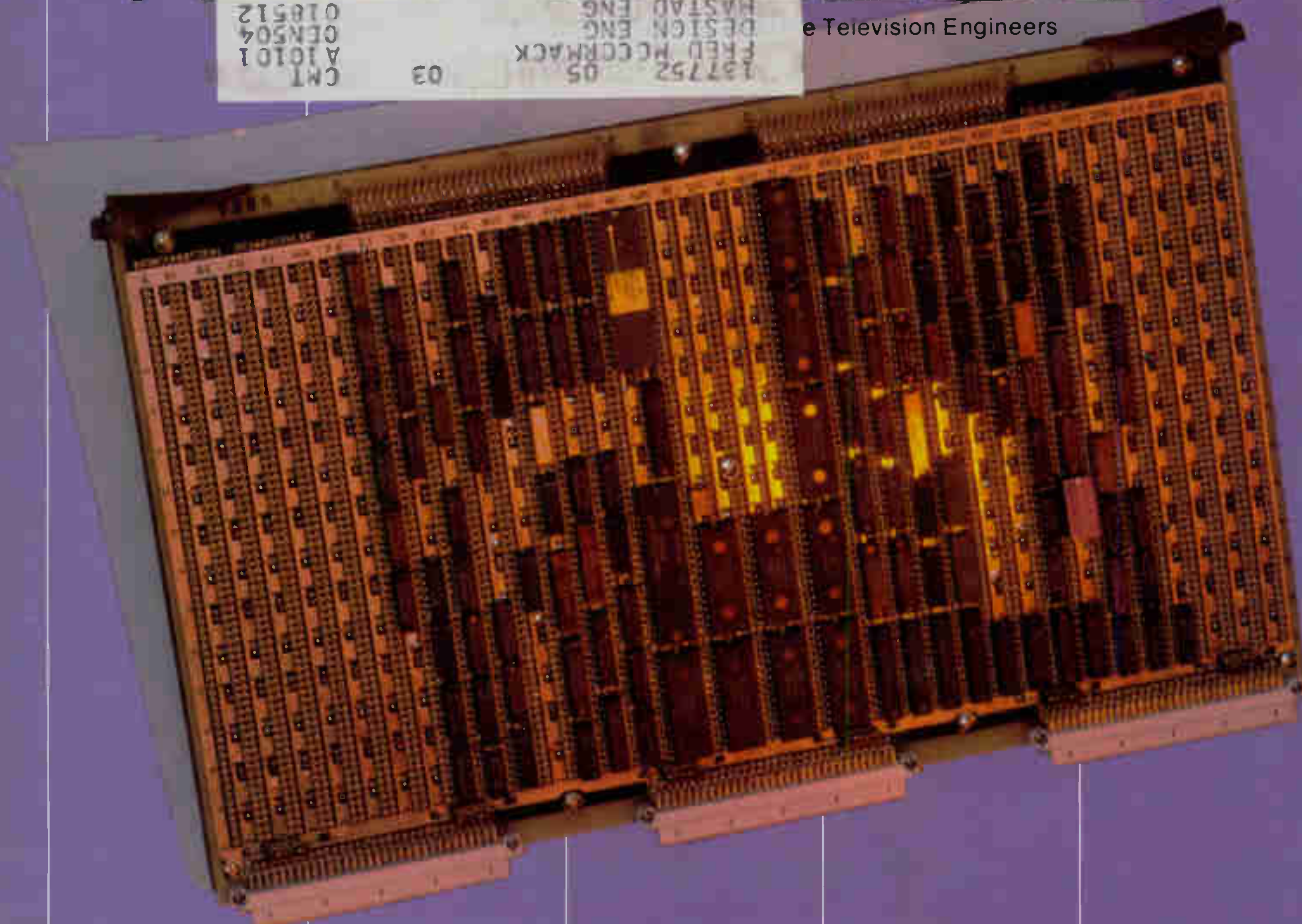
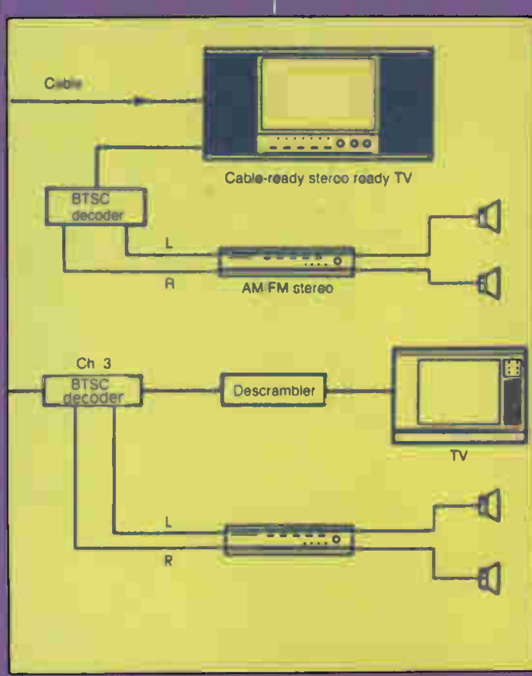
COMMUNICATIONS TECHNOLOGY

e Television Engineers



Data on cable: Implementation and reliability



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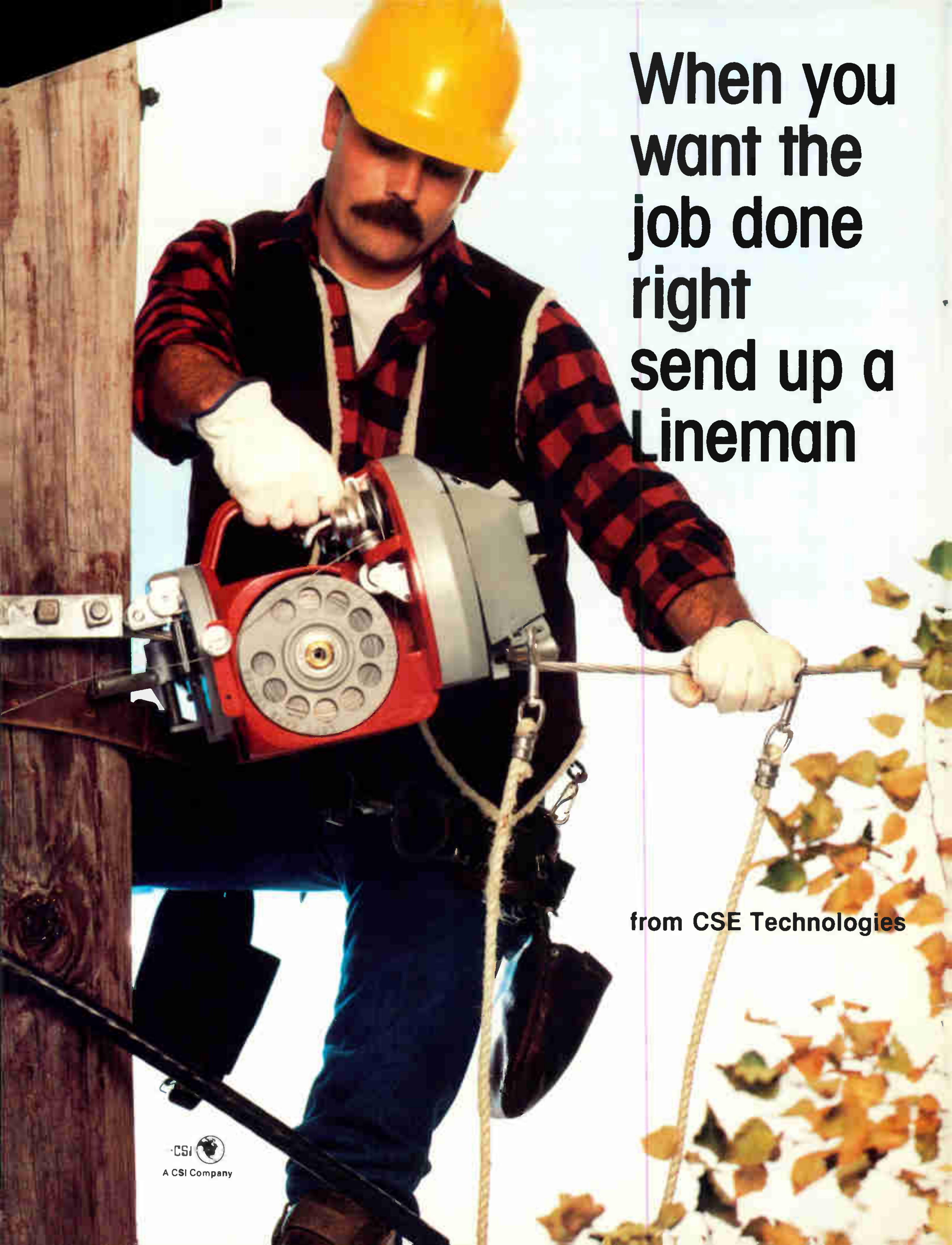
May 1986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CONTENTS

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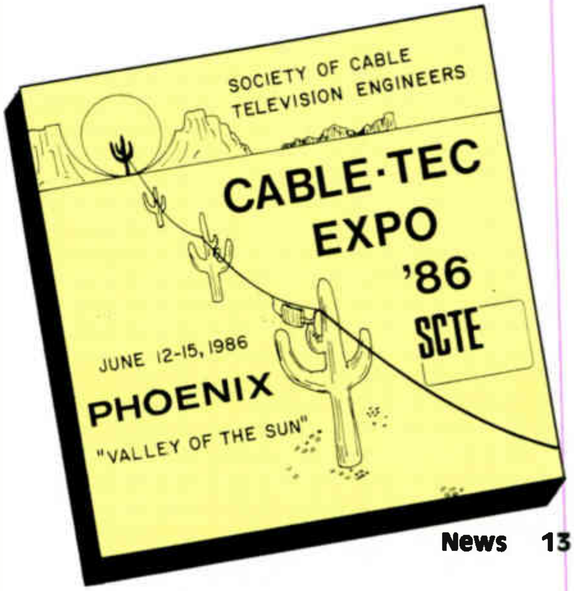

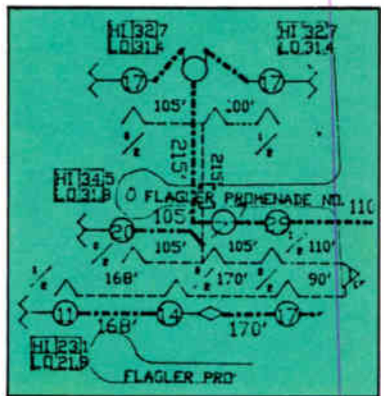

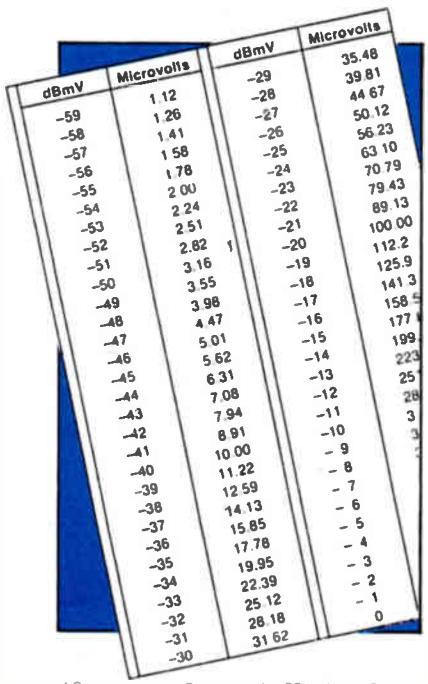

Features

Cover
Photograph of the QuickData user processor board courtesy of CableData.

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GENERAL INSTRUMENT

EDITOR'S LETTER

Knowledge is power

Once again, it's time for cable industry engineers and technicians to whet their appetites and get a handle on what's happening technically in our industry. The event, of course, is the Cable-Tec Expo, which will be held June 12-15 at the convention center in Phoenix.

As far as the engineering community is concerned, the expo is the most important show of the year. You don't have the programmers' hoopla, the gala receptions and fanfare that accompany a national show. At other major shows, multiple system operators usually send one or two key engineers to track what's going on. And the technical sessions usually pinpoint the emerging technologies like stereo TV and pay-per-view. That's as it should be. However, the problem is that most industry engineers and technicians don't get to go to these shows, and the technical level is not hands-on training.

MSO alert

Many MSOs still believe the Cable-Tec Expo is just another seminar on multichannel sound. Wrong! The focus of this show is training. It's also not just party time. There is more technical training going on per square inch than you can find anywhere in the industry. After all, in mid-June in Phoenix, there are not many tourist attractions to distract attendees.

While MSOs should know how critical it is for engineers to attend the expo, we polled some manufacturers and others for their views on attending this invaluable show.

What the vendors say

Rex Porter, vice president of Times Fiber, stated, "It's the only engineering show in town. The other shows have gotten away from the basic engineering training that the SCTE does. The SCTE expo is a meeting of the minds. I would exhort MSOs to send their engineers. It's the only chance for an engineer to spend 100 percent of his time attending technical training."

According to Graham Stubbs, vice president of science and technology for Oak Industries, "To me, the value of the expo is exposing system level engineers and technicians to the variety of equipment that is used in the industry. A lot of times," Stubbs explained, "an engineer or technician will become used to just the specific products that happen to be used in his system."

Jon Ridley, applications engineer for Jerrold Electronics, advised, "Cable-Tec Expo is the one event each year during which hardware and systems manufacturers address themselves totally to the need of engineers and technicians. It is a unique opportunity for CATV technical people, an educational and informational supermarket."

Scientific-Atlanta's James Farmer, division technical manager for the Broadband Communications Group, commented, "Broadband coaxial cable is a high-technology business facing severe competition from other high-tech businesses such as VCRs and satellite direct-to-home. In order to stay ahead of the competition, we must keep abreast of the latest techniques for delivering the best possible pictures."

Wendell Bailey, vice president of science and technology for the National Cable Television Association (NCTA), stressed, "I think the expo is valuable and the reason is, not only do you meet the people who will be dealing with your product there but in the sessions and exhibit floor you'll find out what is of interest to the people who make decisions in your marketplace."

Wavetek's Jim Harris, engineering manager, gave us his views. "We at Wavetek are sending several people, including our product manager exclusively in charge of CATV products. To be able to talk on an engineering level, avoiding all the sales hype, is invaluable. Plus, of course, the technical seminars which are all-necessary for the professional."

Ron Polomsky, General Electric's sales manager/instruments division, said, "I believe it's the very best opportunity for people working in the technical part of cable operations to both have an excellent learning opportunity through the extensive workshops that are offered, and also an opportunity to see exactly what's happening on the hardware side of the market."

Triple Crown's Dave Emberson, director of marketing, pulled no punches on his view of the expo. "The only thing I feel that is more important than the technicians going to the expo, talking to the vendors and listening to the sessions, is the exchange of experience they get talking to other technicians."

The bottom line is that by precluding system engineers and technicians from attending Cable-Tec Expo, we are only hurting ourselves. Engineers have been, and will always be, the backbone of our industry. After all, knowledge is power!

Toni I. Barnett

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SCTE Cable-Tec Expo highlights

EXTON, Pa.—The SCTE has promised busier days than ever before for this year's Cable-Tec Expo, in Phoenix, and a look at some of the daily highlights proves those promises to be more than just a lot of hot desert air! For more information on the Tec Expo, see pg. 84, for Bob Luff's column, and *The Interval*.

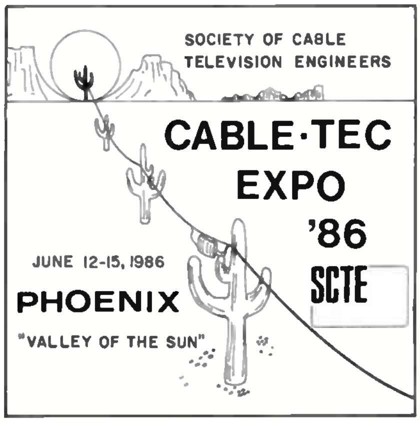
Those Tec Expo highlights include, on Thursday, June 12, the annual Spring Engineering Conference focusing on:

- increasing communication between management and engineering,
- grounding and bonding,
- pay-per-view revisited and
- developing technical management skills.

The luncheon speaker for Thursday will be James Mooney, president of the NCTA.

On Friday, June 13, and Saturday, June 14, breakout sessions will be held from 9 a.m. until noon. They include:

- developing an effective preventive maintenance program,
- video and audio signal sessions (preparation session for video and audio BCT/E certification),
- CPR and industrial first aid,
- basic electronics and electricity (sponsored by the National Cable Television Institute [NCTI]),
- implementation of stereo headend equipment,
- field intensity and RF field strengths,
- system sweep and analysis,



- new technology in system power supplies,
- commercial insertion equipment update and
- meet the FCC.

From 1-5 p.m. on Friday and Saturday, the exhibit floor will be open.

On Sunday, June 15, the program will be on developing SCTE local chapters, plus there will be BCT/E exams administered for two categories:

- distribution systems and
- video and audio origination.

The exams will cover both the technician's and engineer's levels.

There's still time to register for the expo, if you haven't already. For more information, circle #1 on the reader service card in this issue and just drop it in the mail.

MPAA, NCTA escalate combat of signal theft

WASHINGTON—The Motion Picture Association of America and the National Cable Television Association have jointly announced plans to expand efforts to combat theft of cable service through the Coalition Opposing Signal Theft (COST).

COST initially was formed 18 months ago by segments of the cable and motion picture industries as an informational resource group to aid cable operators in initiating programs to reduce signal theft. COST now will relocate from New York to Washington, where staff resources will be provided by the NCTA's newly formed Office of Cable Theft.

"There now are laws on the books in Washington and many of the states that clearly state that theft of service is wrong and illegal," said MPAA President Jack Valenti. "With the full weight of the cable and motion picture industries behind COST, I think we will soon see effective enforcement of these laws," Valenti added.

COST will draw upon the expertise of an advisory board whose members will be representatives of cable multiple system operators, pay services, basic services, the NCTA, MPAA, the Community Antenna Television Association, individual MPAA members and sports programmers.

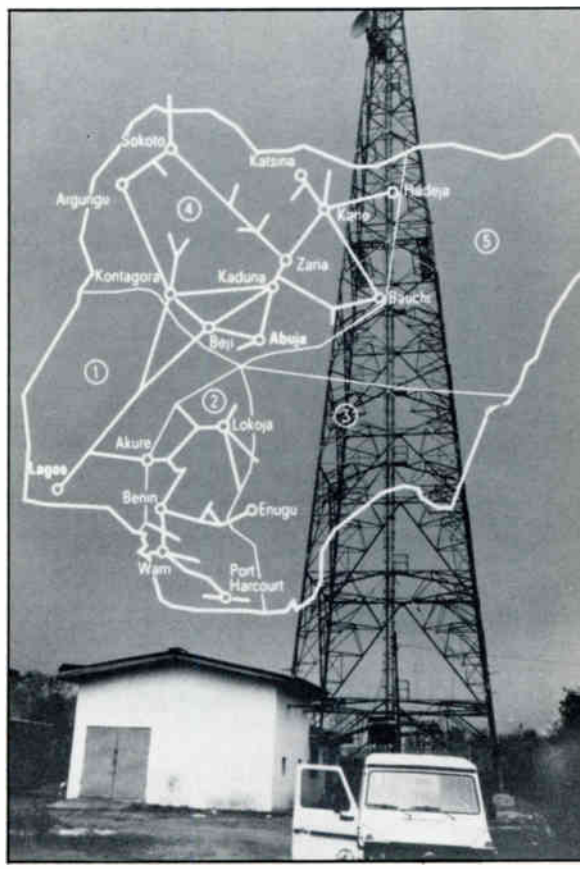
One of the key functions of COST will be to serve as a national clearinghouse to assemble and disseminate existing information and data that will help local cable operators conduct theft of service campaigns. Initial projects for the COST staff have been identified as assembly of an Industry Theft of Service Resource Packet, consolidation of existing audio/visual signal theft materials and establishment of state targets for model legislation. COST also will track legislation and litigation on the state level relating to theft of service. Formation of a three- to five-member executive committee and resource groups also will facilitate the implementation of COST programs.

A search is now underway for a director of the NCTA office, who will be director of COST. That person will be assisted by an assistant director of COST and a secretary. The COST staff will be employees of NCTA's Office of Cable Theft.

Nigerian communications project completed

MUNICH, West Germany—With 80 German and 600 Nigerian personnel, and during the course of 30 months, Siemens has carried out a major telecommunications project in Nigeria worth more than $180 million. In this short time a widely ramified radio relay network has been set up for television, telephone and telex transmission, covering two-fifths of the country and linking the south to its northern areas. A total of 300 kilometers of coaxial cable were laid and about 6,000 network kilometers of radio relay links have been installed.

The extreme climatic and geographical conditions — swamps, karst-like savannas or dense jungle — were formidable obstacles for engineers at the start of



One of the steel lattice towers erected in Nigeria that carry the antennas via which television, telephone and telex signals are transmitted.

planning. Access roads to the stations had to be built, and radio relay towers up to 140 meters high with their heavy concrete and steel foundations had to be erected. Repeater station buildings had to be built to house the generators for powering the radio systems, the air-conditioning systems that protect the electronic radio relay equipment and the batteries for emergency power supply. A total of 10,000 tons of steel for 110 radio relay antenna towers, 160 tons of paint, and all the electronic equipment (packed in 1,200 containers) for 190 stations was transported by ship to Lagos, the Nigerian capital and from there by truck into the interior to the stations' sites.

The Nigerian staff were given on-the-job training for skilled installation work. Basic skills, such as soldering, wiring and installation work required on-site instruction programs. Simultaneously, specialists held 18-month courses for about 200 employees of the Nigerian administration with theoretical and practical instruction in transmission, radio relay, coaxial cable and power supply technology.

Penn State receives $3.5 million in C-COR stock

UNIVERSITY PARK, Pa.—The Pennsylvania State University has received one of the largest gifts in its history — approximately 600,000 shares of C-COR Electronics stock, with a current market value of about $3.5 million, from James and Barbara Palmer of State College, Pa. Palmer was for 31 years chief executive officer of C-COR, a State College firm.

The Palmers' gift will be used for the expansion of the physical facilities of the University's Museum of Art ($2 million); and to establish an endowed professional chair in either electrical engineering or communications ($1 million). The Palmers have not yet determined whether the Palmer Chair will be established in the College of Engineering or the new School of Communications at Penn State. The gift also will be used to establish an endowment fund for Penn State's theater and to establish an endowed chair in electrical engineering at Iowa State University in Ames, from which the Palmers graduated.

Also at Penn State, E. Stratford Smith of Key West, Fla., a nationally prominent legal counsel in communications and a member of the Cable Television Pioneers, has been named first visiting lecturer in the lecture series of the new National Museum of Cable Television.

Cable computer interest growing

SAN FRANCISCO—Interest in cable-delivered computer-based information services is rapidly growing, according to a survey released by the ELRA Group. Seventy percent of heads of cable households now report that they are interested in videotex services delivered via cable. This is a doubling of interest in two years and rivals current interest levels for movies, news, music, sports and other popular cable programming forms. Videotex also appeals more to cable subscribers who spend fewer dollars monthly than non-videotex interested subscribers of pay services.

ELRA asked 1,000 respondents in its quarterly CableMark Probe survey about their interest in a cable videotex service

Nominations call for SCTE awards

JENKINTOWN, Pa.—The SCTE has launched a national call for entries for its 1986 achievement awards. The awards, intended to honor SCTE members who have shown dedication to improving their skills, as well as improving their company's services, will be given to those who have demonstrated this high level of personal achievement.

SCTE is encouraging self-nomination for these awards (see pages 49-50 of this issue for information and forms). The deadline for receipt of the entries is June 2. The decisions of the awards committee will be announced at the Cable-Tec Expo, June 12-15 in Phoenix.

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

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that would allow them to access newspaper features and information files and to send electronic mail messages. A price range of $15 to $20 per month was tested. Forty-five percent of all cable subscribers over age 11 were very interested and another 25 percent were somewhat interested.

To tap the potential market for computer-oriented services, cable operators may need to look beyond those who currently own personal computers. Computers tend to be concentrated in cable homes that are upscale, have larger families, multi-pay subscriptions and high VCR usage. About half the cable-computer homes have teenage children.

Jones sets fees for dish owners

ENGLEWOOD, Colo.—Jones Intercable Inc. has announced that the company will attempt to allow home satellite dish owners residing in its franchised areas to subscribe to scrambled cable television services at a monthly subscription fee no higher than that charged to its cable subscribers. The company also will work with TVRO dealers regarding the marketing of descrambling devices to their customers, and to provide an easy method for their customers to purchase its cable products.

Glenn Jones, president of the company, said, "We at Jones Intercable want to encourage everyone to receive cable programming, through whatever technology the consumer chooses. We support the involvement of TVRO dish owners and dealers who are willing to pay fair rates for premium service because they are an indispensable part of the communications revolution taking place in this country. Although in some respects they represent competition, it is also obvious that the broader the support base can be for good program production, the more quality programming we will have to deliver. It's America — we don't mind competition as long as it's fair."

