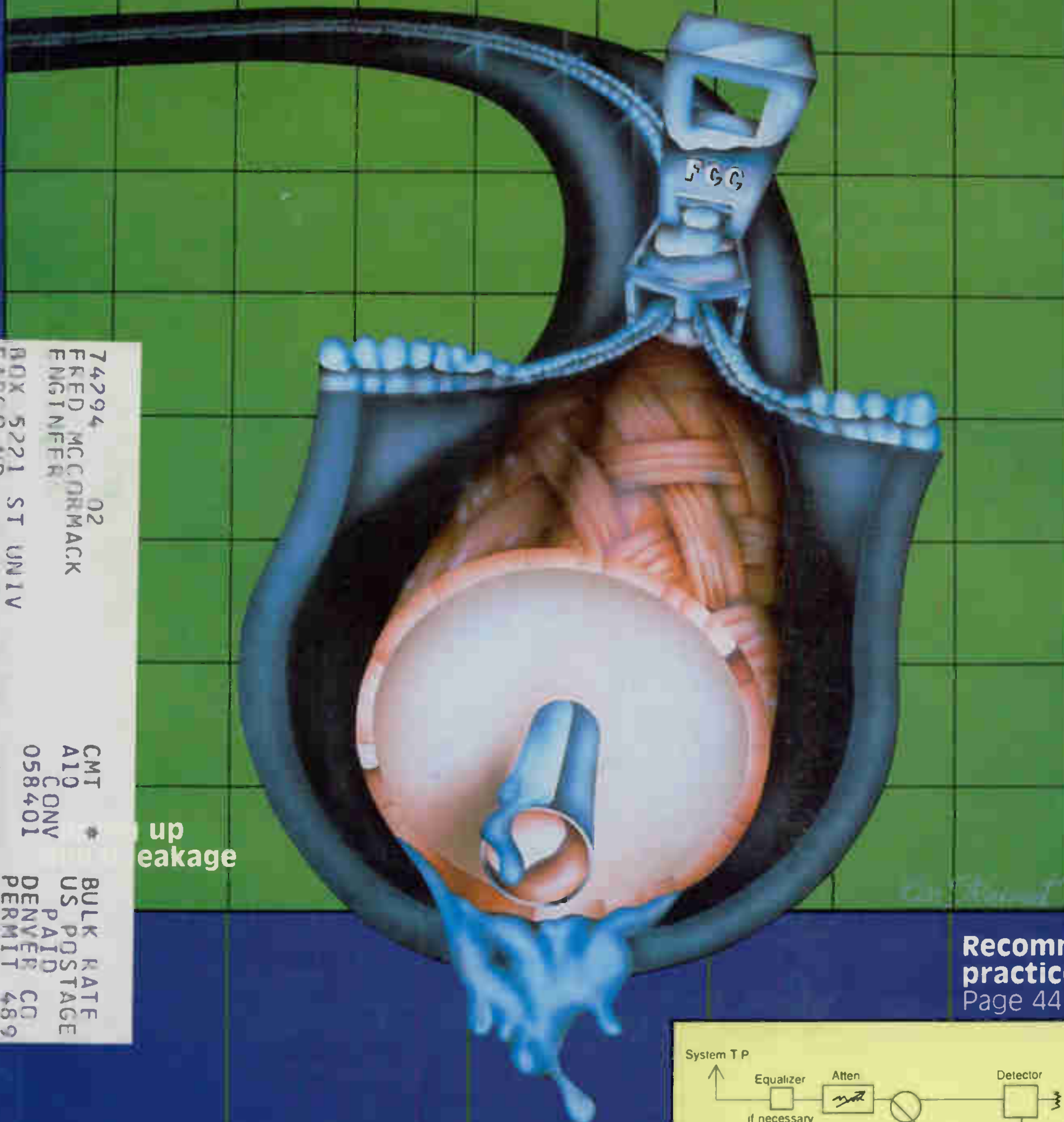
COMMUNICATIONS TECHNOLOGY



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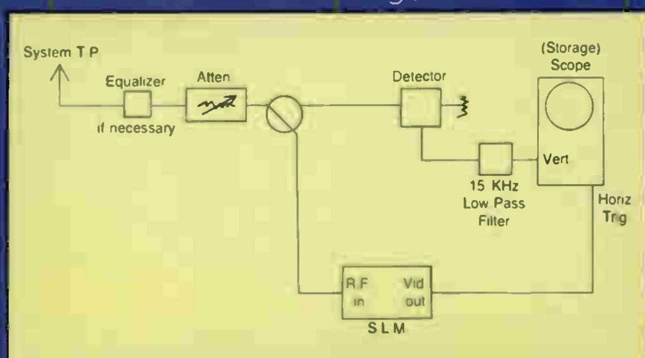