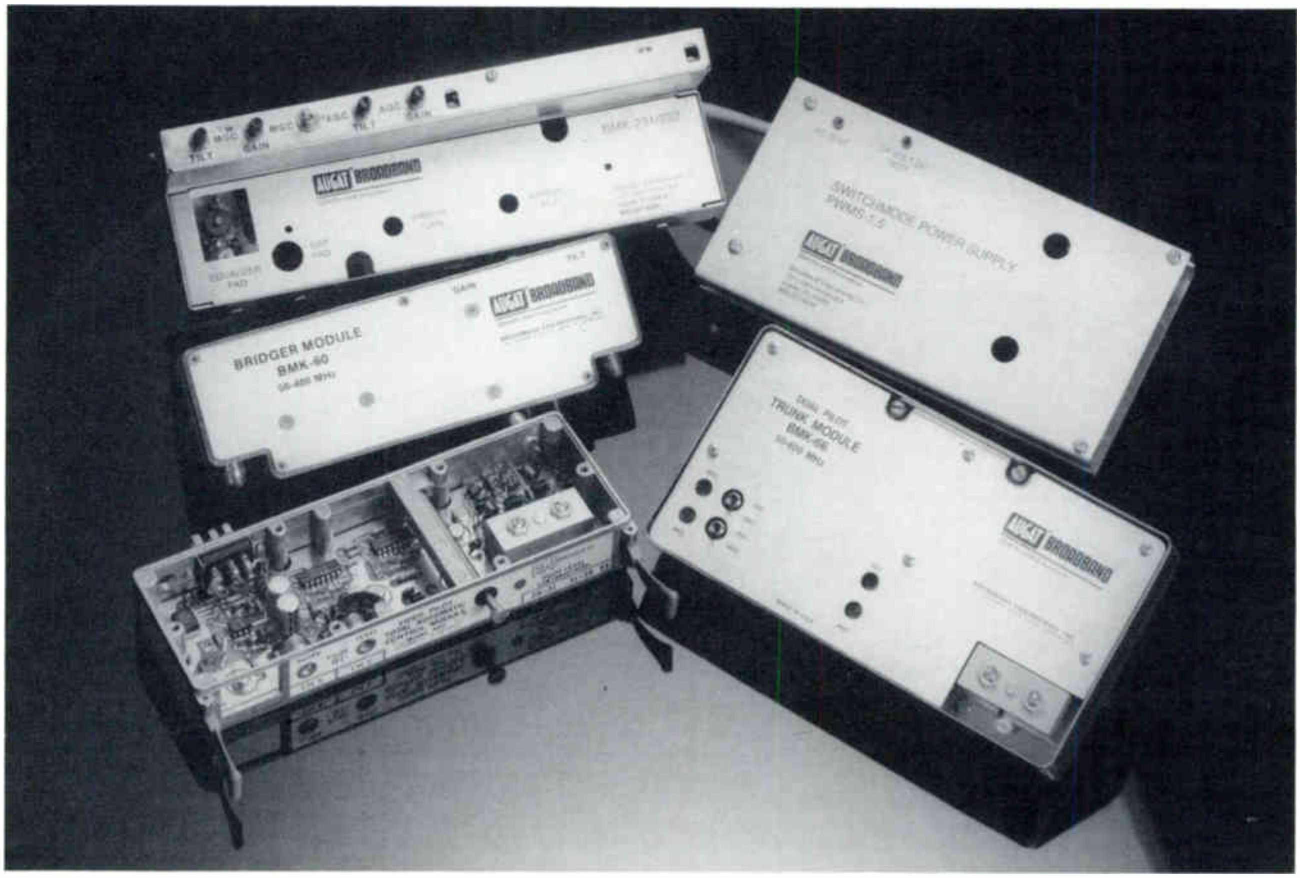
Wilcom, Cossor sign agreement

LACONIA, N.H.—Wilcom Products Inc. announced that it has signed an exclusive distributor agreement with Cossor Electronics Ltd., a subsidiary of Massachusetts-based Ratheon Co. According to the agreement, Wilcom will be the exclusive U.S. distributor of Cossor's fiber-optics test equipment.

Three models of Cossor's optical time domain reflectomers (OTDRs) will be made available: OFL-108, T313M and T313S. The OFL-108 is a general purpose OTDR for use with multi-mode fibers, including plastic clad silica (PCS) at 830 nanometers; the T313M operates on both single- and multi-mode fibers at 1,300 nanometers; and the T313S is used with 1,300 nanometer single-mode fiber.

NOTES

- Cable America Corp. (CAC) has opened a Western regional office in Phoenix. The new office is located at 9034 N. 23rd Ave. in Phoenix, and also will house CAC's Western marketing and operational functions. The telephone number is (602) 870-3145. CAC, headquartered at 4350 E. Camelback Rd. in Phoenix, owns and operates over 30 cable franchises throughout the Southern, Western, and Mid-Western states.
- Ben Hughes Communications Products Co., manufacturers of Cable Prep products, has moved to a new, expanded facility at 207 Middlesex Ave., P.O. Box 373, Chester, Conn. 06412. (203) 526-2291.
- Scientific-Atlanta Inc. has received an order from Harte-Hanks Cable for S-A's newest set-top terminal, the Model 8525. Harte-Hanks will use the products and remote controls in its Broomall and Lansdale, Pa., and Ocean Township, N.J., systems.



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

Technology drives the system, or does the system require new technology to meet its goal? If there is in place a usable TV technology, why should society displace the old for the new? If there are no complaints, why offer an answer before its time?

To the scientist, research is rewarding in and of itself, regardless of the boils it may raise in the body politic. Innovation follows a linear path only on the charts plotted by MBAs. Sometimes good ideas tumble over each other, snuffing out a viable technique before it can recover from the trauma of being the runt of the litter.

The compact disc (CD) explosion, which threatens to obliterate the LP, is a vivid example of what can take place in the unregulated sectors of the electronics world. But the technical revolutions are run in slow motion when they must pass the scrutiny of the FCC and its congressional masters. The programmed deliberations before the commission, and the consideration shown to every dissenting voice regarding the proposed report and orders, are necessary safeguards to assure an orderly transition from the old technologies to the new.

A troubling and largely unresolved problem with the FCC management on new technologies is the lack of long-range planning and research. On occasion, there will be a request for industry to form a study committee to formulate a consensus on an isolated subject in a form suitable for rulemaking by the FCC. Thus arose NTSC, CTAC, BTSC, ATSC, on all of which I devoted many hours, either as a member or as an observer. A common characteristic of all these study committees is the narrowness of their goals and objectives. This is not said as a criticism or carping at the results, but merely as my assessment of the way industry responds to the FCC needs.

The Advanced Television Study Committee (ATSC) is a currently active committee recognized by the FCC as the industry spokesman on new television systems. The industry participation is so universal that none can question its authority to act as the only fountainhead through which one may communicate with the Great White Father — the FCC. Why is high-definition TV their principal target? A very minor portion of the television public will benefit from this objective. The price of HDTV is out of the reach of your average citizen!

Multiplex TV

I have suggested in writing and in person that the committee study with equal energy another cloud on the horizon — multiplex TV. Why multiplex TV and not HDTV? In my opinion, it will arrive unheralded as did CD and unless it is encouraged and guided with love and affection, our presently entrenched TV delivery systems will collapse financially, leaving many citizens unserved during the transition period.

Multiplex TV research has long been with us. RCA publishes articles about two-channel transmission on one satellite channel. Thompson-CSF, Philips and NEC have demonstrated their dual-channel microwave links at the trade shows. GE is promoting Comband for the delivery of two channels on a single 6 MHz format. Even Blonder-Tongue demonstrated a two-channel B&W pay TV system back in 1957. The most impressive multichannel demonstration that I have witnessed was the dual program Philips E-Mac system. Philips engineers affirmed that it indeed could be expanded to four programs on a single satellite format at a quality level suitable for home display.

Add to the picture the imminent appearance of the redoubtable digital TV receiver with full-frame store. The slight loss in quality of the multiplexed picture will be more than compensated for by the superior presentation of progressive scan. Go to the demos; you will react as favorably as I did.

The bottom line: lower cost TV. DBS can appear on a single satellite having the capacity of 4 x 24 = 96 channels! Ultimately, with mass production, 12 GHz delivery, progressive scan, proprietary scrambling, MAC TV system, new non-NTSC TV receiver, all controlled by efficient central computers, the cost per channel will beat anything now operating. Plus, no snow, ghosts, outages, human frailties — just perfect pictures 99 percent of the time, for sure.

Like the CD story, the DBS multiplex TV revolution will arrive without notice. Unblessed by the FCC, eagerly embraced by the public and futilely cursed by its fallen competitors.

Data communications primer

By Robert Lottero
President, Northern Techology Inc

Only a handful of cable operators are currently using their system to transmit data. Why aren't more doing it? A possible explanation lies in two questions that anyone in management might rightly ask:

- Will the implementation of this application result in either savings or increased income sufficient to offset its installation and maintenance costs?
- Could this application in any way cause the company to be classified as a common carrier?

Unfortunately, most ideas die right there since all too many cable operators dismiss cable data communications categorically as not cost-effective and as an invitation to legal hassles over common carrier status. While many of the ideas for cable-based data systems are more reminiscent of franchising hype than solid business ventures, there are a number of applications that are practical, easily implemented and cost-effective today on existing two-way systems. Even operating a strictly one-way system is no excuse to ignore data. There are, at last count, 14 cable-based, one-way utility load management systems that have paid for themselves many times over by reducing electric utility generation and purchased power costs.

While there are many questions to be answered regarding the common carrier situation, there are cable-based data communications systems in operation today where there is no hint of a challenge either from regulatory agencies or private companies. The point of all this is not to suggest that the age of cable-based data communications is here, but rather that there are applications out there that can be of significant benefit to cable operators and will not result in costly legal problems. The trick is to identify and evaluate the ones that apply to your particular situation.

Modern technology

Data is transmitted over cable channels using modems. The word "modem" is a contraction of the two words, modulate and demodulate. A modem does for data what transmitters and receivers do for audio. The modem takes data output from a computer or terminal and modulates a carrier in a format capable of being demodulated at the receiving end by a remote modem, which then presents this data to the remote computer/terminal.

Depending on the data network configuration and modem type, a data channel capable of supporting either polled or point-to-point communications at data rates up to 19,200 baud will occupy 100 kHz of bandwidth. Currently available T1 modems allow telephone-equivalent T1 service (1,544,000 baud) in a 2 MHz channel.

Although there are a few possibilities for one-way data comunications, most of the applications that you will run into will require two-way. There are any number of vendors who will provide the equipment and engineering assistance; you may even have people with the requisite capabilities in-house. That's not the problem. Most of us cringe at the thought of maintaining a full two-way subscriber system with all the attendant ingress, cascade and balancing nightmares. There are, to be sure, techniques such as switched feeders and packet-switched data networks, but somehow that doesn't make us feel any better.

That's just the point, you may be grumbling. The time for full, two-way subscriber systems is not here yet. But actually, *none of the applications* with which I've been involved have required full two-way activation of either a subscriber or institutional network.

This is the "big secret" of cost-effective two-way data communications systems over cable. You target applications that require a minimal portion of the cable system to be activated two-way — just enough to support your application. For example, a headend-to-office data link can cost as little as $2,500 (materials and labor) and save over $4,000 annually in leased telephone data line charges in the first year.

Let's take a simple case where the office is located on a main trunk two miles from the headend. Modern line amplifiers are delivered with the appropriate filters in place so all that is necessary is to add a reverse module to every other amp (this means two, assuming that there are four amplifiers in the cascade), jumper the in-between amplifiers, and set the return levels. Come to think of it, that $2,500 estimate may be a bit high.

How do you find those applications that will be right for your company? Where do you look? Actually, you may not have to look; you just have to recognize the opportunity the next time it knocks. Most of the data communications applications that I've seen on cable systems were not "found" by the operator. In almost every case they emerged as the only reasonable solutions to problems.

Each of the following reasons for cable-based data communications may surface in your system in such a way that cable emerges as both the obvious and logical choice.

- *Refranchising* — During the late '70s and early '80s franchising era, many communities watched with envy as data communications channels were promised to communities "for the life of the franchise." Now it's time to refranchise in those communities and the community will expect you to deliver those services. They'll have specific applications identified in detail after reading all those old franchise proposals.
- *Contract requirement* — Many operators have specific language in their fran-

Case histories

Probably the best way to get a feel for how cable-based data communications applications are identified and implemented, is to analyze case histories of projects that are on-line and operating satisfactorily. Those systems include:

1) Rowley, Mass., where a pilot electric meter reading and appliance load monitoring system is in operation over American Cablesystems' subscriber network. This system utilizes the AM Cable/E-Com Tru-Net 500 system to read electric meters at 100 subscriber locations.

2) Hanover Park, Ill., where a polled water system supervisory control and data acquisition (SCADA) system is in operation over dedicated telephone lines. The system communications is to be converted to cable without any modifications in the SCADA hardware or software but by the direct substitution of Jerrold Metronet 1000 modems for existing telephone modems on Cablenet's institutional system. This is typical of many applications where existing telephone-based computer communications is to be converted to cable.

3) Boston, Mass., where a pilot project in public building security monitoring is operating over Cablevision's subscriber and institutional networks using the Cablebus Micro-2 security monitoring system. The goal is to replace citywide telephone-based municipal building security systems with a cable-based system.

4) Springfield, Mass., where Continental Cablevision is utilizing its subscriber and institutional networks for in-house data communications applications.

5) Boston, Mass., where city computer terminals are linked over Cablevision's institutional network using the Sytek LocalNet packet-switched data system.

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chise contract requiring that certain channels be set aside for municipal use. Few municipalities have asked that these channels be activated for data yet but the rapid proliferation of office automation systems is forcing a need for interconnection of building data systems. As the transmission of data over cable becomes more widespread, you can expect to receive inquiries from your franchises.

- *Bargaining chip* — Many times during negotiation with a municipality, it may be possible to provide data channels along with assistance in implementing an application, which could be of benefit to the community in exchange for concessions in other areas.
- *Cable company internal use* — There are a number of reasons why you may want to send data over your system for internal company purposes. Right now you are probably leasing telephone data circuits from your local telephone company at a cost of $500 to $5,000 annually. Several, if not all, of those leased telephone pairs are probably hung on the same poles that carry your cable along much the same path. The only difference is that your cable can provide a cleaner and faster (9,800 baud is considered high speed over telephone — cable has no trouble with speeds in excess of 1,000,000 baud) link at a much lower price. The annual "fee" is your internal carrying charge on the marginal investment to activate and maintain equipment and limited two-way for this purpose.

The two common needs most cable operators have is to establish data communications between the cable office and the headend, linking terminals with addressable converter controllers, and addressable controllers to billing computers.

Another use for office-to-headend communications is for security and level monitoring purposes. The headend could be monitored for vandalism, unauthorized entry, fire and environmental conditions. (Recent FCC regulations outlined in Docket #21006 impose frequency stability standards that can only be met by rigid control of the temperature at the headend.) The need to monitor and control levels at the headend is increasing, driven by a combination of new technologies and the desire to reduce manpower required for headend operation.

Other possible applications include linking computer terminals in several offices in an interconnected system, tying several independent headends and hubs together using a combination of two-way cable channels and two-way microwave links, and line amplifier status monitoring.

- *Channel leasing* — Of course the most talked about cable-based data communications applications is the leasing of channel space to others for profit. Due to the current uncertainty over common carrier classification, coupled with the attitude of telephone companies eager to protect what they regard as their turf, implementing a service of this type is not for the faint-of-heart.

While this is not to be considered a legal opinion, evidence indicates that you may not have to worry about common carrier hassles as long as your application does not involve multiple access. You should verify this before you try it, but as long as the application you are considering involves dedicated linking of specific sites (such as the interconnection of a bank's computer to its terminals at branch

Potential data customers

If your system is considering leasing channel space to others for data communications, you might include the following on your list of potential data service subscribers.

- Banks with branch offices
- Finance companies
- Retail chains
- Accountants who tie directly to clients' computers
- Stores linked to common computer services (e.g., credit card institutions)
- Computer data processing service organizations (e.g., payroll)
- Supervisory control and data acquisition (electric utilities, municipal water and sewer systems, gas companies, etc.)
- Traffic control
- Interconnection of local area networks between buildings
- Interconnection of energy management systems between buildings
- Interconnection of telephone systems between buildings

offices) you may not be classified as a common carrier.

As to the matter of dealing with the telephone companies, you may have to proceed carefully. However, as with any venture, the rewards may justify the risk. I will quote an unnamed official of a large West Coast telephone company who said to me, "If the cable companies ever figure out how much money they can make selling data channels, we're in trouble."

Guidelines

Before you rush out looking for data communications applications in your franchise, there are several points you may want to consider that can impact on the course you take in identifying and implementing data communications projects.

- *Cascade noise* — The trick to minimizing cascade noise problems on a subscriber system is to select only those applications that require small sections to be activated two-way so that the carrier-to-noise ratio can stay within the modem manufacturer's specifications. This will be a system-specific decision since no two systems will exhibit the same noise characteristics.

If it is necessary to implement a systemwide application over the subscriber network, you may have to look into techniques for switched feeders or packet-switched data transmission. You may confine all data to an institutional network where the limited number of ingress points together with smaller size and less active components will result in reduced cascade noise problems.

- *Reliability* — A major consideration in implementing any new cable-related service is an accurate assessment of the reliability requirements for the application. The standard of measurement to be used here is the reliability experienced using other commonly employed media. If you are considering replacing a telephone link between the headend and the office with a data channel on the subscriber network and you have experienced an average of three interruptions per month of one hour each, then that should be your yardstick.

The situation is different when you are providing data service to others for a fee. If the reliability of your system is not equal to or greater than that which a potential data service subscriber has experienced (or expects), then you have to factor in the increased cost of preventative maintenance and faster trouble call response to the cost of service.

It may be that while the system reliability is adequate for in-house purposes, the additional cost to provide the reliability level demanded by potential users may drive cost of service too high to offer competitive prices.

- *Phased implementation* — Since many different cable communications projects have been implemented in various systems around the country, chances are that with a little research you can pattern your project after a successful one and avoid some of the pitfalls of starting from scratch. This does not necessarily mean that it is a good idea to plan a full scale project from day one. Some of the techniques employed by others may be system-dependent and may not work for you. As with the practical application of any new technology, it pays to follow the safe route of feasibility study, pilot project and full scale.

The future

The cable television industry has done well providing the traditional information and entertainment programming services to subscribers. The future for a continuing market for these services looks bright, although there is a tendency to approach new services and/or cable uses with a "don't rock the boat" attitude. But the fact of the matter is that if a technology exists and is cost-effective, then the laws of the marketplace will ensure that it will be utilized. You may feel this pressure to provide cable data services whether or not you initiated it.

You can see that no matter what the community, there is a tremendous amount of potential here.

Industry Scrambles

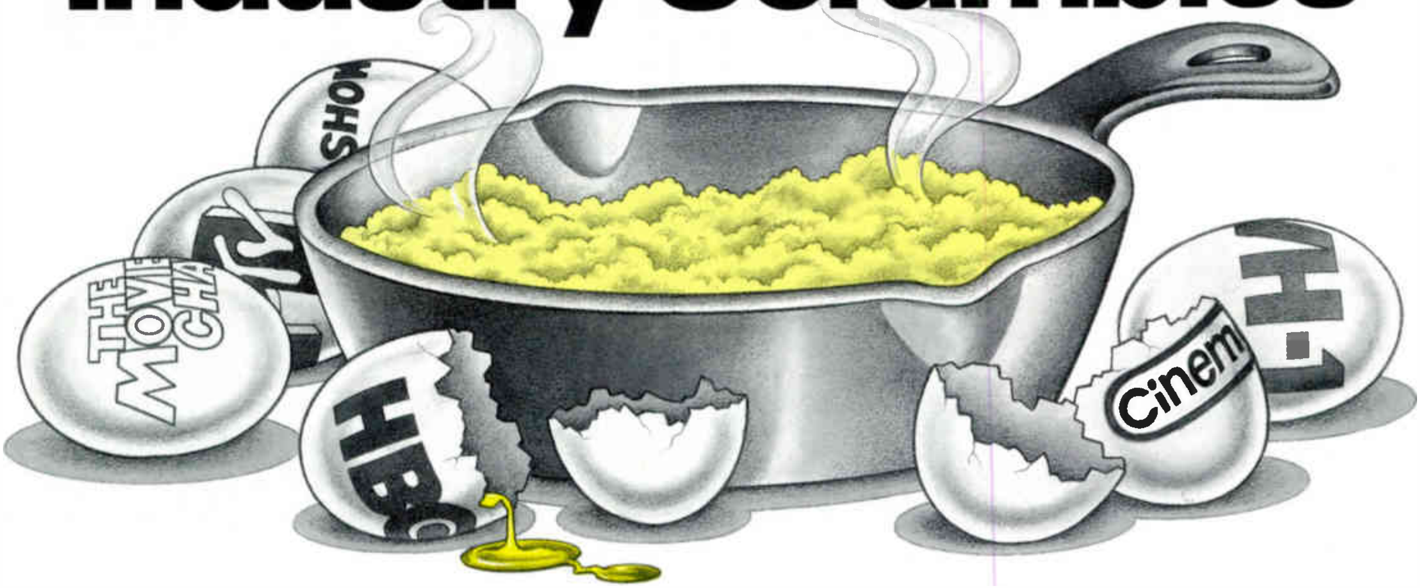

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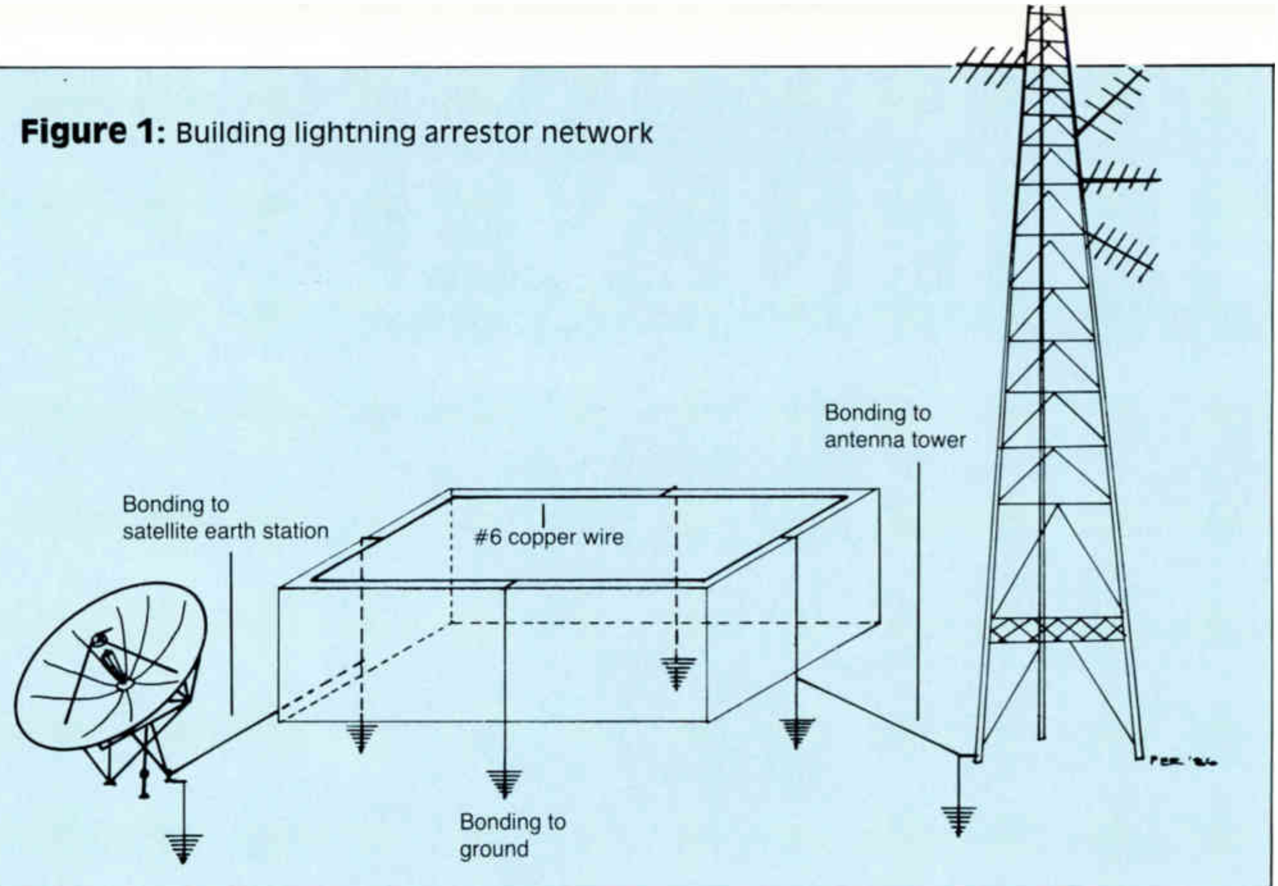
Figure 1: Building lightning arrestor network



Data terminal lightning protection

By Ralph A. Haimowitz
Director of Engineering, American Cablesystems of Florida

Here in South Florida we have the dubious honor of being one of the areas in this country to receive the highest number of lightning strikes per year, most of these occurring between June and September. A lot of people have written articles or discussed this phenomenon at various seminars, and the information has centered around protection of cable plant, earth station and headend equipment. This article is going to take an in-depth look at another victim of lightning — the computer data terminal.