February 1985

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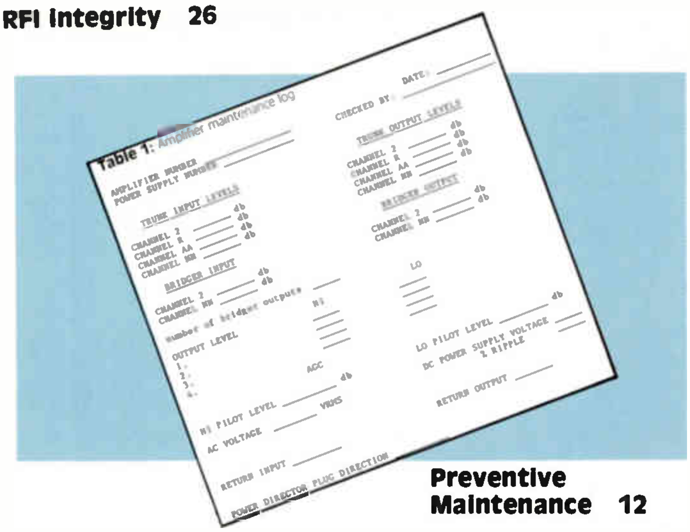

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Communications Technology is published monthly by Communications Technology Publications Corp., 12200 E. Briarwood Ave., Suite 250, Englewood, Colo. 80112—or—P.O. Box 3208, Englewood, Colo. 80155, (303) 792-0023. February 1985, Volume 1, Number 12.

Remember, back in 1951, when TV stations were low in power and antennas not very efficient? Milton Jerrold Shapp, the founder of Jerrold, didn't realize he was helping to create a new industry when he developed an amplifier that Bob Tarlton needed for his Lansford, PA community antenna system.

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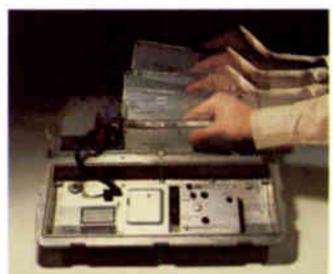

See us at the Texas Show booth # 210.

GENERAL INSTRUMENT

Doing it for the subscriber

Historically, technical changes have been spurred by specific fragmented groups within the communications industry. Because of this, the results were such that they have typically benefitted the particular segment promoting those changes. Fortunately, we are now seeing a spirit of cooperation *among* these diverse, but nevertheless related, entities.

A giant step

One such example of working cooperation is the EIA/NCTA joint engineering committee. The fact that this committee was formed in the first place is a giant step in the right direction. Walt Ciciora, ATC's VP of Research and Development in Advanced Cable Technologies, said at the Western Show, "The EIA/NCTA joint engineering committee is an indication that two industries which up until recently haven't paid sufficient attention to one another, have recognized that they have some common interests and needs."

The goal of the EIA/NCTA joint engineering committee is to coordinate technical discussions on common technical problems. The biggest problem this committee has been working on through its Cable Interference Working Group, has been tackling the cable-ready TV problems.

"I have been working with this sub group," Ciciora said, "and we're investigating several issues. One issue was what kind of connectors, impedance levels and signal levels are to be used in interfacing to cable. Those problems," he said, "were very quickly settled. There was little controversy."

The next issue this group tackled was more complicated. Ciciora refers to this issue as the 70 dB syndrome. "There's been an unfortunate lack of good cooperation between the two industries," he emphasized.

"From the manufacturers' viewpoint, a lot of these specifications not only are impossible to achieve but also are impossible to measure." However, Ciciora did stress that "some of the behind-the-scene progress that has been made in this committee is the sitting down of reasonable people at a common table to discuss common problems and the avoidance of the 70 dB syndrome."

After speaking with several members of this committee, the general consensus was that there has been a noticeable increase in the spirit of cooperation, exchange of information and searching for common solutions to common problems.

It's time to forget the paranoia. The NCTA, EIA and TV set manufacturers are finally working towards a common goal—for the benefit of all concerned. In the end, it's the subscriber who notices (and pays for) the technological improvements in our industry.

Rehashing leakage?

This issue of *CT* again features several articles on our old nemesis "Signal Leakage." Has this subject been overdone? Not in my opinion. Signal leakage is still one of the most important and ignored issues plaguing the cable industry.

Cable veteran Bob Dickinson of AM Cable presents "Signal leakage: 85 style." He touches on some interesting facts about this arch villain. Dickinson then focuses on means of leak detection and measurement regarding accessible and not so accessible parts of the cable system.