We were experiencing numerous losses of data terminals on a routine basis. During a particularly severe thunderstorm one evening, we lost 20 terminals immediately (about 35 percent of the total number of terminals in operation), and had a residual loss of another seven or eight terminals over the next few days.

When I first arrived here and learned about the problems with the data terminals, I found that preliminary steps had been taken to provide some protection through the use of two- and four-receptacle plug-in power surge suppressors. These units plug into a standard three-prong AC outlet and have three stages of surge protection to reduce the probability of power surge damage through to the outlet receptacles. Our units, which are manufactured by Panamax of San Rafael, Calif., also provide noise filtration with noise reduction up to 70 dB, attenuating from 10 kHz to 100 MHz in 12 dB octaves from 50 kHz (see Table 1 for product specs).

I was impressed by the capabilities of these units and was surprised to find that standard procedure was to unplug the power cord from the AC and the data line from the terminal every time there was a thunderstorm and whenever the terminals were not in use in the evenings and on weekends. When I questioned this I found that we were still losing terminals at an extremely high rate during storm activity. Thanks to a technical seminar sponsored by the Florida Meeting Group of the Society of Cable Television Engineers, and Dr. Rodney Bent of Atlantic Scientific Corp., who presented the seminar on lightning and surge protection, we were able to solve our problems. (Bent will be appearing at Cable-Tec Expo '86 in Phoenix, Ariz., June 13-15.)

The causes of those problems were not just from electrical power surges through the power company's lines. Most of the damage done to our data terminals was caused by a voltage potential inductance into the data lines running through the building ceiling between the computer and the various data terminals. This type of problem can occur from a lightning strike that is more than a mile away from the building and equipment, and requires several different actions to provide maximum protection against damage.

First we needed to take a close look at how well we had covered the electrical power service in our building, and the effectiveness of proper building grounding. In addition to the continued use of the Panamax receptacle surge protectors, we also installed a General Electric surge suppression system across the *incoming* primary transformer winding of the incoming commercial power.

Lightning arrestor network

To reduce the inductive coupling of high voltage potentials into the wiring within the building, we installed a building lightning arrestor network. The old theory of a pointed lightning rod to ground for protection during storms turned out to be part of the problem, as it has a tendency to attract or create a lightning discharge. What we did was install #6 copper wire around the top edge of the entire building, bonded to a good, measured ground on each side of the building (see Figure 1).

This configuration would shunt the majority of any radical voltage potential induction from affecting the wiring in the ceiling of the building. To ensure that we would not encounter transient problems caused by potential differences, we also bonded the building together with the antenna tower and satellite earth stations as shown in Figure 1.

Table 1: MAX 2/MAX 4 specifications

Specification	Stage 1	Stage 2	Stage 3	Units
Clamping level	200 +5%	200 +10%	230 +15%	volts
Response time	5 pico	1 nano	1 nano	seconds
100 microsecond	45,000	2 million	1 million	watts
Power dissipation:				
Dynamic impedance	100	.05	.1	ohms
Rated energy dissipation	4.5	200	100	joules
Capacity	Maximum rating 15 amps			
Type of surge protection – transverse and common				

Finally, to protect the in-house computer and the data terminals from any stray voltage potentials that might possibly get through to the data lines, we put in additional surge protection into the data lines. At Bent's suggestion, we isolated each data line from both the computer and the terminal. On the computer side, where the data lines from the various terminals are connected to the computer interface board, we inserted a 232/VF/CL surge protector manufactured by Black Box Corp. of Pittsburgh.

The 232/VF/CL protects up to four lines to ground. The unit is a passive device in a thermoplastic enclosure. It has a response time of 1 picosecond, with power dissipation of 50,000 watts over 1 microsecond, a breakdown response at 28 volts, and a clamping response at 43 volts. Each unit (see accompanying photograph) is installed so that the protected end of the unit is connected to the computer, and the unprotected end is attached to data line going to the data terminal. The unit can accommodate wire sizes from 22 to 12 AWG and, since a separate device is required for each data line, they should be collocated so that the fifth terminals (ground) are interconnected and one lead connected to the building ground.

At the data terminal we installed the DataMAX RS-232-11, a surge protector built into a standard 25-pin RS-232 connector that provides surge protection for 11 of the most commonly used data transmission pins. This unit plugs directly into the input/output port of the data terminal, and the 10 semiconductor components clamp high-voltage spikes with 16 to 20 VDC clamping voltage at 1 mA, maximum surge current protection of 250 A (8 x 20 msec pulse), and maximum energy dissipation of 0.8 joules (2 msec). The Panamax DataMAX RS-232-11 has provided us with complete isolation of the data terminal from the data lines at a floating potential.

We no longer unplug our data terminals when they are not in use and so far we haven't lost a single data terminal because of power surges or storm activity. Altogether the cost was less than $200 per terminal, including the building protection.

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Reader Service Number 18.

Broadband LANs: Reliability considerations

By Geoffrey S. Roman
Vice President, LAN, General Instrument Jerrold Division

Broadband local area networks (LANs) offer the capability of supporting a multitude of simultaneous video, audio and data communication services on a single network. Given frequency channels or bands can be used independently to provide freedom to optimize the modulation technique and access protocol to best suit a particular service. Further, any frequency channel can be subdivided in time, using token bus, CSMA (carrier sense multiple access), polling or other techniques, to allow multiple users to share the channel, thus providing both increased throughput and varied connectivity.

However, as this single network becomes the transmission path for more and more of the information critical to an organization's operation, the need for that network to possess high reliability becomes increasingly critical. In addition to being reliable, meaning few failures occur, it must possess high availability, meaning those failures that do occur are quickly located and repaired.

Most broadband networks use access devices whose protocol is implemented on a decentralized basis or when central control is required. This controller is relatively simple and often redundant. Thus, failure of an individual device is unlikely to cause a disruption of all network services or even of a single service to all users as a whole. However, since all network services are available at all points in the network, failure of a portion of the distribution network can at the very least deprive some users of network service. In many actual installations a single failure can disrupt many or even all users.

Network failures can occur both as a result of a physical disruption of the network or as a device failure. The former issue is best dealt with by carefully planning the locations for devices and the routing of cables. This will not be addressed here. However, even with optimal device locations and routings, failures can still occur and several techniques can be used to minimize their impact. Device failures, although no more predictable, can be minimized as to impact through both component choice and system implementation.

Typical failures

The broadband distribution network uses cable television-type components with two devices, the amplifiers and the power supplies, which are the causes of most failures. Of the two, the power supply with a mean time between failures (MTBF) of five to 10 years is most likely to fail. Several currently available supplies better this value through added heatsinking, while operation in hot environments, poor air circulation and operation at less than the minimum current necessary to achieve regulation will result in reduced life.

Since the failure of a power supply or even its 120 volt AC source can cause the disruption of power to a number of amplifiers, guaranteeing power availability to all amplifiers is a priority. Two techniques are widely used. Where 120 volt AC power failure is unlikely, such as in systems where an uninterruptible power system (UPS) is in use, a system consisting of a power supply with a backup ferroresonant transformer or two separate power supplies and an automatic changeover relay is often used. When 120 volt AC power failure is not protected against by other means, a power supply with a battery backup is often the choice. Such power supplies typically provide for operation for a period of two to four hours or more — longer than the duration of most 120 volt power outages and long enough to locate and repair a ferroresonant transformer failure provided a monitoring system is installed to detect the failure.

When a battery supply is to be installed within a building, frequently the case in a LAN, it is important to check local building codes as they may restrict their use or dictate the type of battery.

Amplifiers have demonstrated a MTBF of about 50 years. With systems consisting of tens or even hundreds of amplifiers, however, the probability of an amplifier failure somewhere within the system is not as remote as the 50-year MTBF might imply. Therefore, in systems where the utmost in availability is required, highly featured amplifiers incorporating some form of redundance and status monitoring are often employed. Redundant amplifiers primarily offer backup capability in two forms: backup of the internal power supply that converts the 60 volt input power to the 24 volts DC required by the amplifier module and/or backup of the amplifier modules themselves. The user usually has the choice of implementing either feature separately or together. Furthermore, the forward and reverse trunk amplifiers and bridger amplifier also can be independently installed in a redundant mode allowing for implementation of redundancy only in the most critical portions of the network, if so desired, as a cost saving measure.

'(LANs) must possess high availability, meaning those failures that do occur are quickly located and repaired'

The cost of a fully redundant amplifier may appear expensive at first — costing two or more times as much as the non-redundant counterpart. However, when the cost of system down time — in terms of lost work time, interruption of critical processes, etc. — is considered, they often can become a bargain. Further, the distribution network is rarely a significant portion of the total system cost when the interface unit and data processing equipment are included. In any case, amplifier cost is rarely the significant cost contributor when compared to the distribution system and the labor associated with installation, particularly within buildings, is considered. Thus, redundancy is often provided at a cost delta of a few percent compared to the non-redundant system.

Redundant amplification

When using redundant amplification, it is important that the transition to the backup state is accomplished as smoothly as possible. For example, even the fastest switching devices can result in a momentary loss of signal. While this may be nearly imperceptible in a video program, at data rates of megabits per second this momentary interruption can result in the loss of device synchronization or of entire packets of information.

As an alternative to switching, two normally active amplifiers can be combined in parallel. In normal operation both amplifiers are functional and can be used to achieve improved system performance. When either module fails, signal level is reduced by 6 dB. This approach has several important advantages. First, the status of both modules is readily known; there is no risk of switching to a defective module and there is no need to disrupt communications to check a spare module. Second, there is no dependence upon a switching device, which can also fail, to perform a transfer and there is no loss of data during transition.

The 6 dB of signal loss is discernible in a reduction in video carrier-to-noise ratio but is rarely noticeable with data signals, which typically require lower signal-to-noise ratios and operate well above threshold. Further, since each amplifier module — trunk (forward and reverse) and bridging amplifier — is independently backed up, failure of one module will not have any adverse effect on the other paths. Repairs are accomplished by locating and replacing the failed module, which again can be accomplished without shutting down the system or further disrupting data flow.

As discussed earlier, high availability has two components: reliability and maintainability. Reliability is addressed during the selection of components and design of the system. The modular construction of amplifiers makes repair straightforward but addresses only part of the maintainability issue. The remaining part is the detection and location of a failure. Status monitoring systems address this requirement.

Status monitoring

Status monitoring systems for broadband networks have evolved considerably since they were introduced 10 years ago. Modules for monitoring the status of high featured amplifiers are most often built into the amplifier itself; stand-alone units are available for compatible installation in existing systems or with lower cost amplifiers for use at ends of distribution lines. Microcomputer-based central control is typically used allowing more data to be gathered for better prediction of failures and to prevent a "soft" failure from becoming a "hard" one.

The status monitor system provides for accurate measurement of forward and return signal level providing immediate indication of module failures and such soft failures as failure of the automatic gain control (AGC) or thermal compensation network. It can further provide information about temperature, power supply current and voltage, yielding further information about the cause of failure or conditions likely to yield a failure in the future. The system also can correct, for non-amplifier systems, related failures such as noise ingress by feeder attenuation. Inserting a 6 dB pad into successive feeders will cause a noise reduction at the headend when the feeder contributing noise to the system is located. The pad can be left in line or the feeder disconnected entirely until the source of ingress is located and the problem is corrected. Status monitoring also can control enhanced features such as station or return trunk bypass to completely remove a failed amplifier or module from the signal path while allowing for continued flow of critical communications. Amplifier status monitoring also can provide information pertaining to power module failure and station temperature.

The same status monitoring system can give information on the network power supplies. Monitored functions include output current, indicating network or component failure modes; information on battery charger status; and voltage and alarm status. The system provides instantaneous alert of power supply failure that was corrected by backup power supplies.

As status monitoring systems have advanced to use microcomputer headends, the information available to the system manager has increased. Various system parameter trends can be monitored over time and displayed to give data on performance characteristics changing with temperature or other external influences. Such systems also can accommodate multiple alarm thresholds to allow the system manager to know, before he dispatches a technician, the severity of the failure and permitting him to defer minor degradation until the next preventive maintenance cycle.

The state-of-the-art broadband transmission can provide for many capabilities to yield enhanced network reliability. These capabilities become increasingly important as the value of the network information increases. Many of these capabilities can be added modularly but it is important to keep network availability in mind from the inception of network design. ■

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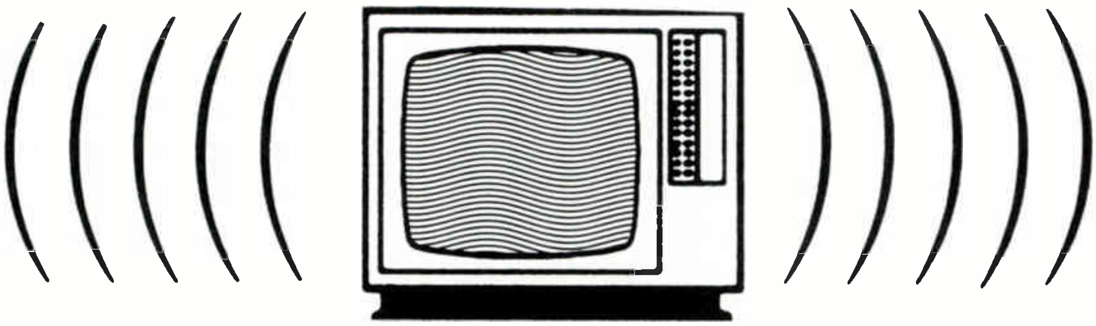


BTSC: The stereo for cable

Stereo programming is presently available to the cable operator. The enhanced entertainment value of stereo video programs should be provided to the cable subscriber as soon as possible in order to stay competitive. BTSC is the best choice of stereo formats for video program audio because of the ease of interface and compatibility, both in the headend and the home. Video buzz interference has been the major drawback to BTSC stereo, but it has been eliminated with the dual detector system. Other limitations, such as bandwidth and separation, are minimal and turn out to be audibly insignificant. BTSC stereo has a better dynamic range than the typical FM stereo receiver. BTSC requires no separate tuning system as out-of-band FM systems do, which makes BTSC the easiest to operate and the least expensive alternative.

By Clyde Robbins
General Instrument Corp

Quality stereo audio is a significant enhancement to the entertainment value of any video source. Cable television should be no exception. In a time when competition from videotape rentals is strong — many of which are in a hi-fi stereo format — cable must move quickly to provide stereo.

The BTSC format is compatible with broadcast, cable and home equipment. Broadcasters in many areas are presently transmitting in BTSC stereo, but their source of stereo programming is still limited. Cable operators have an advantage over broadcasters, in that many pay services are already available in stereo.

BTSC is the most convenient means available to the cable system operator for providing multichannel television sound. Passing the BTSC signal through to the subscriber on broadcast channels usually requires no changes. To put a satellite channel in BTSC stereo requires a subcarrier receiver and a BTSC encoder/modulator. The result of this small addition to the headend is an enhanced service that requires no truck rolls and no additional subscriber equipment provided by the cable operator. The subscriber interested in stereo may purchase a stereo TV or stereo adapter. The cable operator may choose to sell or lease stereo adapters. BTSC adapters do not require tracking tuning or separate tuning by the subscriber, as out-of-band stereo systems do. BTSC provides increased customer satisfaction and an opportunity for increased revenue and pay service retention.

BTSC has been criticized by some in the industry for being a system with inferior audio quality. The poor quality claimed is a result of early non-optimum encoders, modulators and inferior receiver designs, as well as improper equipment alignment and operation.

Video interference

Video interference has been the major limiting factor in the most BTSC measurements and listening tests. The primary prob-

Figure 1: Intercarrier detector

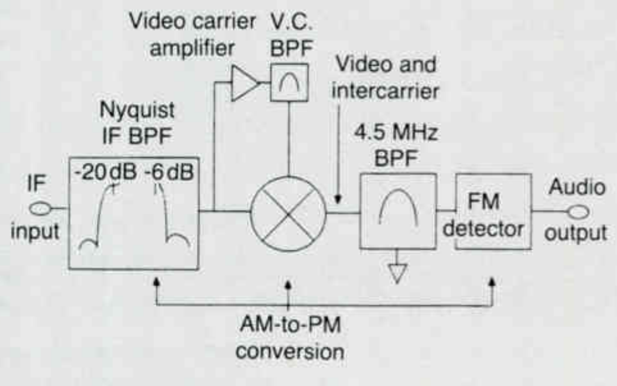
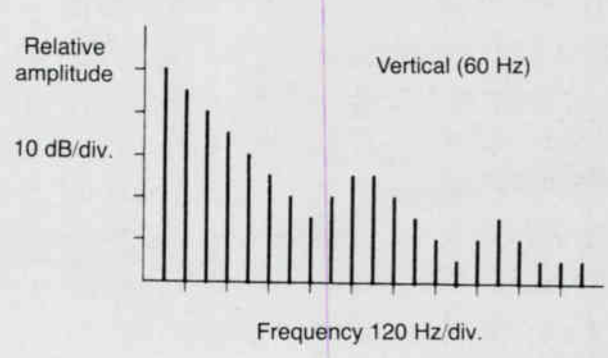


Figure 2: Vertical video interference



lem area is in the BTSC receiver, which exhibits high buzz interference levels. The buzz is a result of AM-to-PM conversion in the Nyquist intercarrier detection system commonly used (Figure 1). Some of the AM video modulation present on the video carrier is converted to phase modulation of the sound carrier in the detection process, which results in video spectra overlapping the audio information. This overlap occurs at video vertical rate (Figure 2) and harmonics, as well as horizontal rate (Figure 3) and harmonics. The horizontal interference also has vertical rate sidebands (Figure 4). Monaural TV receivers with small speakers were usually not bothered greatly by intercarrier buzz, having most of its energy outside the TV sound system's bandwidth on both ends.

There are techniques that reduce the level of the intercarrier buzz components. The quasi-parallel (Q-P) sound system (Figure 5) is significantly better than the Nyquist system because of

Figure 3: Horizontal video interference

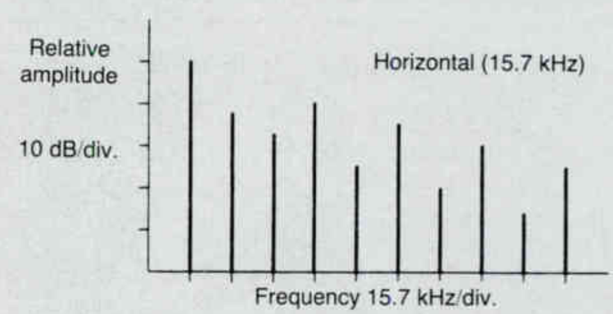


Figure 4: Horizontal video interference with vertical sidebands

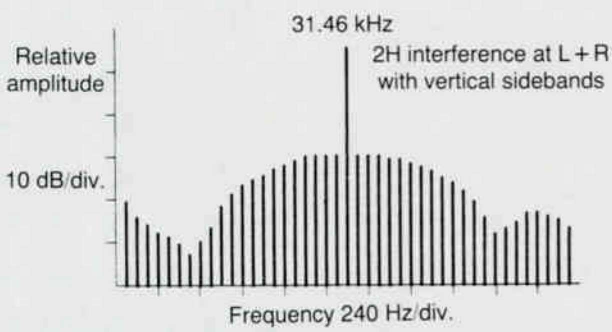


Figure 5: Quasi-parallel detector

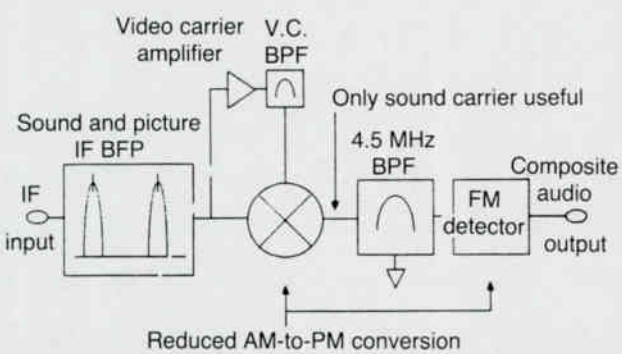


Figure 6: BTSC spectrum

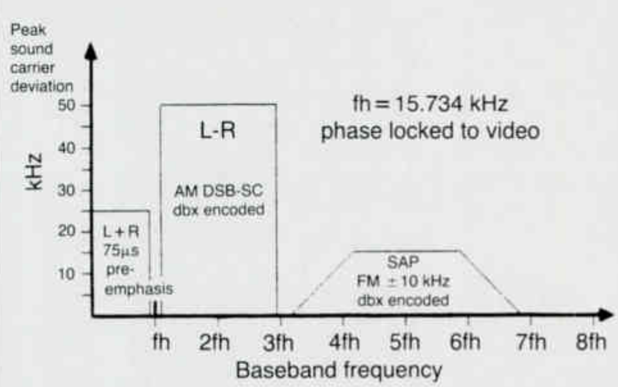
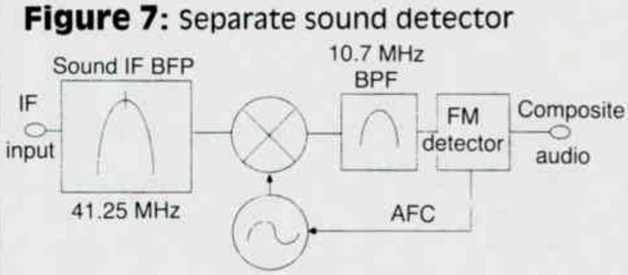


Figure 7: Separate sound detector



the reduced AM-to-PM conversion of the video carrier due to the symmetrical filtering. The choice of FM detectors also can have a significant impact on buzz level. AM rejection is very important.

Although the quasi-parallel technique is an improvement, it does not eliminate the video interference at horizontal frequency and its harmonics. Both the TV transmitter or modulator and the Q-P intercarrier receiver have residual levels of AM-to-PM conversion. The BTSC spectrum (Figure 6) pilot, L-R, and SAP carriers are centered exactly where the highest level of video interference falls. In order to achieve buzz-free stereo sound, another detection scheme is required. The obvious way to eliminate video interference is to detect the sound carrier independent of the video carrier. This approach is known as separate sound detection (Figure 7). This system works extremely well for high frequencies (i.e., pilot, L-R, SAP — Figure 8), but exhibits a severe problem at low frequencies (i.e., L + R — Figure 9). The low-frequency noise is a result of the oscillators used in the converter's tuning process. The separate sound detection system is unacceptable, except where oscillators of instrument grade phase cleanliness are used. This is not the case in CATV converters, TV receivers and sometimes TV modulators.

Dual detector system

A dual detector system is the solution of the conflicting problem of either high- or low-frequency noise by using both types of detectors simultaneously. A dual detector system consisting of a quasi-parallel detector for the L + R component and a separate sound detector for the pilot, L-R and SAP components gives superior performance. Not only is the buzz problem eliminated, but channel separation also is improved. Because there is no interference component falling on the pilot, its phase relationship to the L-R subcarrier remains unaltered. In addition, the bandwidths of the two receivers can be independently tailored for matched L + R and L-R delays. Figure 10 is a block diagram of one implementation of a dual detector BTSC stereo receiver.

BTSC receivers that do not use dual detectors still offer a substantial improvement in sound impression over the typical monaural TV receiver. The L-R buzz is usually well masked by the dbx noise reduction. The buzz is, however, audible, especially in intermittent quiet situations such as drama, sports dialogue or orchestra concerts. For BTSC to reach high-fidelity standards, a dual detector system is required.

The BTSC system has been compared with high-fidelity systems in the cable press, but the BTSC receivers used were not high-fidelity types. A high-fidelity BTSC receiver requires the same care as a high-fidelity broadcast FM receiver. Multiple ceramic filters for high-frequency video rejection, advanced quadrature or pulse-count FM detectors for high linearity and a linear multiplier for clean L-R detection would be required in order to compare apples-to-apples. However, BTSC, even in its inexpensive implementations, does exhibit one advantage over the majority of FM stereo receivers: The hiss level is much lower due to the dbx noise reduction. This reduced hiss is usually apparent even to the casual listener.

BTSC measurements are greatly enhanced by the use of a fast Fourier transform (FFT) spectrum analyzer. An FFT is superior to analog audio spectrum analyzers because of the very narrow resolution bandwidth achievable while maintaining rapid-display updates. An FFT spectrum analyzer is much more useful than a distortion analyzer because individual signal components are immediately distinguishable, rather than receiving one summation number.

Hum, buzz, harmonic distortion, spurious signals and random noise are immediately obvious on the FFT analyzer, but often are disguised by a total harmonic distortion plus noise (THD + N) reading. A THD + N of 0.5 percent may have pleasing sound quality or be annoying depending on the source of the 0.5 percent. Spurious signals 46 dB down are quite obvious against

Figure 8: Separate sound detector output — High frequency

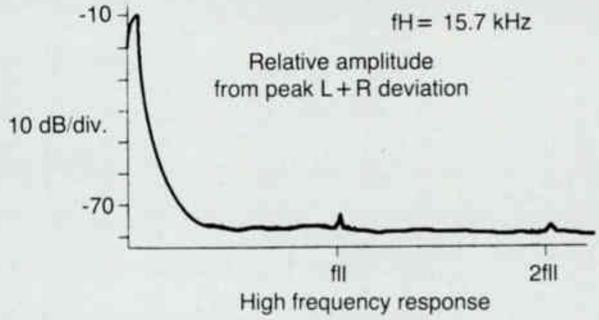
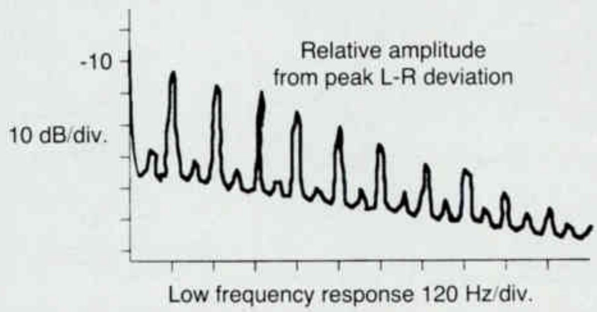


Figure 9: Separate sound detector output — Low frequency



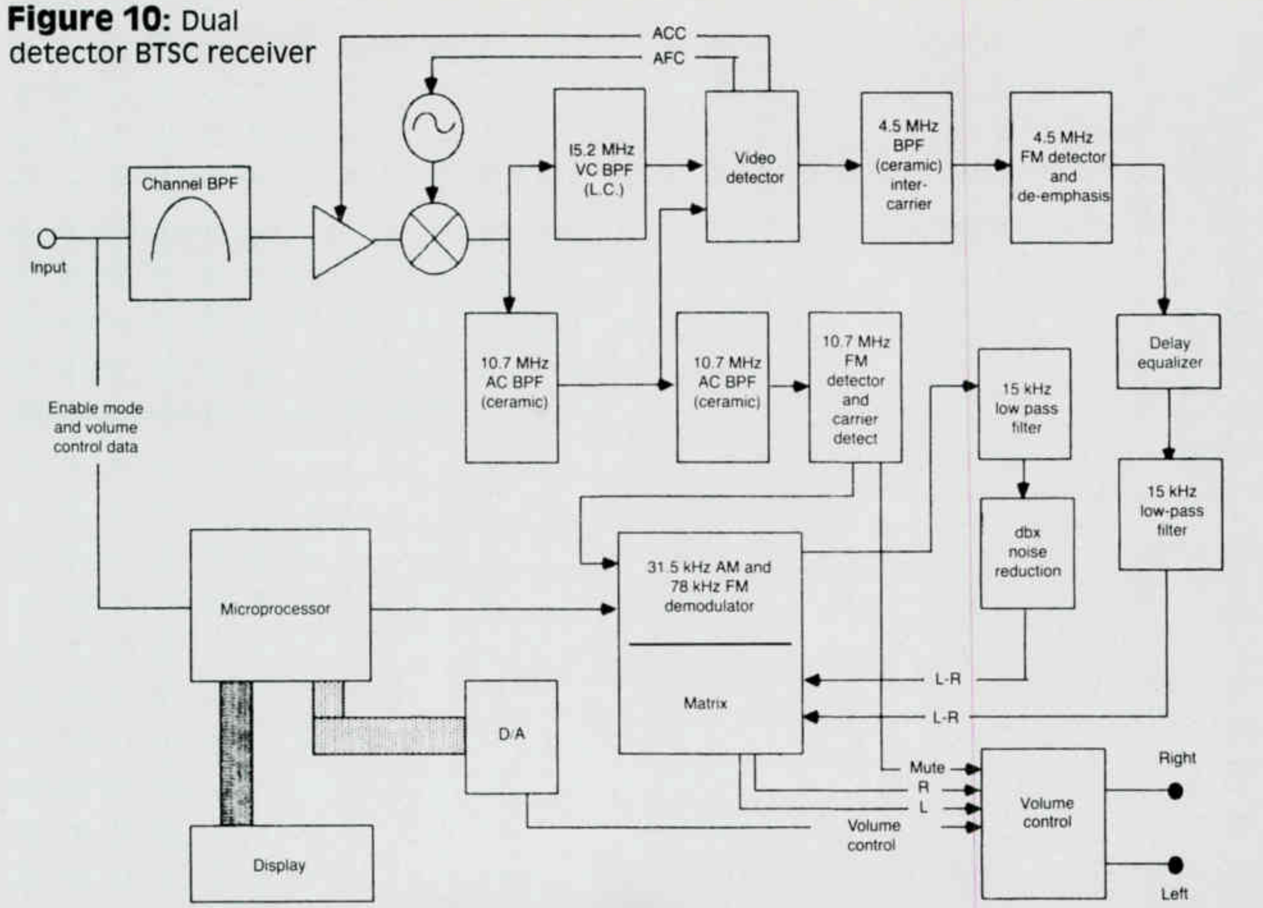
rather pure tones such as piano notes, but second harmonic distortion at the same level is not. For BTSC receivers, THD+N numbers do not tell the story. FFT spectrum analyzer photos say a lot.

Channel separation capabilities are limited in the BTSC system because only the L-R component is dbx processed. Any tracking errors in the noise-reduction processing reduces channel separation when the components are recombined to recover the left and right channels. Separation in practice generally will be greater than 20 dB over the frequency range where separation has significance, roughly 100 Hz to 8 kHz. This does not seem to be a very impressive number by comparison with other systems, but fortunately, the audible difference between 40 dB and 20 dB separation is rather insignificant.

The dynamic range of a currently available dual detector BTSC receiver is 65 dB at 1 kHz. This is by no means a theoretical system limitation. A higher cost implementation could certainly achieve further improvement. For cable applications with limited carrier-to-noise ratios (C/N), further improvement may be a bit academic. The signal-to-noise ratio (S/N) of the L+R component at 1 kHz with a video C/N of 40 dB and sound carrier 15 dB down should theoretically be 70 dB. The L-R component, however, would have only 43 dB S/N for the same conditions. The dbx noise-reduction system has a masking effect that generally provides about a 20 dB apparent improvement, giving the sound quality of 63 dB S/N.

The bandwidth of BTSC audio must be hard, limited to 15 kHz to prevent interaction of audio with the fH pilot. The net system -3 dB bandwidth, including the decoder, can easily achieve 13 kHz. Again, there is very little difference between the sound quality of the BTSC 13 kHz and the 15 kHz available in other systems. On the low-frequency end, BTSC audio is not limited in comparison with other systems.

Figure 10: Dual detector BTSC receiver



Summary

It is very important to realize that although BTSC does not challenge the specifications of compact disc players, it can provide good stereo sound for a theater-style effect. BTSC sound, in fact, is better than the audio reproduction capabilities in the vast majority of subscriber homes.

BTSC stereo is intended for video program audio rather than separate premium audio services. The ease of interface and low cost cannot be beat. If you are still not convinced that BTSC stereo is a major improvement to the entertainment value that can be delivered by cable, may I suggest that you perform the following experiment: Connect a BTSC stereo receiver to a quality stereo system. Watch and listen to *Miami Vice* broadcast from a stereo transmitter. You will most likely come away from the test wishing your TV screen was larger to match the depth and impression of your sound.

Acknowledgements

Thanks to General Instrument for supporting an extended investigation of BTSC receivers.

Thanks to Alps Electric Co. Ltd. for an economical implementation with superior performance.

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1 Carl G. Eilers and Pieter Fockens, "Television Multichannel Sound Broadcasting — A Proposal," *IEEE Transactions on Consumer Electronics*, Vol. CE-27, No. 3, August 1981

2 Multichannel Television Sound Transmission and Audio Processing Requirements for the BTSC Systems, *OST Bulletin* No. 60, April 1984, FCC, Office of Science & Technology, Authorization and Standards Division

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By Ron Hranac and Bruce Catter
Jones Intercable Inc.

The decibel can be used as a shorthand method of dealing with the sometimes unwieldy numbers occurring in everyday cable television operation. RF signal levels in a typical system, although relatively small voltages, are sometimes a bit clumsy to work with.

A trunk amplifier may operate with a nominal output of 39,810 microvolts; a line extender, 251,200 microvolts; and the signal level at a subscriber's TV set, 1,000 microvolts. But when we invoke the power of the decibel, these same voltages can be expressed as +32 dBmV, +48 dBmV, and 0 dBmV respectively!

The following table simplifies this conversion. A detailed explanation is on the back of this page.

dBmV to microvolt conversion table

(Reference level: 0 dBmV = 1,000 microvolts across 75 ohms)

dBmV	Microvolts	dBmV	Microvolts	dBmV	Microvolts	dBmV	Microvolts
−59	1.12	−29	35.48	1	1,122	31	35,480
−58	1.26	−28	39.81	2	1,259	32	39,810
−57	1.41	−27	44.67	3	1,413	33	44,670
−56	1.58	−26	50.12	4	1,585	34	50,120
−55	1.78	−25	56.23	5	1,778	35	56,230
−54	2.00	−24	63.10	6	1,995	36	63,100
−53	2.24	−23	70.79	7	2,239	37	70,790
−52	2.51	−22	79.43	8	2,512	38	79,430
−51	2.82	−21	89.13	9	2,818	39	89,130
−50	3.16	−20	100.00	10	3,162	40	100,000
−49	3.55	−19	112.2	11	3,548	41	112,200
−48	3.98	−18	125.9	12	3,981	42	125,900
−47	4.47	−17	141.3	13	4,467	43	141,300
−46	5.01	−16	158.5	14	5,012	44	158,500
−45	5.62	−15	177.8	15	5,623	45	177,800
−44	6.31	−14	199.5	16	6,310	46	199,500
−43	7.08	−13	223.9	17	7,079	47	223,900
−42	7.94	−12	251.2	18	7,943	48	251,200
−41	8.91	−11	281.8	19	8,913	49	281,800
−40	10.00	−10	316.2	20	10,000	50	316,200
−39	11.22	− 9	354.8	21	11,220	51	354,800
−38	12.59	− 8	398.1	22	12,590	52	398,100
−37	14.13	− 7	446.7	23	14,130	53	446,700
−36	15.85	− 6	501.2	24	15,850	54	501,200
−35	17.78	− 5	562.3	25	17,780	55	562,300
−34	19.95	− 4	631.0	26	19,950	56	631,000
−33	22.39	− 3	707.9	27	22,390	57	707,900
−32	25.12	− 2	794.3	28	25,120	58	794,300
−31	28.18	− 1	891.3	29	28,180	59	891,300
−30	31.62	0	1,000	30	31,620	60	1,000,000

An RF signal level expressed in microvolts is converted to dBmV using the formula:

$$\text{dBmV} = 20 \log \left(\frac{\text{microvolts}}{1{,}000} \right)$$

Example: Convert 8,913 microvolts to dBmV.

Solution:

$$\text{dBmV} = 20 \log \left(\frac{8{,}913}{1{,}000} \right)$$

$$= 20 \log (8.913)$$

$$= 20 (.9500239)$$

$$= 19$$

To convert dBmV to microvolts, use the formula:

$$\text{Microvolts} = 1{,}000 \times 10^{\frac{\text{dBmV}}{20}}$$

Example: Convert +19 dBmV to microvolts.

Solution:

$$\text{Microvolts} = 1{,}000 \times 10^{\frac{19}{20}}$$

$$= 1{,}000 \times 10^{0.95}$$

$$= 1{,}000 \times 8.913$$

$$= 8{,}913$$

Application:
Understanding these formulas and how to use a dBmV to microvolt conversion table is useful when performing signal leakage measurements. Signal leakage limits are usually expressed in microvolts per meter. To convert a measurement made in dBmV to microvolts per meter first requires changing from dBmV to microvolts. When this has been done, microvolts can then be changed to microvolts per meter using the formula:

Microvolts per meter = microvolts x 0.021 x frequency in MHz

Example: A leak is found that measures -22 dBmV at 121.25 MHz. What is this leak in microvolts per meter?

Solution: Use the chart (or the formula microvolts = $1{,}000 \times 10^{\frac{\text{dBmV}}{20}}$) to change -22 dBmV to microvolts (Answer: 79.43 microvolts); then convert to microvolts per meter using the above formula.

Microvolts per meter = 79.43 x 0.021 x 121.25 = 202.25 microvolts per meter

These formulas could be used to develop a dBmV to microvolts per meter conversion table for use in CLI monitoring. If, for example, you are using 108.25 MHz to perform leakage measurements, a table similar to the following could be created:

108.25 MHz	
dBmV	**Microvolts per meter**
-35	40.46
-34	45.47
-33	50.92
-32	57.06
-31	64.11
-30	71.83
-29	80.70
-28	90.48
-27	101.61
-26	113.89
-25	127.76

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ELIGIBILITY: All current SCTE National members are eligible to submit an award application or be nominated without limitation as to their job categories. Nominations may be made only by SCTE National, Chapter or Meeting Group members. For these national awards, there is no filing fee required for either applications or nominations.

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.

DEADLINE: All entries must be received by Monday, June 2, 1986 at the above SCTE Office address so as to be considered for the 1986 National Achievement Awards, which will be announced at the CABLE-TEC EXPO-86 scheduled for June 12-15, 1986 at Phoenix, Arizona.

ENTRY PROCEDURE

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.

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:
Attn: 1986 Awards Committee
Society of Cable Television Engineers
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West Chester, PA 19380

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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Please provide brief outline of your reasons for support of the nominee such as the following:
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(Use additional sheets if necessary)

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2) What contributions have you made to improve the service provided by your company?

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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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SCTE Member ☐ Yes ☐ No

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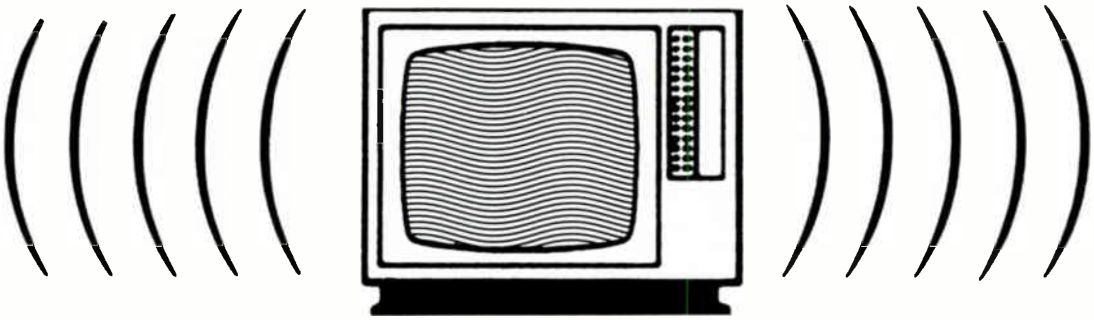


The Gillcable stereo television tests

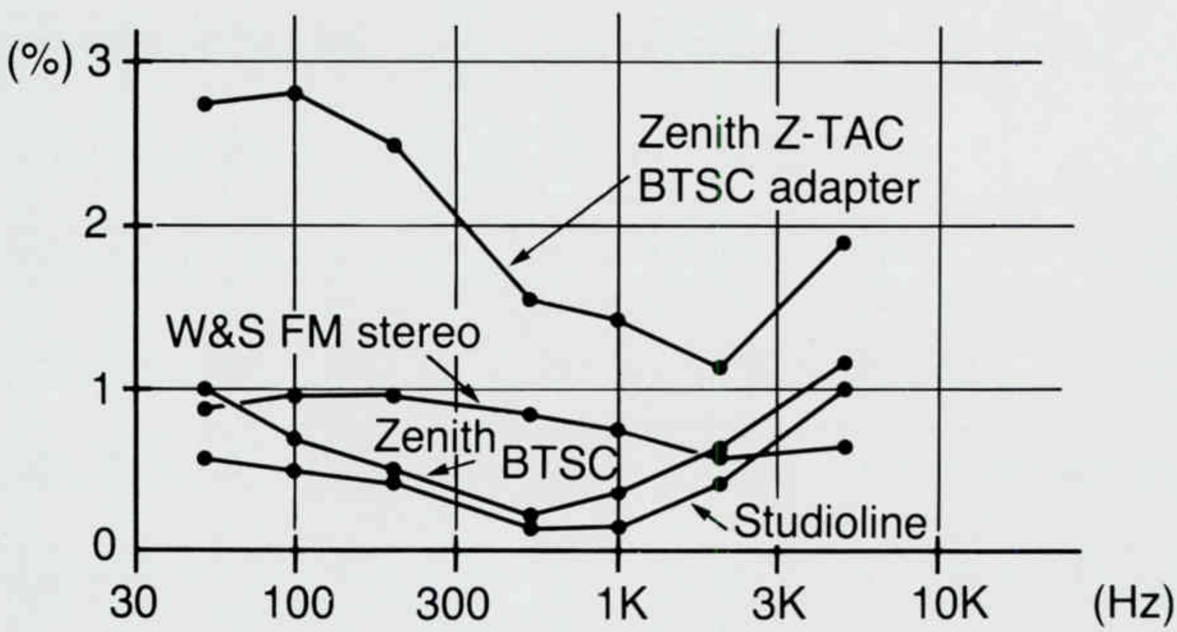
As an aid to its internal evaluation of possible technologies for delivering stereo television, Gillcable ran technical comparison tests of broadcast television (BTSC), FM and Studioline formats under actual system operating conditions. This paper details the results of those tests.

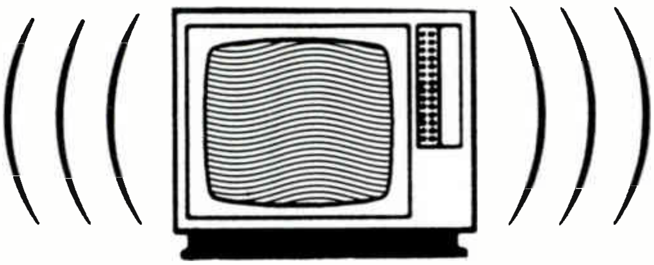
By David J. Large
Vice President, Engineering, Gillcable TV

The advent of broadcast stereo television has presented the cable industry with technical and marketing challenges of very serious proportions[1,2,3]. A full discussion of the issues is beyond the purpose of this paper; however, the principal concerns are:

- Incompatibility with existing scrambling systems.
- Incompatibility with baseband converters.
- Possible degradation of stereo separation in a cable system as a function of signal processing equipment.
- Degradation of signal-to-noise in a cable system due to cascaded transmission system noise and reduced aural carrier levels.

Figure 1: Harmonic distortion





- Miscellaneous other issues including compatibility with microwave transmission equipment, adjacent channel interference, etc.

In response, manufacturers of cable equipment have proposed solutions, including both equipment modifications to better handle the broadcast (or BTSC) format and equipment to allow operators to handle stereo sound via various out-of-channel schemes.

The FCC, faced with evidence of very high retrofit costs, decided not to rule at this time on the issue of whether cable operators would have to carry broadcast stereo in the transmitted format. The FCC's stated intent is to monitor the development of stereo in the marketplace with an eye to later rulings, if necessary[4]. The recent ruling of the D.C. Court of Appeals, overturning the must-carry rules in their entirety, may make the FCC issue moot; however, there still is to be heard the issue of whether stereo content of a broadcast signal may be modified in format without violating the integrity of the copyrighted product.

The SCTE stereo seminar

In January of this year, many of the industry's best authorities in the field gathered at a national SCTE-sponsored seminar to discuss both BTSC and alternate stereo technologies. Although attendees were exposed to many alternative strategies, there also was a distinct lack of field experience, largely unsupported conjecture on subscriber reactions and a lack of real apples-to-apples format comparisons. Based on the limited data available, there also were strongly differing opinions on the probable technical performance of various formats. Gillcable personnel, at least, felt that we did not have sufficient information to make an informed decision on a strategy for our company.

As a first step toward making that decision, Gill determined to run a carefully controlled comparison test including BTSC, FM multiplex and at least one of the advanced formats available. The test was to include both technical performance and subjective listening data. Included within the second were questions of cost and operating and equipment complexity associated with various schemes, as these are very important to the ultimate need to sell the technology to our customers.

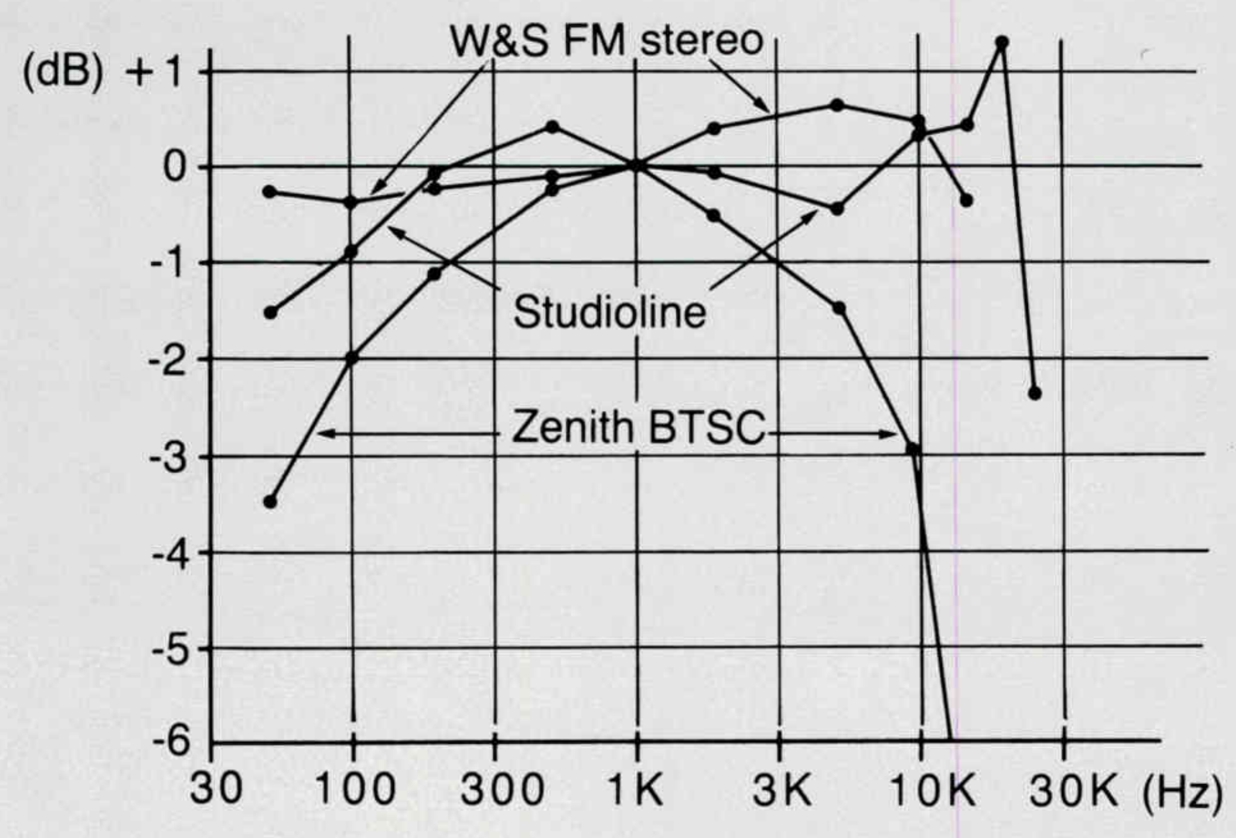
Equipment

The test configuration was designed for as much flexibility as possible and to provide a variety of equipment so that a particular format might not be judged on the basis of a single sample. To that end, the following were provided:

Signal sources—Video:
- VH-1 video
- Video test patterns from a Tektronix Model 149A generator
- Video from a Zenith Model VR-4000 VHS video tape recorder

Signal sources—Audio:
- VH-1 digital audio from a Wegener Model 1739-03 demodulator
- Hi-fi audio from the Zenith VCR
- Compact digital disk audio (Realistic Model CD-1000)
- Pink noise from a Heathkit Model AD-1309 generator

Figure 2: Frequency response



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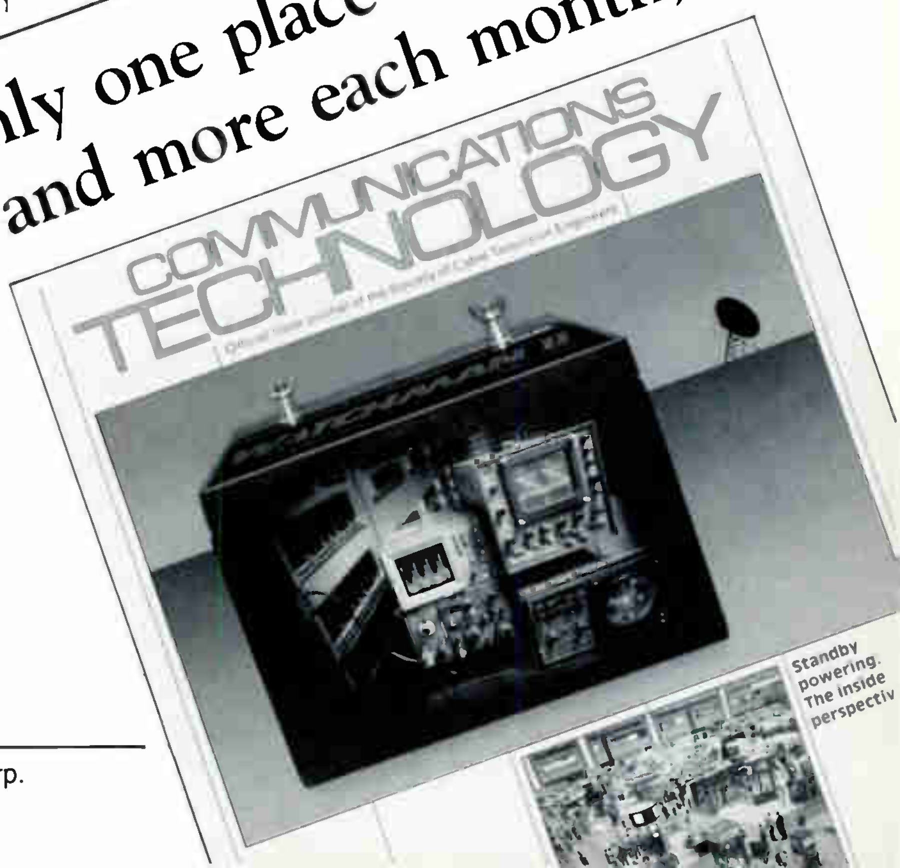

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Transmitters:
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- Scientific-Atlanta Model 6380 BTSC encoder
- Wegener Model 1691A FM modulator
- Leaming Model FMT615C FM modulator
- Leaming Model FMT652 Studioline modulator

Receivers:
- Zenith BTSC adaptor for Z-TAC premium decoder (prototype)
- Zenith Model CV524 BTSC adaptor for VCR
- Sony Model MLV1100 BTSC television adaptor
- Realistic Model STA110 FM receiver
- W&S Model SM2001 tracking FM stereo tuner
- Studioline receiver

Measurement equipment:
- Sound Technology Model 1710A audio distortion analyzer
- TFT Model 850 BTSC analyzer
- Heathkit Model AD1308 audio spectrum analyzer

The original intent to have multiple BTSC encoders available had to be scrapped as the Wegener unit was withdrawn from the test.