Tom Hill with Sammons Communications has found that passives are often prone to signal leakage, especially the splitters used on subscriber drops. The R&D department at Sammons has devised an interesting RFI chamber to test the signal leakage characteristics of drop splitters and other devices. We think you'll find this article quite interesting.

Also included in this issue is a portion of the NCTA's Recommended Practices. This section discusses five techniques for measuring the frequency response of the distribution system. Our thanks to the NCTA for allowing us to disseminate this useful information.

And who knows, there may come a time when we, as a communications industry operating within a "closed system," can *close* the book on signal leakage. We can only hope.

Toni I. Barnett

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BPA membership applied for November 1984.

CATV Texas Cable TV ASSOCIATION, INC.

Texas show technical agenda

SAN ANTONIO, Texas—The following are the SCTE-sponsored engineering presentations that will occur on Jan. 31 at the Texas Cable TV Association's annual convention. Credit for organizing this year's Texas Show tech lineup goes to Richard Covell, SCTE director at large.

- 9-10:15 a.m.—Digital Television
  Robert Luff, United Artists
- 10:30-11:45 a.m.—Two Degree Spacing
  William Riker, SCTE
- 1:30-2:45 p.m.—Signaling and Control
  Scott Tipton, HBO
- 3-4:15 p.m.—Multichannel Sound
  Alex Best, Scientific-Atlanta

Exhibit floor hours for 25th annual Texas Show are: 2-7 p.m. on Wednesday, Jan. 30; 9 a.m.-12 p.m. and 2-7 p.m. on Thursday, Jan. 31; and 9 a.m.-1 p.m. on Friday, Feb. 1.

Buckeye opts for MARC/10 system

STAMFORD, Conn.—Buckeye Cablevision Inc. has selected a Magnicom Systems MARC/10 in-house information management system for its Toledo, Ohio, operation. Buckeye serves over 118,000 subscribers through its cable systems in Toledo and Sandusky, Ohio, and Monroe, Mich.

The Buckeye MARC/10 system comprises a DEC VAX-11/750 computer located at its Toledo headquarters with remote workstations at the Sandusky and Monroe offices. In addition to MARC/10's basic tier capabilities, the Buckeye system includes software to handle trouble calls and dispatching, collections and write-offs, full accounting, converter inventory, and interface with Jerrold and TOCOM addressable converters. Installation is scheduled for the first quarter of 1985.

CCI acquires rights

CHATTANOOGA, Tenn.—The marketing rights for Stationmaster™ ad insertion and verification equipment have been acquired by Commercial Cable Inc., the manufacturer. Commercial Cable developed the Stationmaster system in 1980 and entered into a marketing agreement with TV Watch in 1982. Under that agreement, TV Watch was responsible for selling the equipment, while Commercial Cable continued to manufacture and develop new products.

John Brady, president of Commercial Cable Inc., said, "Consolidating sales with manufacturing will bring us closer to the customer and will improve our response time for new-product development."

TV Watch will continue with its local ad sales operation and will continue to use Stationmaster equipment and Commercial Cable's production services.

Panasonic signs distribution pacts

SECAUCUS, N.J.—Panasonic Industrial Co. announced the signing of BR Satellite Communication Inc. to distribute Panasonic's satellite television receiving equipment. Panasonic will supply BR Satellite with two C-band low-noise block down converters (Model CI-LNB-100 and Model CI-LNB-85) and two satellite receivers (Model Ku/C-6000 and Model C-2000). Delivery is set for March 1985.

Panasonic also announced the signing of Satellite Reception Systems Inc. (SRS) to distribute Panasonic's satellite television receiving equipment. SRS is based in Athens, Ohio, and it has sales operations in Lansing, Mich., and Columbus, Ohio. Future plans include sales offices in Pittsburgh, Charleston, W.V., and Cincinnati. SRS began operations in the second half of 1981 with total sales reaching $250,000. The company's sales for 1984 were over $11 million.

SRS will distribute the same Panasonic equipment as BR Satellite.

White House uses electronic mail

WASHINGTON—News and information from the White House is now being distributed to the media and other subscribers over an electronic mail network operated by ITT Dialcom Inc. The White House News Service electronically transmits news releases, speech texts, statements, personnel appointments, announcements of new legislation and other news to subscribers throughout the United States.

The service, developed by the White House Office of Media Relations and the Office of Administration, provides information from the White House Press Office, the Office of the Vice President and the Office of Management and Budget.

The White House News Service utilizes ITT Dialcom's E-PUB electronic publishing software, which allows a user to publish information and make it available for mass distribution.