All sources were connected to a common audio distribution amplifier, then fed to the individual modulators. This allowed maximum flexibility in interchanging audio sources. At the receiving end, RF splitters and attenuators were used to feed RF to all equipment. All decoders were connected to an external switching box, then to the auxiliary input of the Realistic FM receiver. For subjective listening purposes, it was felt that this eliminated factors related to the amplification and speaker equipment. Technical data was generally taken at the output of the passive switching box to eliminate any possible noise contributions from the preamplification stages of the receiver.

Test conditions

In the Gill system, the earth station receiving site and laboratories are located approximately five miles from the headend. A transportation trunkline of 10 amplifiers' length connects them. For this test, the subcarriers of VH-1 were carried on a separate, dedicated Catel Model VFMS2000 video FM link. This allowed the deviation to be increased for maximum signal-to-noise without interaction with the video signal. VH-1 was chosen initially because of its superior format for satellite link transmission of audio.

The test point in the laboratories is located 12 amplifiers deep in the transmission system. The measured carrier-to-noise (C/N) ratio on the special video channel set up for the tests was 47 dB. This allowed tests to be made at various C/N ratios up to that level.

The aural carrier with BTSC encoding was at the normal 15 dB below the luminance carrier. FM multiplex transmission was carried 10 dB below video as is the standard at Gill. The Studioline transmission was carried 15 dB below video, even though the manufacturer claims satisfactory performance should be attainable with carriage 25 dB down. We felt that there was no point in needlessly degrading performance unless system loading factors required it.

Back-to-back tests were made with certain combinations of equipment to determine measurement capabilities. The results will be mentioned with the discussions of individual tests, where relevant.

Test results: Signal-to-noise

Since expected signal-to-noise performance was the area that engendered the greatest disagreement among the SCTE seminar participants, a great deal of attention was paid to these measurements[5,6]. Data was taken for all combinations of equipment under conditions of varying carrier-to-noise ratios.

In the case of BTSC, data was taken with various video conditions to measure the effect of buzz components on overall audio noise. This was done because the Electronic Industries Association's (EIA) earlier reported test results had shown significant noise increase in the presence of video, multipath and video transmitter incidental carrier phase modulation (ICPM)[7].

The measurement method used was to insert a 1 kHz tone into a given channel at a level sufficient to produce full modulation. After measurement of the recovered audio level, the tone was removed and the level of the remaining broadband noise was measured. We recognize that in systems using active noise-reduction circuitry (both BTSC and Studioline) this method does not measure instantaneous signal-to-noise, but rather dynamic range. However, we lacked equipment to do the more complex notched carrier noise measurements required for true signal-to-noise (S/N) measurements under those conditions. It also should be noted that our measurement method sums together both gaussian noise and discrete noise components (such as buzz components related to video) and should therefore be characterized as "signal-to-crud" ratio. This was felt to be acceptable since any audible spurious noise degrades the quality perception to a listener.

In all cases, measurements were made separately on left and right channels, averaged, and the results rounded to the nearest whole decibel.

The measurement test limit, determined by connecting the audio source through the distribution amplifier to the audio analyzer was 94 dB.

Several observations can be made about the test results. First, of course, is that the Studioline format performed very well in all cases. The lack of degradation as the carrier-to-noise ratio was decreased would seem to be an indication that internal Studioline equipment noise sources, rather than distribution system noise, is the limiting factor. This is borne out by the lack of significant change between back-to-back equipment connection (measured at 84 dB) and that through the 12-amplifier cascade.

Second, the BTSC quality in general also degraded more slowly than carrier-to-noise ratio. This would again seem to indicate that significant contributions to overall noise are internal to the equipment. The TFT Model 850 BTSC monitor measured a transmitted S/N ratio of 65 dB for the Scientific-Atlanta BTSC encoder.

Third, the FM multiplex signal degraded dB for dB with the decrease in system noise margin. This was the expected result, but caused FM to perform comparatively worse than BTSC in a noisy system. Results were not significantly different between the two FM receivers, nor between the two available modulators.

Subjectively, the differences in noise level between the BTSC and FM (at 47 dB C/N) were difficult to detect during active music programming of the type transmitted by VH-1. During quiet passages, however, both had detectable noise. In evaluating relative noise levels of these two formats, it should be kept in mind that during the test sequences the video modulation level was carefully controlled. Should video modulation exceed normal levels, significant sync buzz occurs in the BTSC signal (just as it now occurs in monaural sound) while the other formats are free from video side effects.

Looking to the future, notice should be taken of the proposed improved system for FM broadcasting proposed by the CBS Technology Center at the recent Chicago ICCE show. This technology holds the promise for an improvement in FM signal-to-noise ratio of 15 dB or more and would clearly give this format an advantage over BTSC[8].

Harmonic distortion

The second area in which measurements were taken was harmonic distortion of the audio signal in passing through the entire system. Measurements were taken with the audio analyzer and, in the case of BTSC, also with the TFT analyzer. In the former case the instrumentation limit was below 0.25 percent (generally below 0.15 percent) from 50-20,000 Hz. Video content during these measurements was active VH-1 video. As with noise measurements, data was taken for left and right channels and averaged.

Figure 1 shows the data taken with the audio analyzer for some of the equipment. As can readily be seen, selected samples of all formats achieved a distortion generally below 1 percent. For unknown reasons, the Zenith stereo adapter for the Z-TAC descrambler exhibited somewhat higher distortion.

Other combinations of FM modulators and tuners exhibited similar results with maximum distortion numbers under 1.5 percent in all cases. The Sony BTSC demodulator, though not plotted, had distortion numbers in the 1-2 percent range. Transmitted BTSC harmonic distortion was below 1 percent at all frequencies and below 0.5 percent from 200-2,000 Hz. In general, no clear pattern of preference for a particular format is obvious from our data. It appears that differences in individual equipments were more important than transmission type.

At the suggestion of one of the participants, BTSC total harmonic distortion was measured at 1 kHz as a function of video content with the following results:

	BTSC stereo adapter		
Video modulation:	Sony TV	Zenith VCR	Zenith Z-TAC
Black screen	1.6%	0.6%	1.5%
50 IRE gray screen	1.6%	1.0%	1.5%
White screen	2.8%	2.5%	2.5%
Color bars	2.0%	0.8%	2.0%

It appears that all of the tested decoders exhibited a degradation as a function of video content and level. Insertion of a 400 Hz high-pass filter in the measurement loop substantially decreased the readings in all cases, indicating that low frequency components were a major contributor.

Frequency response

Overall system gain as a function of frequency was measured for all systems using the distortion analyzer and precision oscillator. In the case of BTSC, the transmitted response also was plotted using the TFT analyzer. The test instrumentation was flat within 0.5 dB to 10 kHz, rolling off to 1.15 dB at 25 kHz. Figure 2 is a plot of several of the systems.

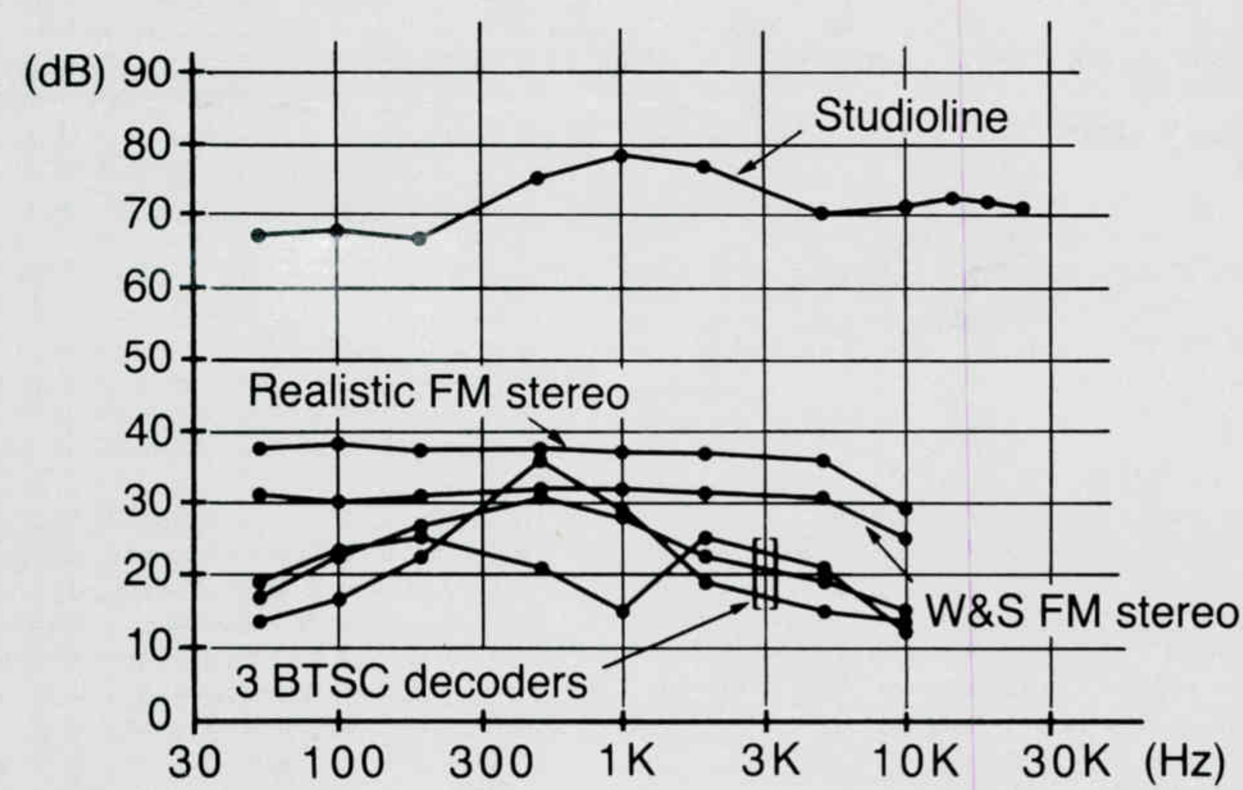
In the case of BTSC, the upper and lower 3 dB points are very similar for the Sony equipment. The Zenith VCR adapter is similar, except for less low-end rolloff. Interestingly enough, the transmitted BTSC signal was quite flat with no low-end rolloff and only 0.8 dB at 10 kHz. At 15 kHz, the transmitted signal was down 5.8 dB. It would seem, therefore, that the principal contributor to the relatively poor frequency response of the BTSC equipment was decoders rather than the encoder.

If this kind of suppressed low-frequency response is typical of BTSC decoders (perhaps in an attempt to diminish sync buzz), it perhaps offers an explanation of the "subjective loss of bass response" that was reported by the NCTA's observers in the Chicago tests last year.

The Realistic receiver was similar to the W&S receiver except for a 1.6 dB rolloff at 50 Hz and rapid rolloff after 10 kHz to 6 dB at 15 kHz.

In general, the FM proponents were superior to the BTSC and very similar to the Studioline except for that system's superior high-end response. (Continued on page 60.)

Figure 3: Stereo separation



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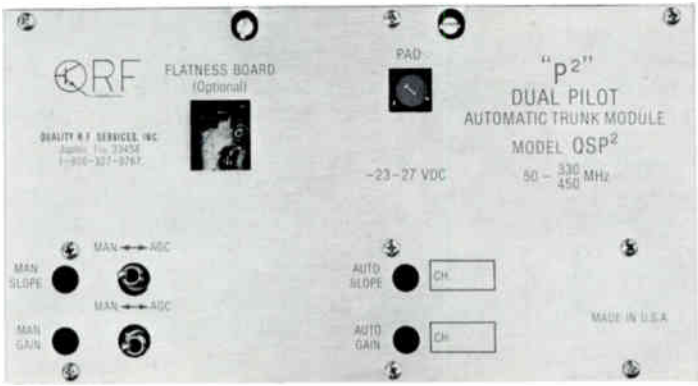

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Min. Full Gain dB	29 or 30	29 or 30	29 or 30	29 or 30	30	30	30	30
Gain Control Range dB	8	8	8	8	8	8	8	8
Slope Control Range dB	-1 to -7	-1 to -7	-1 to -7	-1 to -7	-2 to -8	-2 to -8	-2 to -8	-2 to -8
Control Pilots ASC: Turned to Ch.	"Q"	"Q"	"W"	"W"	"W"	"W"	"W"	"W"
Oper. Range dB	Selectable	Selectable	Selectable	Selectable	Selectable	Selectable	Selectable	Selectable
AGC: Turned to Ch.	4	4	4	4	—	—	—	—
Oper. Range dB	Selectable	Selectable	Selectable	Selectable	Selectable	Selectable	Selectable	Selectable
Return Loss dB	16	18	16	16	16	18	16	16
Noise Figure dB	6	6	6	6	6	6	6.5	6.5
Typical Oper. Level dBmV	34/30	34/30	34/30	34/30	35/30	35/30	35/30	35/30
Distortion at C/CTB	-93dB	-86dB	-92dB	-87dB	-91dB	-86dB	-89dB	-84dB
Typical Oper. XMod	-94dB	-89dB	-93dB	-86dB	-91dB	-86dB	-89dB	-84dB
levels 2nd order	-85dB	-82dB	-85dB	-82dB	-85dB	-82dB	-85dB	-82dB
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Note 2: Specifications should be referenced to the modules, not the connector chassis.

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(Continued from page 56.)

Stereo separation

Stereo separation is what differentiates stereo from monophonic transmission, although there is disagreement about how much separation is required or useful. The primary tool used for making separation measurements was the Sound Technology analyzer. Point-to-point measurements were made for a range of frequencies on each channel with the deviation set to 100 percent in each case. The channels were averaged and rounded to the nearest dB. In the case of BTSC, data also was taken with the TFT analyzer so that the transmitted separation could be measured independent of any decoder degradation.

Figure 3 is a graph of the significant results. The very high measured separation of the Studioline system was expected since that format uses independent RF carriers for the left and right channels. The graphed FM separation was taken using the Wegener FM modulator. Separation measured using the Realistic receiver and the Leaming modulator was degraded by approximately 13 dB compared to that measured using the Wegener modulator.

The most widely varying results were obtained using the various BTSC equipment. While the decoders agreed within reasonable limits at low and high audio frequencies, differences of the order of 15 dB were found in the critical mid-ranges, and the results were generally poor, compared with either of the other formats tested. Such variations presumedly result from phase and amplitude errors in the decoders either adding to or partially cancelling similar errors in the encoder. When the transmitter was measured with the TFT BTSC analyzer, the separation was found to be a uniform 21-24 dB from 50-1,000 Hz, falling smoothly to 15 dB at 10 kHz and a little over 9 dB at 15 kHz.

In defense of manufacturers of both BTSC encoders and decoders, there has been very little standard measuring equipment on the market to use in factory alignment of their products until the last few months. Hopefully the advent of the TFT and similar products will result in more consistent results in the future.

Nevertheless, the relatively poor showing of the BTSC contenders points out the weakest element in the BTSC system: the companding that is applied only to the L-R signal components in the encoding process. Any relative gain or phase errors between L+R and L-R portions of the aural signal between the encoder and decoder quickly degrade separation. Such errors can result from audio, IF, or RF filtering or any horizontal line rate signals adding to the pilot, for instance.

Finally, it should be pointed out that there is certainly an upper limit of usefulness in stereo separation, just as there is an upper limit of usefulness in S/N performance. Certainly, there is a psychoacoustic limit beyond which the human mind cannot detect further improvement, but more importantly, most television viewers will be listening to television through loudspeakers rather than headphones. In that environment, speaker quality, physical separation, room acoustics and listener location all act to limit achievable separation. A discussion of a reasonable electronic separation is beyond the scope of this paper, but readers are urged to review the materials published by such groups as the Audio Engineering Society for further information.

Baseband converters

Certainly, existing baseband converters are not compatible with BTSC stereo signals if they use audio demodulation and remodulation in order to achieve volume control and mute functions. Without giving up those functions or adding prohibitively to the cost by incorporation of BTSC decoders and encoders, the usual approach to stereo is to add an external BTSC decoder whose baseband audio outputs feed external sound amplification equipment[9].

Given that some systems or some customers may elect not to add the additional adapter, it is important to know what happens if a BTSC encoded signal is fed through a normal baseband converter and to a stereo television. Since the audio bandpass of the baseband converter may or may not pass the stereo pilot, but will surely not pass all of the L-R sideband, it would be expected that the result would not be identified as quality stereo.

We found that the Z-TAC decoder used for our tests passed a sufficient quantity of the pilot to light the stereo light on the Sony decoder. The resultant sound, compared to monaural sound, was nearly identical in our case, except for a slightly audible degradation in S/N. It would be dangerous, however, to draw conclusions about how other decoders or converters would act under similar circumstances.

Table 1: Audio signal-to-noise ratios

	Video carrier/noise ratio *		
	47 dB	**41 dB**	**35 dB**
Studioline	82 dB	82 dB	80 dB
FM-W&S receiver	59 dB		
FM-Realistic receiver	57 dB	49 dB	43 dB
BTSC-Zenith Z-TAC stereo adapter			
Blank black screen	52 dB		
Active video	55 dB		
"Buzz pattern"	52 dB		
BTSC-Zenith VCR stereo adapter			
Blank black screen	61 dB		
Active video	63 dB	60 dB	58 dB
"Buzz pattern"	58 dB		
BTSC-Sony TV stereo adapter			
Blank black screen	57 dB		
Active video	57 dB	53 dB	46 dB
"Buzz pattern"	53 dB		

* Other test carriers were varied accordingly.

High-level sweep interference

Given that many cable systems still use high-level interfering system sweep testing, the effect of such signals on the various contenders seemed relevant. Based on subjective judgments, the amount of "pop" audible in BTSC and FM systems was comparable and somewhat objectionable just as it is now in standard monaural television sound and simulcast FM. The Studioline system also reacted to the sweep, but its amplitude seemed to be lower and the duration somewhat longer. No conclusion was reached as to which result represented the highest degree of subscriber irritation.

Certainly, in evaluating other high-quality sound systems, such as digital, such interference and its effects should be evaluated. Perhaps the error correction schemes in digital systems will completely eliminate the audible effects.

Subjective observations

Carefully constructed subscriber listening tests will be conducted using this equipment under the auspices of American Television and Communications' (ATC) market research department to determine the reactions of non-expert observers to the various formats under various conditions. Those will be reported separately by ATC at some future time. Nevertheless, our panel of technical observers made a few subjective observations under conditions of live programming which may be of interest.

First, under high-average modulation-level conditions with typical VH-1 music programming, differences in S/N ratio were not obvious. When pauses in program audio occurred, though,

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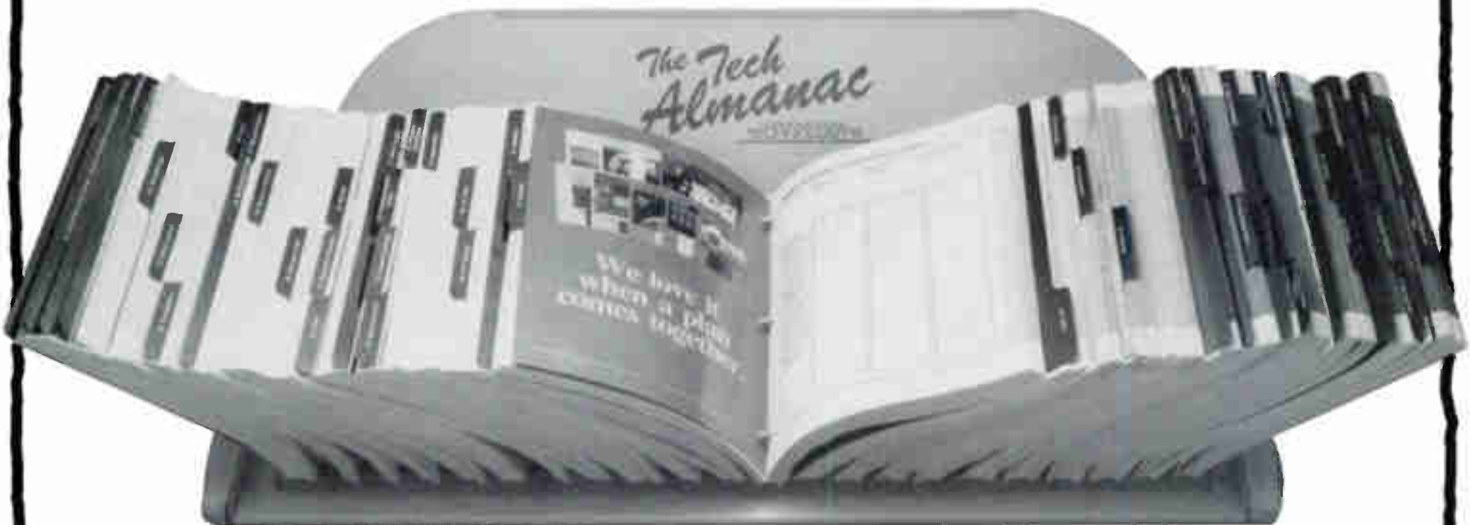

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the noise level in both FM and BTSC were noticeable and significantly higher than Studioline. Our observers did not note significant differences between FM and BTSC in this regard. Thus, while the relatively noisier formats may be adequate for popular music formats, only further tests will detect whether movie programming, for instance, will find listeners equally unaware of the differences.

Second, most observers were aware of a quality degradation when switching between either of the other formats and BTSC. It was variously described as a lack of "sharpness," "depth" and/or "crispness." Whether it was due to the lower separation or the inferior frequency response or some other factor could not be determined.

Third, none of the differences between formats was dramatic to a casual listener using loudspeakers. In all cases there was a significant loss of spatial feeling when switching to monaural, even using the same amplifier and speakers. Also, as expected, there was a significant improvement using the external audio system compared to the internal television speaker in the monaural mode.

As expected, the Studioline system far outperformed all other contenders in technical performance and seems to be a very durable system from the standpoint of distribution system degradation. FM simulcasting appears to have an advantage over BTSC, at least at this time, in stereo separation and the resistance of that separation to degradation. BTSC would seem to have a S/N advantage over FM under degraded signal conditions; however, widespread adoption of the new CBS technique for improved FM transmission would give FM a significant edge in the future.

The Gill stereo tests are certainly not a comprehensive test of even the three formats represented. Only one BTSC encoder was used, for instance, and a limited sampling of equipment for other formats. Also, the tests considered only the relatively technical merits of these formats. The upcoming ATC listening tests will complement the technical data by adding subscriber subjective reactions. Finally, the ATC engineering department intends to run tests concentrating on the BTSC format and will add useful information on such areas as specific degradations of BTSC due to various cable equipment. Engineers called upon to make choices of stereo format for their systems should review all the available literature carefully.

Acknowledgements

Many people participated in the Gill tests on various levels. Particular thanks should go to Wegener, Leaming, Studioline, Scientific-Atlanta, Zenith, TFT, W&S Systems and Bay Area Interconnect for the loan of equipment and particularly to the engineering personnel of those participants who spent the time to get the equipment to us and make sure it was running correctly. Walt Reames and his crew and Bill Kostka of the Gill engineering department contributed many hours to construction, coordination and taking of data. Finally, a special note of thanks is owed to Walt Colquitt of ATC and to Frank McClatchie for lending their time and expertise to the project.

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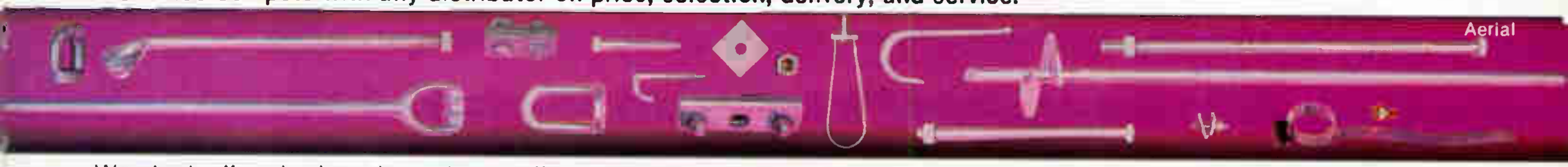

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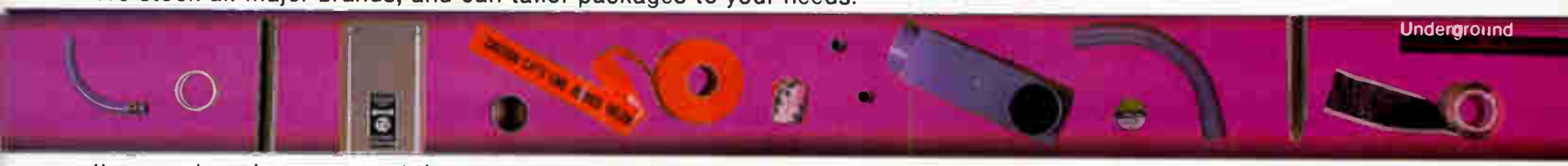

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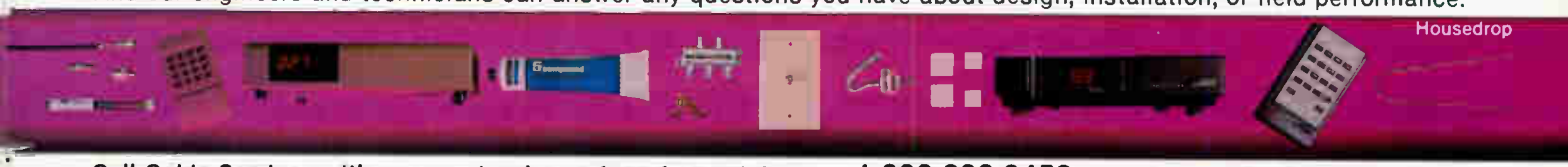

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Implementing BTSC stereo

By Karl Poirier
Vice President, Corporate Development, Triple Crown Electronics

In 1984, the FCC adopted the BTSC format for stereo television sound. This system is functionally similar but *incompatible* with normal FM stereo radio. Its purpose is to allow the transmission of the normal television sound in a format that allows either monaural or stereo sound reception by the customer's television.

Figure 1 shows the normal audio signal as presently carried on cable or broadcast over the air. The particular parameters of this signal that differ from the BTSC signal are bandwidth 15 kHz and aural carrier deviation 25 kHz peak.

The BTSC multiplexed signal (Figure 2) is the signal produced by a stereo encoder from the discrete or matrix inputs. This signal has three primary components: left plus right, left minus right pilot carrier. The left plus right (L + R) is identical to, and carried in the same location as, the normal monaural audio. The left minus right (L-R) signal has been processed, dbx companded and modulated as a double sideband suppressed carrier AM signal (DSSC-AM) centered on two times the horizontal frequency, or 31.468 kHz.

Figure 1: Mono audio signal

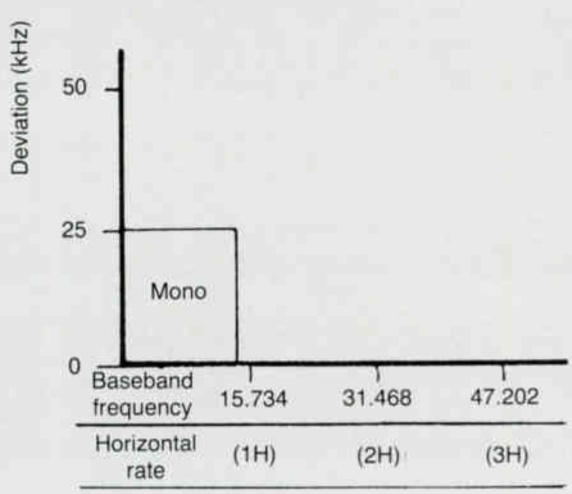
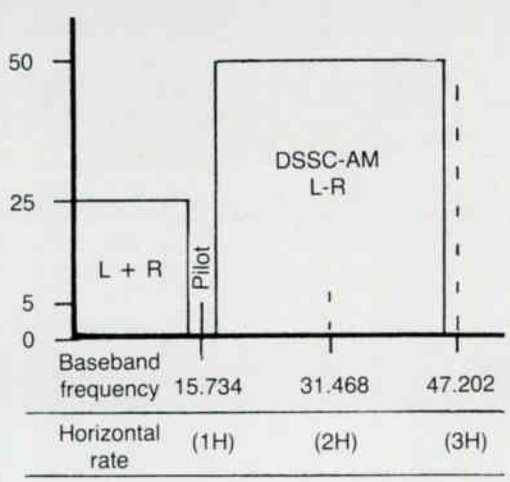


Figure 2: BTSC audio signal



The recovery pilot, phase locked to the video-sync information, is carried at 15.734 kHz. This multiplexed signal requires a bandwidth of 46.5 kHz, and causes a carrier deviation of 50 kHz.

How BTSC is generated

The generation of BTSC stereo is similar to the generation of FM stereo radio, with one basic difference. It was realized early in the standardization process that the low deviation allowable would create quality problems with the left minus right signal. It therefore was decided to employ a proprietary companding technique by dbx to provide improvement to this signal.

The following is a brief overview of the BTSC generation process (Figure 3). The generator requires three input signals: left audio, right audio and video sample. This is required in order to generate the recovery pilot, which must be phase locked to the video sync.

The incoming left and right audio signals are matrixed into a left minus right and a left plus right audio signal. The left plus right, equivalent to a mono signal, is pre-emphasized and filtered to a maximum 15 kHz bandwidth. The left minus right is dbx companded, filtered to 15 kHz and fed to the DSSC-AM modulator. The pilot generator provides a 15 kHz pilot locked to the video sync, and a carrier at two times pilot frequency. This two times pilot frequency is fed to the DSSC-AM modulator. The three signals thus produced — 15 kHz left plus right, 15.734 kHz pilot and 31.468 kHz left minus right DSSC-AM — are combined and filtered to 48 kHz maximum bandwidth. This is the BTSC stereo signal.

How BTSC stereo is received

The customer has several market options to receive BTSC. These are:

- Stereo television receivers;
- Stereo-ready television receivers and converters; and
- Several types of stereo optional decoders.

Stereo television receivers are fully capable of receiving the BTSC signal. Many models incorporate second audio program (SAP) reception as well as stereo. The stereo recovery circuits automatically are engaged when a pilot is sensed, although the stereo can usually be manually disabled if desired.

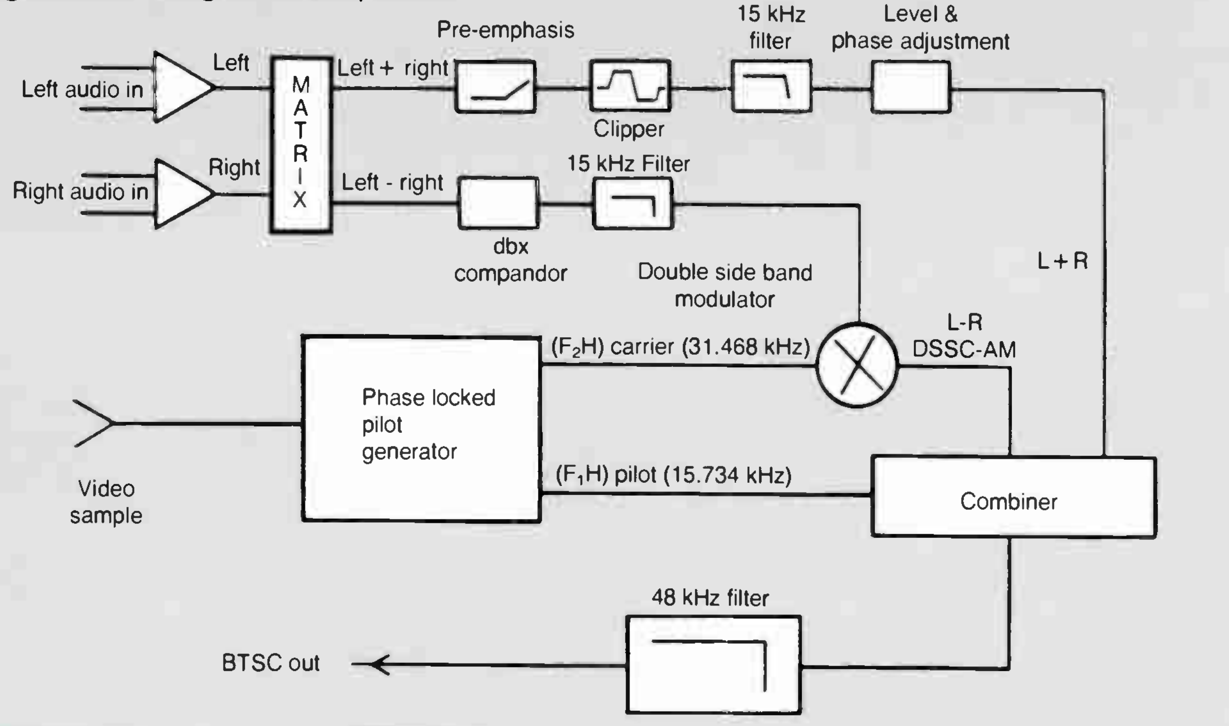
The stereo-ready set normally incorporates no stereo circuitry, but merely provides a sample of either multiplexed baseband or 4.5 MHz aural carrier for processing by means of an external decoder. Many customers will be unpleasantly surprised to find that they still require an additional price of electronics in order to deliver BTSC to their stereo receiver. In fact, there is almost no advantage whatsoever to a stereo-ready device, as the recovery circuitry is invariably contained in a purchased decoder (Figure 4).

Various models of stereo television decoders are presently available for those who do nbt have stereo television receivers. These devices usually deliver the stereo audio to a stereo amplifier, but some models have been made that incorporate a stereo amplifier and speakers. These are designed to be placed near the television receiver and provide a more accurate stereo display.

Most decoders are designed for a specific application. Multiplex input accepts the wide band baseband from the stereo-ready television set. Channel 3 input accepts that input from a TV converter. This is useful when the converter is followed by a baseband descrambler.

In almost all cases, the use of an external stereo decoder provides the user with something less than the stereo television is designed to do, and he is still faced with hearing the TV sound from his audio system.

Figure 3: BTSC generation process



Audio sources

The CATV operator will acquire source signals in one of three formats for processing (Figure 5). These are: 1) discrete audio baseband sources, as in studio application; 2) discrete or matrixed subcarrier pairs from satellite or telecommunications feeds; or 3) multiplexed BTSC stereo from broadcast transmitters, either in baseband or modulated carrier format.

Discrete signals are the individual right and left sources normally generated by the studio. Matrix signals are the left and right formatted into a left plus right and a left minus right signal. Multiplexed signals are the discrete or matrixed signals assembled into a composite stereo signal, with the possible addition of a second audio program and/or professional communications channel (MTS).

Only the first two of these formats require the use of a stereo generator. The third format normally will be carried through an IF processor and will require no modification to the headend. Only if the off-air channels are carried through a baseband processor might significant alterations be required.

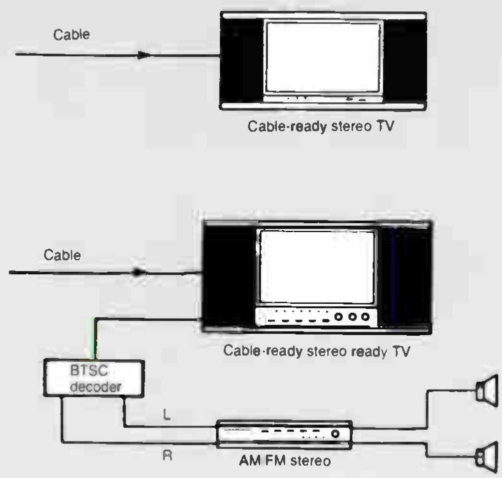
There are stereo generators designed to accept either discrete or matrixed sources at either baseband or high-level subcarriers. Thus, most of the stereo signals available to the CATV operator (i.e., MTV, The Movie Channel, etc.) will interface directly. Only in the case of low-level companded subcarriers will additional recovery processing be required in the headend.

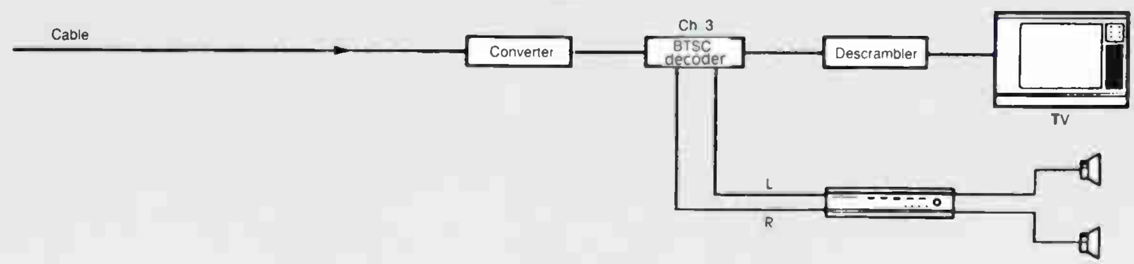
Converting headend to stereo

In most cases, the conversion of off-air signals to stereo will be automatic, providing that the signal processor has sufficient bandwidth. If problems occur in this area, the processor manufacturer should be consulted.

In most cases, the conversion of satellite or studio signals requires only the installation of a BTSC stereo generator in the modulator audio input line (Figure 6). The generator is internally programmable to accept either discrete or matrixed signals. In addition, for satellite use, an optional subcarrier demodulator will

Figure 4: BTSC reception options





Now MMDS Operators Don't Have To Go Through Channels To Double Their Channels.

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Forget about red tape. Because now you can take channel expansion into your own hands.

All it takes is the Comband® system from General Electric.

The Comband system is a necessity for all Multichannel Multipoint Distribution Service operators and Instructional Television Fixed Service operators. Because its unique two-for-one technology lets you quickly double the channels within your allotted bandwidth.

The system also offers other features that will enable your operation to reap greater profits. It's flexible, stereo-ready and contains an unsurpassed one-way addressable baseband system. Plus the Comband bandwidth compression process makes signal theft virtually impossible. Unauthorized programs cannot be seen or heard.

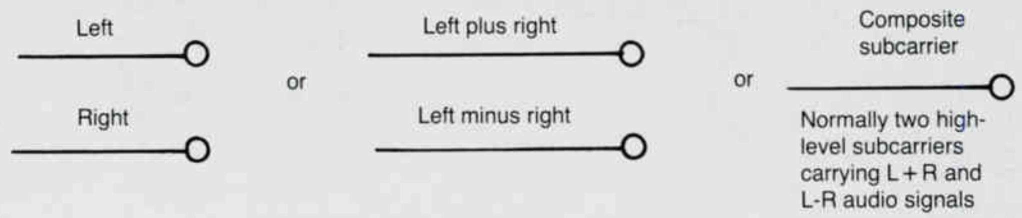
The modular design of the Comband system allows you to control when, and to what extent, you upgrade your operation. So whether you're planning to enter a market or planning to capture a larger share of one, you can do so with minimum time and expense with a Comband system.

Before you make any further plans, see the Comband system in action. Call Ron Polomsky at 1-800-432-2253 to arrange a Comband demonstration.

Because when it comes to doubling the capabilities of your operation, we're the authority.

Reader Service Number 32.

Figure 5: Audio processing formats



extract the two audio sources from the composite satellite video signal.

When dealing with baseband sources, the stereo generator is provided with the individual inputs. The associated video is looped through in order to provide a sync sample. When the optional subcarrier demodulator is employed, the only input required is a composite video, as both audio sources and the sync sample are extracted from the same input.

The output of the stereo generator is connected to the modulator audio input. In all applications, one modification is required: The pre-emphasis circuit in the modulator must be disabled. In some cases, a switch is provided in the modulator, but normally the pre-emphasis is fixed. The pre-emphasis is identified as a parallel resistor/capacitor in the audio circuit (manufacturers can identify the proper component). Removal of this capacitor will disable the pre-emphasis.

Existing system hardware

While in most cases the conversion to stereo will be straightforward and problem free, there will be cases where difficulties occur. These potential difficulties will relate to one of three items: headend equipment performance, scrambling systems and terminal devices.

Headend equipment performance can be detrimental to BTSC in four areas: baseband response, IF linearity, video filtering and incidental carrier phase modulation (ICPM). Luckily, these parameters do not normally prevent stereo transmission, but rather contribute to degradation of the stereo signal. In most cases, the symptoms are in one of two areas. Any baseband response or IF linearity problem that contributes phase or amplitude problems to the 48 kHz audio band will manifest itself as loss of stereo separation. Any video-related problem, such as poor video filtering or ICPM, will normally manifest itself as audio buzz in the stereo mode.

Scrambling equipment that relies on recovery information being carried on the aural carrier may suffer some minor interaction with the stereo signal. The effect on the scrambling system is to degrade the recovery circuits, thus causing occasional jitter or sync loss. This can normally be avoided by level adjustments. The effect on the stereo is to cause loss of separation if there is severe AM-to-FM conversion occurring due to the recovery information.

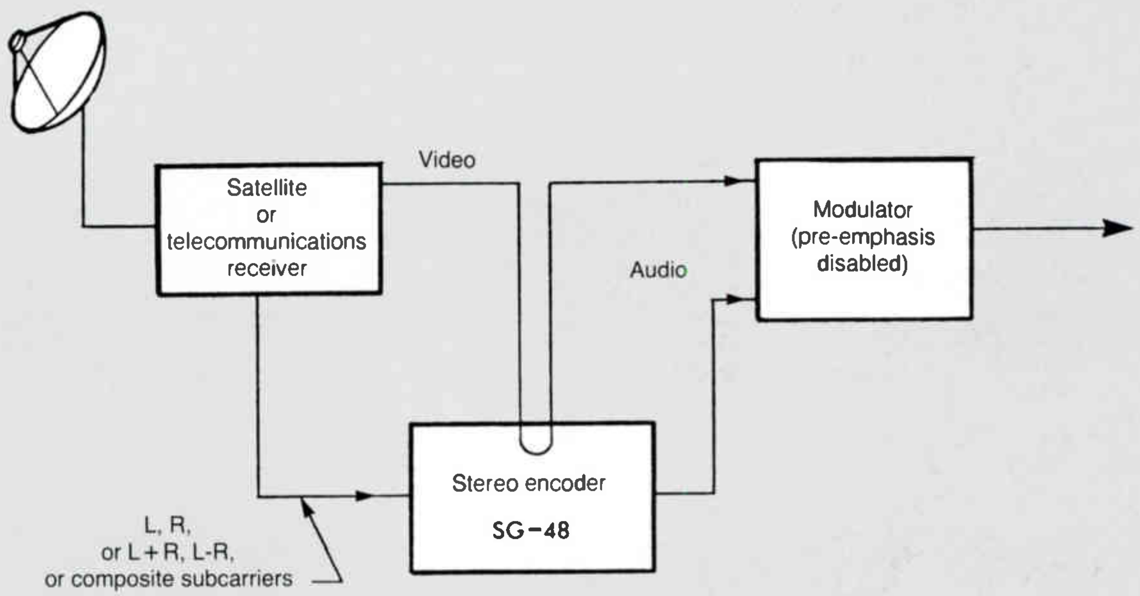
Terminal devices that do not accommodate a 48 kHz audio bandwidth will degrade or destroy the stereo signal. The particular offenders in this area are baseband descramblers, VCRs and volume control converters.

Most current baseband descramblers will not pass the stereo signal due to restrictive audio bandwidth. Newer systems have allowed for this, and most descrambler manufacturers have modifications available for older units. VCRs will normally pass the stereo in the bypass mode, but will not record and replay the stereo signal. Some newer models have this facility, but only a few of these are presently in use. Volume control converters that rely on notch trapping of the aural carrier can affect the stereo due to the notch depth required to suppress the aural carrier.

Any other terminal device that compromises the bandwidth or linearity of the audio signal may have an effect.

In most cases, the conversion to stereo will suffer only a few scattered incidents of this sort, with mostly simple solutions required. It must be recognized that the television system was not designed with stereo in mind and some minor difficulties may accompany the transition. These are far outweighted by the benefits in spectrum utilization and customer satisfaction potential of stereo television.

Figure 6: Addition of stereo generator to CATV system



Frequency agile modulator

United Satellite Systems has announced a new frequency-tunable modulator for CATV and SMATV systems, the MDA-300. It can be tuned to any CATV channel between Channel 2 and Channel W, according to the company. The output channel is selected by push buttons on the front panel and indicated by an LED display. The microprocessor controls the output and there are no filter packs to change. The RF output is greater than 60 dBmV.

All controls for the video, audio and RF outputs and a -20 dB test point are located on the front panel. Output channels can be changed easily. The product also can serve as a standby modulator for any system.

For more information, contact United Satellite Systems, St. Hilaire, Minn. 56754, (218) 681-5616.

Volt ohmmeter

Mercer Electronics, a division of Simpson Electric Co., has introduced a new volt ohmmeter, the Model 9120. According to the company, this model has 25 ranges including dB, 20,000 ohms/volt DC sensitivity (5,000 ohms/volt AC) and a frequency response up to 100 kHz on 3, 12 and 60 VAC ranges. It will measure up to 12 amps DC and has a 3 VAC range. Features include a front panel polarity reversal switch, single-knob range/function switch with an off position, an output jack for DC isolation and a 3.5-inch mirrored, color-coded scale.

Also included is a high-energy fusing system with standard fusing and diode meter protection. Size is 4 inches x 6 inches x 1¾ inches, and weight is 13 ounces. The unit comes complete with batteries, test leads and an operator's manual.

For more information, contact Mercer Electronics, 859 Dundee Ave., Elgin, Ill. 60120, (312) 697-2265.

Cable connectors

Nemal Electronics International has introduced a new line of connectors designed to fit the Belden 9913 and 8214 type cables. The new connectors are available in both type N (part no. NE720) and BNC (part no. NE860) series and will accommodate the 9½ to 11-gauge center conductors in these and other similar cables.

Both series of connectors meet the electrical and mechanical requirements of MIL-C-39012 and incorporate silver-plated contacts and Teflon insulation. Each connector is fully compatible with all other standard connectors in its series.

For more information, contact Nemal Electronics International, 12240 N.E. 14th Ave., North Miami, Fla. 33161, (305) 893-3924.

Storage units

Weather Guard, a division of Knaack Manufacturing Co., has announced a new line of modular shelving units and storage systems for full-size and mini-vans. The shelving equipment includes an all-welded stack unit, four and five shelf rack units and a catalog file unit. The storage equipment includes a wheel well base frame and cabinet, a lockable cabinet, jumbo drawer units and a between-the-seat storage box.

Also in the line is a new work top for mounting on top of other Weather Guard components. These products are intended to work in conjunction with existing Weather Guard products.

For more information, contact Weather Guard, 420 E. Terra Cotta Ave., Crystal Lake, Ill. 60014, (815) 459-6020.

Conductive epoxy finish

Carroll Coatings Co. has introduced a conductive, silver-filled epoxy coating specifically formulated to meet the requirements of electromagnetic and radio frequency interference (EMI/RFI) shielding in highly corrosive atmospheres or where the coating may be exposed to the elements.

Spectraguard C-608 conductive silver epoxy coating is said to offer chemical, corrosion and abrasion resistance, with a shielding effectiveness of up to 83 dB 1-3000 MHz as per ASTM D-9 12.14 for applications requiring a high-grade shielding.

The product also is formulated for use as a conductive shielding on surfaces susceptible to water, solvent, chemical and salt-spray corrosion, as well as with applications with wide variations in temperature. According to the company, it can be used in ground-plane applications that demand optimum conductivity across a non-conductive seam, and in Tempest and FCC applications with rigorous physical requirements.

A two-part epoxy system, C-608 can be applied to various plastics, composites and primed or unprimed metals. It has a tack-free time of one hour and a flash point of 35° F TOC, with a service temperature from -60° to +400° F.

For more information, contact Carroll Coatings Co., 217 Chapman St., Providence, R.I. 02905, (401) 781-4942.

Gas tube equipment

Viewsonics has introduced a line of gas tube, surge-protected blocks and splitters from 5 to 550 MHz with 100 dB RFI integrity. The specifications are: 120 minimum, 297 maximum; with a maximum single impulse discharge of 2.5 kilo amps. Isolation is 10 megaohms minimum and capacitance is 2 peco Pa maximum. The units are bi-directional and self-resetting.

According to Viewsonics, these units, installed at the subscriber drop, will ground all dangerous power surges including lightning. Surge-protected passives are available directly from stock.

For more information, contact Viewsonics Inc., Box 36, Jericho, N.Y. 11753, (800) 645-7600 or (516) 921-7080.

BTSC stereo generator

Leaming Industries has introduced a BTSC stereo generator, Model MTS-1, to its existing line of audio signal processing equipment. The MTS-1 is said to transmit the multichannel sound format by generating a BTSC stereo baseband aural com-

Boring attachment

Line-Ward Corp. has introduced a boring attachment to fit its L-1 and L-2 cable line layers. The device is designed for housedrop work, where sidewalks or driveways are encountered. It is built to retrofit any older Line-Ward L-1 cable line layers. The unit can be attached or de-attached.

For more information, contact Line-Ward Corp., 157 Seneca Creek Rd., Buffalo, N.Y. 14224, (716) 675-7373.

posite signal from left and right baseband audio inputs.

The L-R channel is companded using a dbx 525CH compressor. In addition to the baseband BTSC output, a second output modulated on a 4.5 MHz carrier may be provided using an optional plug-in board, the Leaming MOD-4.5.

For more information, contact Leaming Industries, 180 McCormick Ave., Costa Mesa, Calif. 92626, (714) 979-4511.

Cable tie tool

Lynx Inc. has introduced a compact, lightweight tool to its Catamount line designed to speed the on-site installation of cable ties. The QC-100 tensions the ties and then trims off the tails with a simple twist of the wrist, according to the firm.

For more information, contact Lynx/ Catamount, 45 Francis St., P.O. Box 67, Leominster, Mass. 01453, (800) 222-5969 or (617) 537-6090.

Tool pouches

Koszegi Products has introduced a new line of JAC tool pouches. Made of 1,000-denier luggage-type nylon, these products are said to be nearly impossible to puncture, scratch or scuff. In the event of a cut or tear, they can be repaired. If they become dirty, they can be washed and dried quickly.

The Condura pouches were developed specifically for utility companies and currently are used by installation and service personnel. The complete line includes items ranging from an electrician's pouch to a telephone holster to a pocket secretary. Each pouch measures 9 inches high by 9¼ inches wide. It has a 6 x 2-inch compartment across its entire 9¼-inch width. Inside the compartment are six loops of various sizes. Three belt loops are located on the back of the pouch. On the front are three tool holders plus a pocket with a closed bottom, flap and Velcro closure. Standard color is navy. Other colors and company logos also are available.

For more information, contact Koszegi Products Inc., P.O. Box 1277, South Bend, Ind. 46624, (219) 234-1141.

Satellite products

Avcom of Virginia Inc. is in the process of introducing several new products, including a DC power supply option for noninterruptible satellite reception. The DCC-12 power supply is available for the Com-2, Com-3, Com-20, Com-60, and Com-90 series receivers. The typical current drain of a receiver equipped with the DDC-12 is 1.5 amperes at 12 volts input. Provision is made for a +18 VDC output to power LNAs and downconverters.

Another new product, the MSG-5 microwave sweep generator generates signals in the 3.7-4.2 GHz satellite communications band. A sweep capability is standard over the entire 3.7-4.2 GHz band to bandwidths less than 1 MHz at any center frequency between 3.7 and 4.2 GHz. Frequency can be read on an LED display with better than 1 MHz accuracy. A built-in modulation generator can verify TVRO system performance. An external video modulation input is included.

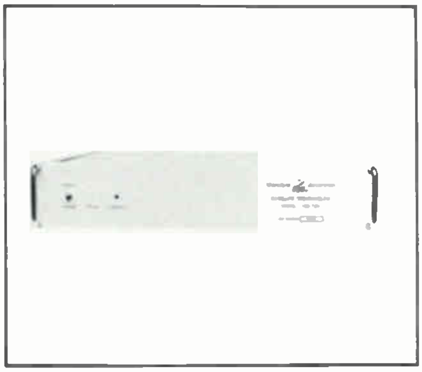
Avcom also is introducing a single channel per carrier intermediate frequency processor, Model SCPC-500, which block converts all signals on transponders 1 through 24 to an intermediate frequency of 50 to 550 MHz. According to the company, an extremely stable microwave oscillator with excellent phase noise characteristics allows unattended reception over long periods of time without significant drift. The low phase noise characteristic of the oscillator results in a higher signal-to-noise ratio meaning smaller diameter dishes can be used with comparable results.

Lastly, Avcom's new single channel per carrier receiver, Model SCPC-2000, has been developed for the reception of SCPC signals from satellites operating in the 3.7-4.2 GHz band. The SCPC-2000 is a complete receiver and can tune specific audio or data channels from a given transponder, process the signals through switchable intermediate frequency filters, and adapt to a variety of de-emphasis requirements. The received audio can be expanded by means of an optional internal, 2-to-1, or 3-to-1 compander module. No FM tuner is required.

For more information, contact Avcom of Virginia Inc., 500 Southlake Blvd., Richmond, Va. 23236, (804) 794-2500.

Scrambling system

Microdyne has introduced its new scrambling/descrambling system for satellite communications requiring video encryption, such as video teleconferencing, pay-per-view television or private communications networks. Because over 2 million keys are required in the proper, continually changing order to decode the



signal, network operators can send sensitive programming via satellite without fear of unauthorized reception, according to the company.

The system, which consists of the 1100 TVL video/audio scrambler and the 1100 TVK video/audio descrambler, can support up to 250,000 decoders per data subcarrier. Transmission of sync, burst and vertical interval signals are unaffected by the scrambling system, and audio companding is provided for an improved audio signal-to-noise ratio.

The descrambler is delivered with its own address and code-key information embedded in memory. All code information is automatically destroyed in the event of tampering, rendering the unit unusable.

The satellite scrambling system has been successfully employed by a nationwide pay-per-view network for distribution of feature films via satellite.

For more information, contact Microdyne Corp., P.O. Box 7213, Ocala, Fla. 32672, (904) 687-4633.

Medium-density jacketed cable

M/A-COM Comm/Scope has introduced a product improvement to its Parameter III and Parameter I series trunk and distribution coaxial cables. All jacketed versions of these products now have a medium-density jacket material that is said to have much improved properties over low-density compounds.

Medium-density jacketed cable installation, whether aerial or underground, is aided by the improved drag coefficient, which allows cables to pass through rollers and chutes with less strain. M/A-COM says direct burial installations will benefit from increased tensile strength, improved elongation, abrasive resistance, column strength and cut-through resistance. The additional stiffness aids in feeding or pushing the cable through conduit or boring holes.

For more information, contact M/A-COM, Comm/Scope, P.O. Box 1729, Hickory, N.C. 28603, (800) 438-3331 or (704) 324-2200.

Flexible heaters

Ocean State Thermotics Inc. is offering etched-foil, Kapton flexible heaters for applications requiring precise temperature control in confined areas.

According to the company, Kapton is a self-extinguishing, transparent material that offers thermal stability over a wide temperature range, up to and including 220° C, allows for low outgassing in high vacuum environments and is resistant to chemicals and solvents. It is used extensively in appliances and electrical, computer, electronic and communication equipment because of its chemical, solvent and radiation resistance.

Kapton heaters are engineered for applications requiring controlled heating in confined areas or on uneven surfaces, "wrap-around" heating or precise temperature control in a defined area. Versatile and lightweight, they can be used in LCD displays, communication antennae and TV monitoring equipment.

For more information, contact Ocean State Thermotics Inc., 107 Railroad Ave., Johnston, R.I. 02919, (401) 231-4640.

Highpass filter

According to Microwave Filter Co., its Model 5184 highpass filter prevents un-

wanted signals from travelling on the return line in dual cable systems while allowing the rest of the band to pass. Insertion loss is 2 dB maximum (10-300 MHz), rejection is 40 dB minimum (DC-8 MHz) and impedance is 75 ohms. It comes in a case 1 inch x 2 inches x 6 inches with type F connectors. The cover has flanges with holes for indoor mounting.

For more information, contact Microwave Filter Co. Inc., 6743 Kinne St., East Syracuse, N.Y. 13057, (800) 448-1666 or (315) 437-3953.

Power switcher

Systems that use large amounts of solid-state mass storage typically need a source of regulated DC power at 5 volts and high amperage. The Powermag A1500 switching power supply from Advance Power Supplies Inc., with its DC output of 5V at 300 amps continuous, is said to meet that need in increments of 1,500 watts.

According to the company, virtually any number of A1500s can be connected in parallel to meet the heaviest immediate or future system requirements. Current sharing capability is built in so that, in multiple installations, no single unit has to carry an excessive load and parallel redundancy can be provided.

Occupying a box 8 inches x 5 inches x 11 inches deep, the compact, fan-cooled A1500 delivers 3.4 watts per cubic inch from either 110 or 220 V nominal, 47 to 440 Hz power mains.

Standard features of the A1500 include electronic soft start; overcurrent, overvoltage and overtemperature protection; margin testing; local and remote sensing; and full-cycle holdup for a 5 V, 300 amp output at 50 or 60 Hz. The 5 V output can be adjusted from 4.5 to 5.5 V by internal potentiometer or from 2 to 6 V via remote programming. Ripple and noise are held to less than 100 mV peak-to-peak over a bandwidth of 30 MHz, and worst-case static regulation is 0.4 percent.

For more information, contact Advance Power Supplies Inc., 32111 Aurora Rd., Solon, Ohio 44139, (216) 349-0755.

Computer-aided drafting and CATV

By C. Tommy Hill
District Engineer, Group W Cable

In 1985, Group W Cable studied the feasibility of upgrading its West Palm Beach, Fla., system. In gathering the required information, it became apparent that it would be necessary to perform an as-built mapping project before an upgrade project could be designed and constructed. Brad Johnston, vice president of engineering for Group W, suggested that a computer-aided drafting (CAD) system might be a cost-effective way to produce the needed system maps.

We began to investigate various CAD systems with our primary criteria being flexibility, ease of operation and, of course, cost. A local dealer recommended the AutoCAD system, which was developed by Autodesk in California, as the system that best fit our needs.

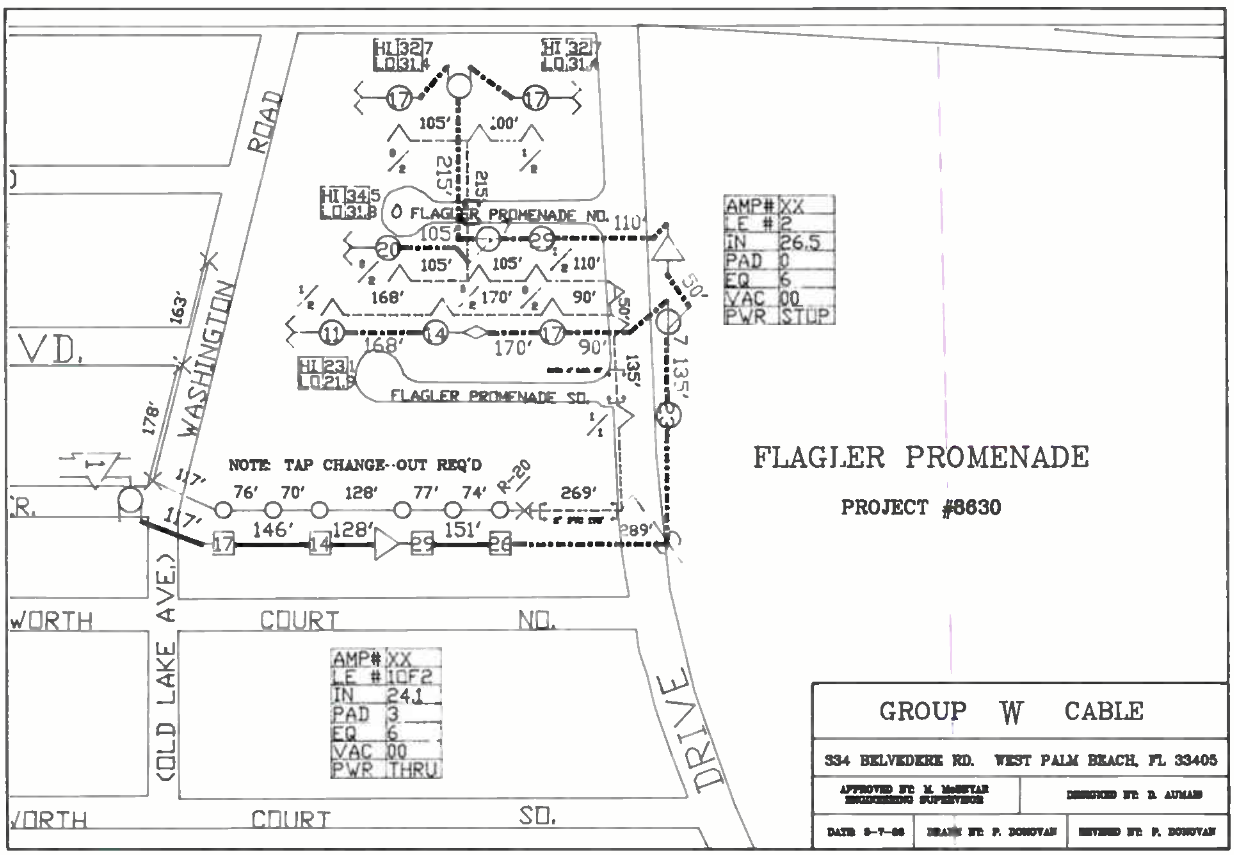
This CAD system had a generic drafting software package and, as such, required some customization to become a CATV drafting tool. An extensive CATV symbol library was developed with special parts' attributes attached to each symbol, so that a listing of bill of material (BOM) information could be derived as the map was drawn. When a symbol is placed on a map, an anchor for example, all the bolts, preforms, clamps, etc., are automatically added to the data base and can later be extracted for BOM information by job or project number with a command.

CATV-specific tablet menus also were created to make symbol insertion on the base map as easy as possible. All symbols and menus are displayed in cable language, not computer language. In addition to the CAD system, Group W purchased the Revelation data base package. This package has been successfully interfaced so that many of the BOM and report functions that we required are processed in Revelation as the drawing is developed. This helps maintain rapid processing of the drawings.

The system will support a lengthy list of hardware. We selected the IBM-AT personal computer with 512K of user memory, 20 megabyte hard drive, 1.2 megabyte floppy drive and 80287 math co-processor. This later was upgraded to 640K to speed processing and to allow the use of some DOS 3.10 commands. The monitor is a Zenith ZVM-136 RGB 13-inch, with long persistence phosphor, driven by a Tecmar Graphics Master board. This combination produces a display resolution of 640(H) by 400(V) pixels.

Higher resolutions and bigger screens are available, up to 1024 by 1024 pixels, 19-inch, at a higher cost. Additional memory is provided by the Iomega Bournoulli Box. This device accommodates two removable 10-megabyte data cartridges. Input devices are the keyboard and the Calcomp 9148 Digitizing Tablet. The system is configured such that most commands are entered on the tablet. The tablet has a resolution of 1,000 lines per inch and can accept up to a 16-button cursor. Each button on the cursor can be programmed to issue a different command on different tablet menus. Output devices consist of the Houston Instruments DMP-52MP plotter and the Citizen MSP-10 dot matrix printer. The plotter has a 14-pen

Figure 1: Example of CAD map showing line extension



'A draftsman who could produce a good base map by hand in three days. . . now can produce the same map with better quality. . . in eight hours'

capacity with a 16-inch per second maximum pen speed. Drawings can be plotted on either device at any scale desired. Again, these were our choices, and they work well for us.

Of course, the primary application of the system is the design and drafting of system maps. This particular system is not a design package, but it is possible to look through a drawing, operate a design program written in Basic and return to the same place in the drawing to enter the information using the DOS Shell command. We also have been entering plant as-built information as it is obtained, and developing permit drawings for pole contacts, road crossings and canal crossings.

Map storage is accomplished by using the Bournoulli cartridges. A typical completed system map might contain 250,000 bytes. Therefore, one 10-megabyte cartridge can hold 40 or more maps. Once the cartridge is full, it is removed and another is put in its place. In this manner, maps for a 1,000-mile system can be stored in the same space required for several large vendor catalogs.

This system also has the ability to draw in three dimensions. This has good possibilities for high-rise apartment buildings. With this system, the user can store information for all apartment buildings with a simple floor plan layout and the location of drops. It also can show locations of amplifiers and feeder cable routes through the building. Our plan is to enter a symbol on the design map for each apartment building. Then by selecting this symbol the user can bring that particular building to the screen.

While our CAD system only has been operational for a few months, we already have begun to see the anticipated benefits. Productivity has markedly increased. A draftsman who could produce a good base map by hand in three days, working eight hours a day before, now can produce the same map with better quality and detail in eight hours. Time savings of this magnitude have been demonstrated in drawing after drawing. Map revisions that once could take hours now can be done digitally in minutes. Maps can be plotted accurately and legibly in any scale required. The detail and clarity of our prints have drawn favorable comments from the Department of Transportation, the water management district and developers.

Figure 2: Bill of materials print out for line extension

VENDOR	GWC #	MANUFACTURE #	DESCRIPTION	UOM	COST/UNIT	QUANT.	TOTAL
COMM/SCP	0100005	P3+75-500 JCASS	P3 500 FL.	MFT.	205.69	289	59.44
INTEGRAL	0105046	C080H01X	1/2" CBLCON	MFT.	530.00	1353	717.09
GILBERT	0801947	GRS500-CH-DU-03	P3 500 ENT.	EA	2.95	17	50.15
"	0800301	GTR-M	HSNG TERM	EA	2.53	4	10.12
"	0801925	GP-90	90 CONN.	EA	4.91	8	39.28
"	0803258	GP-90-3.0	90 CONN. 3"	EA	7.75	8	62.00
CHANNELL	0303512	CPH-658BLK	TAP PED.	EA	17.13	9	154.17
"	0303516	CHP-816BLK	SPL.PED.	EA	27.12	3	81.36
"	0303524	CHP-1016BLK	LE PED.	EA	38.00	1	38.00
ANIXTER	0801919	TRLF	LOCK. TERM.	EA	.63	16	10.08
"	0801874	HSB	SPLICE BLK.	EA	5.70	1	5.70
"	0902383	TCS-15-48	.500 HT.SRK	EA	5.55	3	16.65
AVAIL.PLS.	0302595	21200	2" PVC PIPE	FT	.29	175	50.75
"	0302622	S90224	2"X24" SWP	EA	1.97	2	3.94
"	0302446	G50001	PVC CEMENT	GAL	15.00	1	15.00
GRAYBAR	8800007		4" GALV.PIPE	FT	6.30	40	252.00
WESCO	0200206	J984	1 1/8" U-GRD	EA	4.80	2	9.60
"	0200266	J995	1 1/8" STRP	EA	.24	4	.96
JERROLD	0603397	SSP-3	2 WAY SPLT.	EA	16.71	1	16.71
"	0603399	SSP-7	7 DB D.C.	EA	16.71	2	33.42
"	0601029	SEE-300-6	EQUALIZER	EA	5.10	1	5.10
"	0601191	SXP-Z	0 DB PAD	EA	1.65	1	1.65
"	0601140	SLR-300	LINE EXT.	EA	129.80	1	129.80
"	0601009	FFE-8	LINE EQUAL.	EA	6.80	1	6.80
EAGLE	0604138	EC-2-529PBM	29-2 TAP	EA	6.75	1	6.75
"	0604136	EC-2-523PBM	23-2 TAP	EA	6.75	1	6.75
"	0604135	EC-2-520PBM	20-2 TAP	EA	6.75	1	6.75
"	0603922	EC-2-517PBM	17-2 TAP	EA	6.75	3	20.25
"	0603915	EC-2 514PBM	14-2 TAP	EA	6.75	1	6.75
"	0600444	EC-2-511PBM	11-2 TAP	EA	6.75	1	6.75
		BILL OF MATERIALS TOTAL					1823.77

In other areas, the system also has been very useful for producing various special drawings, charts and graphs for other departments. Further, we envision enhanced project management capabilities as this system becomes fully developed by using different drawing layers to input information such as plant completed, activated, billed and accepted. For example, a small line extension from a selected portion of the map can be drawn and a BOM obtained for that portion (see Figures 1 and 2).

The total price for all the equipment described is approximately $38,000. Justification for this was realized from a proposed upgrade of 550 miles of plant. Since the system in question was 16 years old, existing maps were in poor condition and drawn with old symbols. Because of this, it was necessary to redraw the maps completely, updating them with new house counts, proper footages and equipment placement.

We arrived at our re-mapping cost from estimating in-house labor and outside contractor bids. After investigating the CAD system, we found that we could buy all necessary equipment, contract the vendor to input new base maps into the computer, and hire a contractor to walk out and give us new strand maps, as well as identify cable size, amplifier locations and passive locations.

In comparison, we realized a savings over our original contractor bids. At the end of the project we would still have tangible equipment worth $38,000. This relates to a direct savings for Phase II of 550 additional miles for the next year.

In conclusion, we found this system could be learned and operated effectively in four to six weeks of training without any specialized computer knowledge, while many other CAD systems require four to six months to accomplish comparable results.

Finally, we also will be able to exchange and process data from other systems as they become more common in the industry. Data from our system can be translated for use in other systems, such as Computervision and Intergraph, and vice versa. Drawings and data can be exchanged via diskettes, cartridges or telephone modems.

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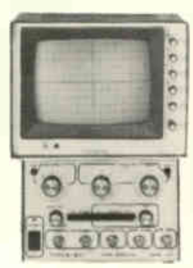

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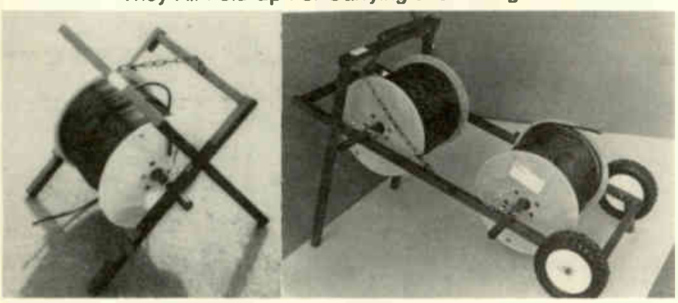

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5	14	23	32	41	50	59	68	77	86	95
6	15	24	33	42	51	60	69	78	87	96
7	16	25	34	43	52	61	70	79	88	97
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5	14	23	32	41	50	59	68	77	86	95
6	15	24	33	42	51	60	69	78	87	96
7	16	25	34	43	52	61	70	79	88	97
8	17	26	35	44	53	62	71	80	89	98
9	18	27	36	45	54	63	72	81	90	99
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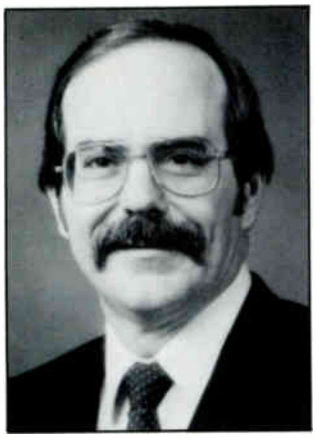
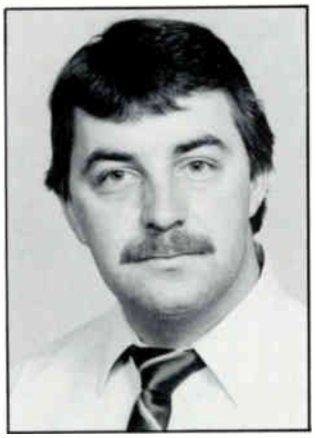


Hooker

M/A-COM Comm/Scope announced that **Joe Hooker** has joined the firm as Northwest district sales manager, responsible for Washington, Oregon, Idaho, Montana and Alaska. Hooker has been in the cable industry since 1962, most recently with Texscan as Pacific Northwest sales engineer. Contact: 12411 Pilchuck Rd. East, Puyallup, Wash. 98374, (206) 845-3875.



Bresett

Robert Bresett has been named shop supervisor at **Microwave Filter Co. Inc.** Prior to working at MFC, he was a manufacturing engineer at S.L. Auburn Spark Plug, Auburn, N.Y. Contact: 6743 Kinne St., East Syracuse, N.Y. 13057, (315) 437-3953.

John Dieckman has been named to the new position of manager, application engineering at the **Jerrold Distribution Systems Division** of General Instrument Corp. Dieckman began his Jerrold career as a sales engineer in 1960, after a successful career in systems operation, which he began in 1951. From 1960 to 1981 he held a variety of management posts at Jerrold both in sales and operations. After a 21-year career at Jerrold he left to become vice-president of sales for AM Cable TV Industries Inc. His most recent position was national director of turnkey marketing for Burnup & Sims. Contact: 2200 Byberry Rd., Hatboro, Pa. 19040, (215) 674-4800.

Rebeschini

Irv Rebeschini was named president of **Simpson Electric Co.** Since rejoining the company in 1970, Rebeschini has served as vice president and director of administrative services. Contact: 853 Dundee Ave., Elgin, Ill. 60120-3090, (312) 697-2260.

Texscan MSI/Compuvid has promoted **Joe Fabiano** to commercial insertion installation and training supervisor. Fabiano has worked for Texscan for two years in various positions from customer service technician to test department supervisor. Contact: 3855 South 500 West, Suite S, Salt Lake City, Utah 84115, (800) 262-8475.

Albert Stem is the new director of operational services for **United Video.** Stem has transferred to the company's Tulsa, Okla., headquarters from United Video's Chicago Teleport, where he was director of operations and engineering. He joined the company in 1980 as a microwave system engineer. Contact: 3801 S. Sheridan, Tulsa, Okla. 74145, (918) 665-6690 or (800) 331-4806.

Dennis Long has been named to the position of manager, broadcast/cable production operations, and **James Crowe** to the position of manager, transmission operations and facilities, for the Operations and Engineering Group of **Group W Satellite Communications** (GWSC). Most recently, Long was manager, facilities and maintenance, GWSC. Crowe was most recently director, transmission facilities, GWSC. Contact: 41 Harbor Plaza Dr., P.O. Box 10210, Stamford, Conn. 06904, (203) 965-6222.

Spatial Communications Inc. has announced the appointment of **Thomas Ferguson** as regional sales manager, Eastern U.S. Ferguson was previously sales manager with Global Systems Corp. Contact: 1416 Olive St., Scranton, Pa. 18510, (717) 347-8997.

AM Cable TV Industries Inc. has announced that **William Ross** has rejoined the company as vice president of its field services division. Ross, who has 20 years of CATV construction experience, was formerly with AM Cable for 11 years. Contact: AM Drive and Rt. 663, Quakertown, Pa. 18951, (215) 536-1354.

Jack Bergstrom joined **Brad Cable Electronics Inc.** as customer service representative in the company's Schenectady, N.Y., location. Bergstrom came to Brad from First Investment Investors Corp., a Wall Street investment firm, and attended Rensselaer Polytechnic Institute, majoring in electrical engineering. He will be handling the Southern portion of the United States. Contact: 1023 State St., Schenectady, N.Y. 12301, (518) 382-8000.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Reader Service Number 39.

May

May 13-15: Canadian Cable Television Association convention and expo, Hyatt Regency Hotel, Vancouver. Contact (613) 232-2631.

May 13-15: Maryland/Delaware Cable Television Association annual meeting, Governor Calvert House, Annapolis, Md. Contact Tim Hanna, (301) 332-4088.

May 14-16: Infotron Institute communications network design seminar, Sheraton Centre Hotel & Towers, New York City. Contact (800) 257-8352.

May 19-21: Arizona State University course on semiconductor facilities and clean room practices, Arizona State University, Tempe, Ariz. Contact (602) 965-1740.

May 21: SCTE Chattahoochee Chapter meeting on headend planning. Contact Gary Donaldson, (404) 979-0010.

May 21-22: Blonder-Tongue SMATV / MATV / CATV / TVRO technical seminar, Airport Hilton, Tampa, Fla. Contact Neville Johnson, (813) 953-9843.

May 22: Central Coast Cable Club meeting, San Luis Bay Inn, Avila Beach, Calif. Contact Dave Methiesen, (805) 925-9504.

May 28: SCTE Appalachia Mid-Atlantic Chapter meeting, Holiday Inn, Chambersburg, Pa. Contact Ron Mountain, (717) 984-2878.

May 28-30: Infotron Institute communications network design seminar, Sheraton Valley Forge, King of Prussia, Pa. Contact (800) 257-8352.

May 28-30: The Armed Forces Communications and Electronics Association 40th annual convention and exposition, Washington, D.C., Convention Center. Contact (703) 425-8590 or (800) 336-4583.

June

June 1-6: International Communications Association annual convention, Congress World Center, Atlanta. Contact (214) 233-3889.

June 4: SCTE Rocky Mountain Chapter meeting on test equipment. Contact Joe Thomas, (303) 978-9770.

June 4-6: Magnavox CATV training seminar, Phoenix. Contact Amy Costello, (800) 448-5171.

June 11: SCTE West Texas Meeting Group seminar on installation and procedures. Contact Jim McCain, (915) 267-3821.

June 12-15: SCTE Cable-Tec Expo, Convention Center, Phoenix, Ariz. Contact Bill Riker, (215) 363-6888.

June 13: Wavetek system sweeping seminar, the Wavetek factory, Beech Grove, Ind. Contact Steve Windle, (317) 788-5980.

June 15-17: Oregon Cable Communications Association annual convention, Embarcadero Resort Hotel & Marina, Newport, Ore. Contact Mike Dewey, (503) 362-8838.

June 15-17: Virginia Cable Television Association 20th annual convention, Pavilion Tower Hotel, Virginia Beach, Va. Contact (804) 780-1776.

June 18: SCTE Delaware Valley Chapter meeting on signal processing centers with BCT/E exams on video and audio signals and systems, Williamson Restaurant, Horsham, Pa. Contact Bev Zane, (215) 674-4800.

June 18-20: Infotron Institute communications network design seminar, Infotron Systems Corp., Cherry Hill, N.J. Contact (800) 257-8352.

June 23-25: SCTE and New York State Cable TV Commission Northeast cable television technical seminar, Roaring Brook Ranch, Lake George, N.Y. Contact Bob Levy, (518) 474-1324.

June 24-26: C-COR Electronics technical seminar, Baltimore. Contact Debra Cree, (800) 233-2267 or (814) 238-2461.

Planning ahead

June 12-15: Society of Cable Television Engineers' Cable-Tec Expo '86, Phoenix (Ariz.) Convention Center.

July 15-17: Community Antenna Television Association annual convention, MGM Grand Hotel, Reno, Nev.

July 20-22: Eastern Show, Merchandise Mart, Atlanta.

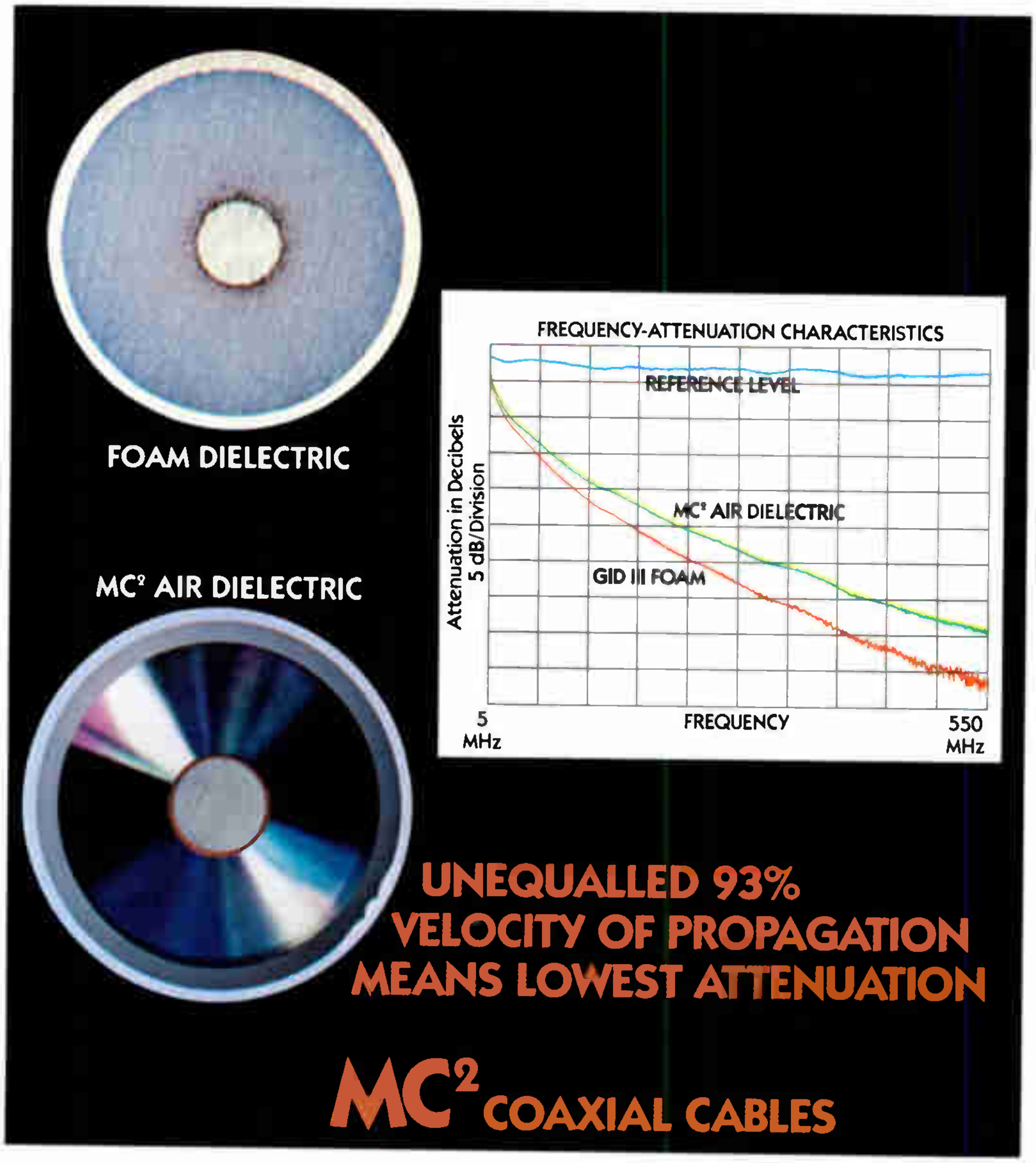
Sept. 23-25: Great Lakes Cable Expo, Hyatt Convention Center, Columbus, Ohio.

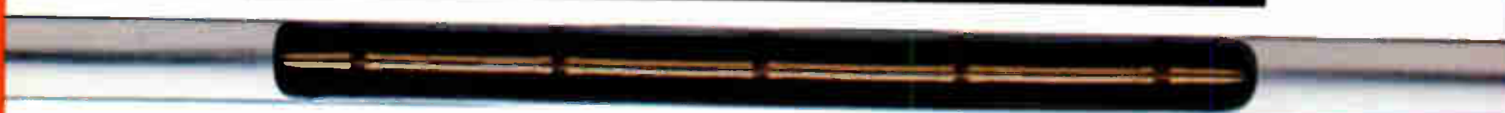
Oct. 28-30: Atlantic Show, Convention Hall, Atlantic City, N.J.

Dec. 3-5: Western Show, Convention Center, Anaheim, Calif.

AD INDEX

TRILOGY LEADS IN TECHNOLOGY:





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Reader Service Number 41.

Cable-Tec Expo: Let's all be there

By Robert A. Luff
Senior Vice President, Engineering
United Artists Cablesystems Corp.

The Cable-Tec Expo is the largest totally CATV technical training seminar and equipment exhibition in the industry today. At a time when attendance is down at nearly every other cable convention and association meeting, Tec Expo has shown a steady increase of upwardly moving installers, techs and chiefs. So what does Tec Expo have that other conventions don't?

The Tec Expo has become the most cost-effective way for installers, techs and chiefs either individually or through company support to improve their systems' everyday technical functions. At only $80 per day for everything but transportation, nothing else in the industry compares.

Last year, for SCTE's third expo in Washington, D.C., 850 attended. This year pre-registration is way up and more than 1,000 are expected to participate in Phoenix, Ariz., June 12-15. But while that may be a record breaking crowd for Tec Expo, there are over 50,000 CATV installers, techs and chiefs employed in the industry! Are you going to be one of 1,000 that will move their practical knowledge, troubleshooting and management skills a giant step ahead or one of the 49,000 that stay home, drink beer, eat pizza and watch TV?

Why Tec Expo?

Tec Expo was designed to fulfill a large, unmet need in the cable industry for a technical-only, hands-on workshop/seminar for all levels of CATV technical personnel. It neither competes with nor is redundant to the NCTA convention or state and regional shows. There are no politicians or political speeches. There are no programmers with premiums. There are no lavish — and costly — banquets or wee hour smashes. Tec Expo is three days of (nearly) all work. You can expect to attend practical, how-to training seminars on installing and maintaining VideoCipher IIs, interfacing mono or stereo commercial insertion equipment on stereo channels (it's not as easy as it looks), surviving 2° spacing, understanding CLI, signal leakage, system tests, BTSC stereo encoders on pay and satellite channels, and where the FCC stands on technical regulations.

For installers there are plenty of topics and new products to speed everyday installation tasks. The latest cable preparation tools, fasteners, masonry drills and bits, required NEC grounding materials and hundreds of helpful techniques developed by the designing manufacturers themselves and those with long-term hands-on experience will all be on view.

This year's expo will have a larger manufacturer and vendor display area than last year, more than 39,000 sq. ft. of display area. To fill this space, more manufacturers and vendors will be represented this year than last, bringing with them not just their products to display, but their engineers, technical troubleshooters and equipment designers to explain and answer questions, and receive field feedback on reliability, features and ease of adjustment and service to all that stop by. If the product moves or requires manual operation, like a new drill, masonry bit or staple gun, the manufacturer usually has it set up for hands-on test use on specially constructed brick and house look-alikes. Additionally, companies like Jerrold, Magnavox and Hughes bring their classrooms or mobile training trailers into the display area and give their special technical training courses.

In addition to the all-day technical conference, June 12, and manufacturers/vendor mobile classroom sessions, the Tec Expo will have more scheduled technical sessions than any CATV meeting to date, including last year's expo. The schedule includes 10 simultaneous mini-breakout workshops, each with a roster of industry experts to share their experiences and answer your questions. Every hour a bell will ring and attendees will move on to the next mini-module of their choice. Even with two full days, it won't be possible for an attendee to participate in all workshops.

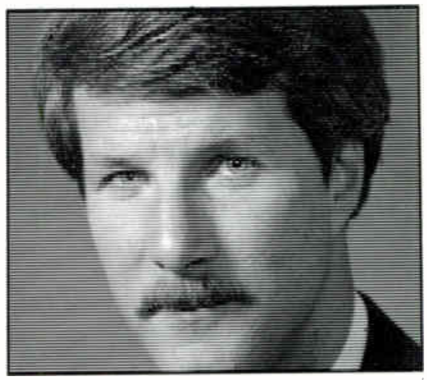
On Sunday, as an appropriate finale to all the technical agenda, SCTE will administer the BCT/E technician and engineering level certification exams for distribution systems, and video and audio origination.

Company meetings and awards

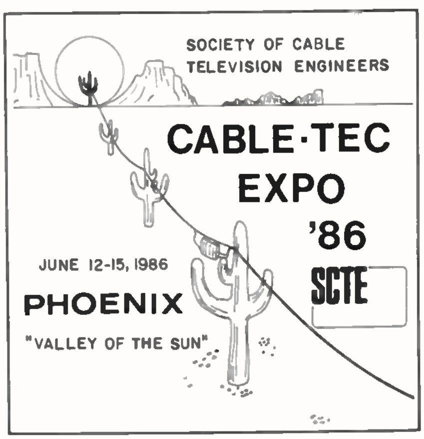
In addition to the ever-expanding and diversified program, another reason expo attendance continues to climb is that after experiencing first-hand the value of previous expos, many MSOs have scheduled their companywide or regional technical meetings in conjunction with this year's expo for cost-effective limited travel and time from the system. Jones, UA, Group W and Storer have already scheduled their company technical meetings in conjunction with the Tec Expo.

Also, many companies have begun to hold incentive programs during the year, and the leading installers, techs and chiefs are sent to the expo for a job well done.

Much is happening in cable technology, techniques and needed skills. We can't "get by" in a modern CATV system with addressability, VideoCipher II, stereo, PPV, data, etc., with 12-channel folklore. If you are a cable installer, tech or chief engineer and want to move up, sharpen your skills and knowledge, or just keep current and improve your present on-the-job performance, you should definitely make arrangements to attend this year's SCTE Cable-Tec Expo. It could be the best investment you'll make this year — an investment in yourself. Be one of the 1,000 or more attending SCTE's Tec Expo, not one of 49,000 staying home.



'We can't "get by" in a modern CATV system with addressability, VideoCipher II, stereo, PPV, data, etc., with 12-channel folklore'



Remember, in cable's early days, when your system went down and you had that utterly helpless feeling knowing there was nothing you could do til morning? Back then, service meant plugging in a spare amplifier or waiting for assistance - usually half the country away. As an operator, you were virtually on your own. Recognizing this, Jerrold became the first manufacturer to supply operators with needed test equipment and strategically-located field engineers, thus providing the first on-site installation support and training. Even then, Jerrold was there.

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- Simulation facilities to pinpoint and resolve problems instantaneously.
- 160 field locations to provide on-site installation and applications support.
- 13 field repair centers located nationwide.

The Jerrold Service Network. More than service, it's training - upfront and ongoing. It's communications. Listening to your needs, providing answers and suggesting better alternatives to give you the competitive edge. And it's solutions. Three decades of solutions. It's why you can count on Jerrold today - and tomorrow - to provide the backup you need anytime, anywhere.

To learn more about Jerrold's service network, call or write today. Jerrold Division, General Instrument Corporation, 2200 Byberry Road, Hatboro, PA 19040. (215) 674-4800.

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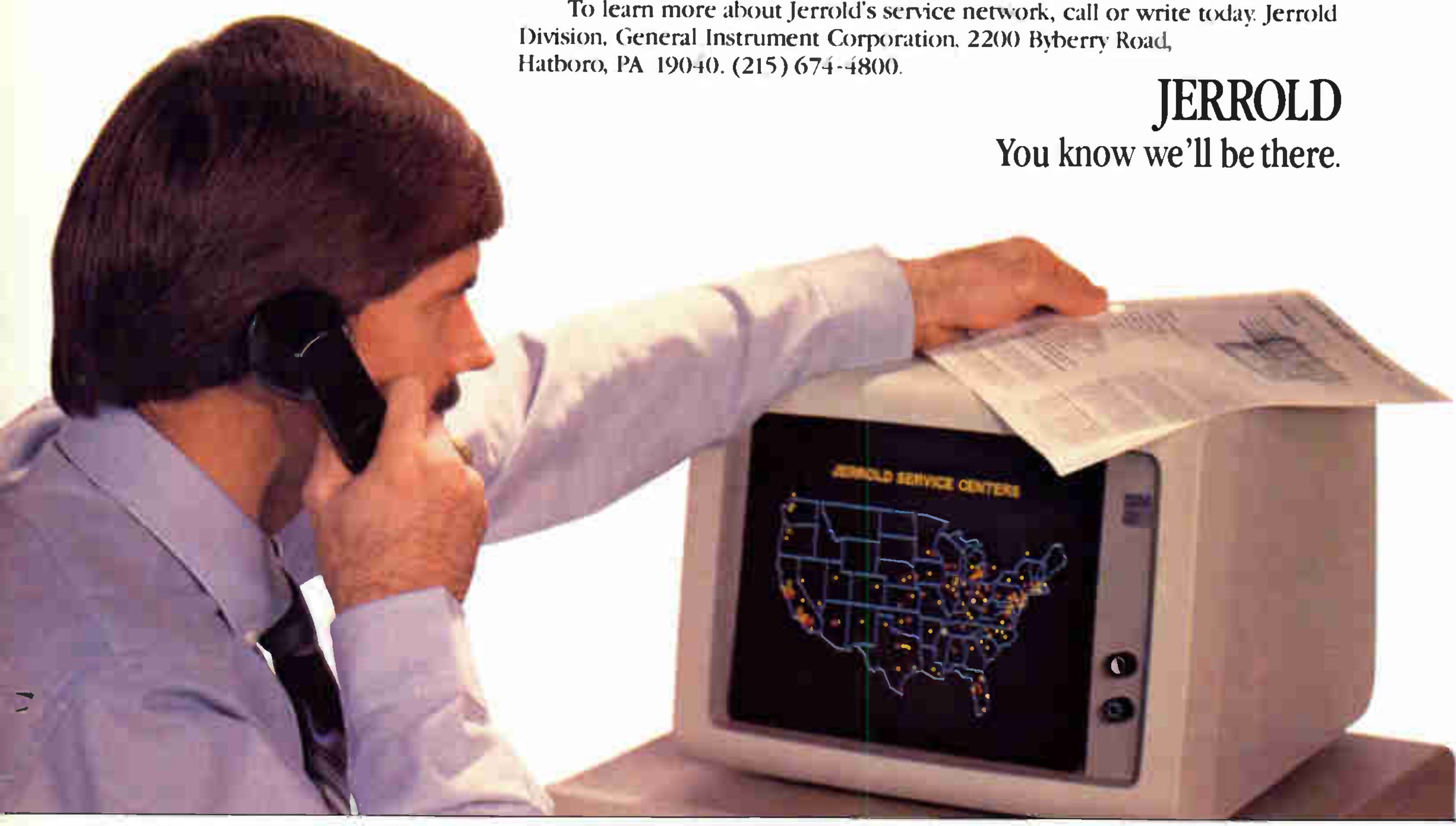

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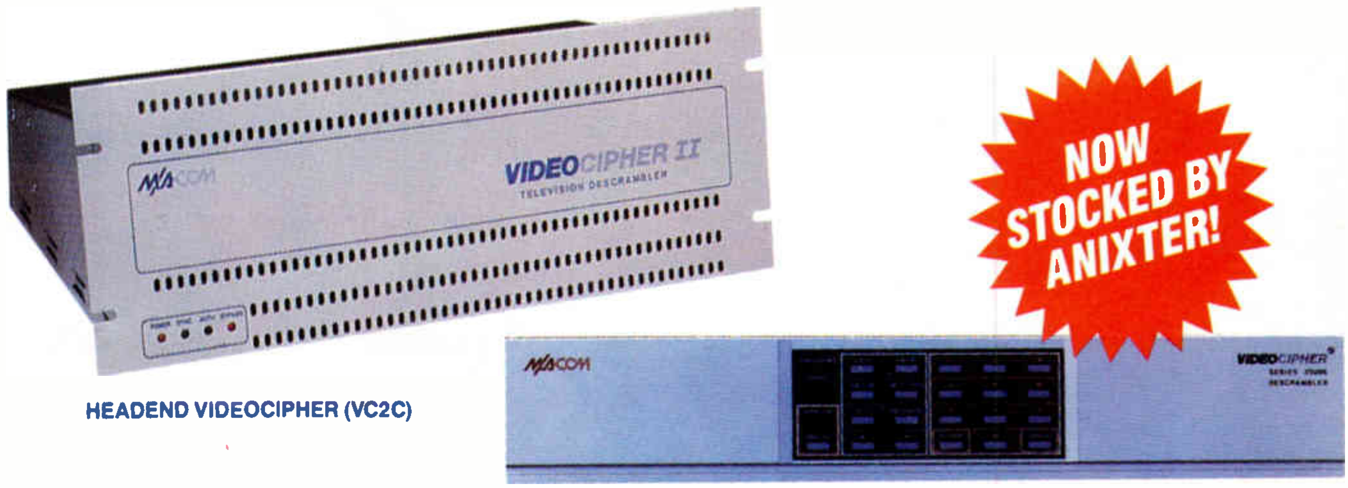

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CT 51