Gulfstream acquires 25,000 subscribers

TAMPA, Fla.—Gulfstream Cablevision of Pasco County has acquired a cable television system from Storer Communications of Miami, Fla. The system serves approximately 25,000 subscribers in the Western portions of Pasco County.

An affiliate of Gulfstream also recently acquired a cable television system. Atlantic American Cablevision of Florida Inc. took on the assets of Pasco CATV Associates, a system operated by Acton Corp., which serves portions of Western Pasco County. Pasco CATV has approximately 2,100 basic subscribers.

Teleport uses Microdyne equipment

OCALA, Fla.—Microdyne Corp. supplied satellite video equipment for the Central Florida Teleport, which went operational on Sept. 1, 1984. Located at the Ocala Airport Commerce Center, it is the first permanent teleport in central Florida. It offers full business services including a teleconference studio, word processing, telephone service and eventual access to any and all domestic communications satellites.

While the Central Florida Teleport presently transmits and receives C-band video for sports and special events, it also is capable of utililizing the Ku-band

NCTA appoints committee to direct 1985 show

WASHINGTON—The National Cable Television Association has named its 1985 convention committee to direct planning for the annual convention, exposition and programming conference scheduled for June 2-5.

Trygve Myhren, chairman and chief executive officer of American Television and Communications Corp., Englewood, Colo., is chairman of the committee.

Members are: David Batalsky, vice president, Showtime Entertainment Inc., New York; Edward Bennett, executive vice president, Viacom Cablevision, Pleasanton, Calif.; John Evans, president, Arlington Cable Partners, Arlington, Va.; Peter Frame, vice president of affiliate relations, Home Box Office Inc., New York; Gordon Halverson, vice president, Anixter Communications, Chicago. Burton Staniar, president, Group W Cable Inc., New York; James Stilwell, president, Teleservices Research and Development, Jenkintown, Pa.; June Travis, executive vice president, American Television and Communication Corp., Englewood, Colo.; Roger Turner, president, Colony Communications, Providence, R.I.; and Barbara York, vice president, The NABU Network, Alexandria, Va. NCTA staff liaison is Ann Dorman, director of industry affairs.

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NCTA: To be or not to be in technology

By Isaac S. Blonder
Chairman, Blonder-Tongue Laboratories

More often than not, a recital of the history of cable television repeats the familiar themes of rags to riches, a migration from the outlands to the cities, from illegality to dominance, and from scarcity to a cornucopia of offerings.

Many segments of our society contributed to the growth of cable TV. The pioneers of the 1950s were the true rugged individuals typifying the American entrepreneurial stereotype; small businessmen, laborers, many without any electronics training, stringing cable in their local communities without franchises and other legalities. In retrospect, the growth of cable homes and specialized cable services that rival both the telephone and broadcasting industries now seems inevitable.

The pioneering phases of cable are usually well publicized and the many legal and congressional battles are minutely examined and described to the layman. However, a similar exposure is not commonly available about our engineering and manufacturing professions. Perhaps it is because the engineering language is more obtuse than the legal.

To review the engineering history of cable, it may be well to segment the technology by establishing landmarks of design that would force a rebuild of cable plant.

1) Open wire—Sometimes nothing more than two strands of fence wire nailed to trees, but with original 300Ω amplifiers, able to cover miles on the low VHF band.
2) Coaxial cable—Military surplus of various impedances and diameters with high transmission loss but superior to open wire for multiple installations.
3) All channel—(2-13) coaxial cable, tubed amplifiers designed for the new cable standard of 75 ohms.
4) Transistorized amplifiers.
5) Superband.
6) Two-way and other services.
7) Dual cable and/or higher bandwidths.
8) TV stereo sound (BTSC).
9) ?

One could conclude that the cable plant had to be rebuilt every five years!

Interposed with these major advances in cable plant design were the many faces of pay TV that were inserted for more revenue potential. Pay TV also may have required major rebuilds as a consequence. And who supplied the research and funds to achieve these new designs to ensure the growth of cable TV? Not the operators, not government-sponsored research; it was American manufacturers.

Looking ahead

The past, however, is not necessarily the future. Now the majority of cable equipment dollars go overseas to foreign firms. With these dollars also goes the R & D, and a foreign research laboratory may not be as responsive to American cable problems (certainly not where political interests are tied into the technology).

The deficiency in R & D also is illustrated in the BTSC dilemma. The cable industry ignored the existence of the multiple television sound committee for three years until it suddenly realized that the FCC was favorably disposed to authorize a TV stereo sound technology that could not be transmitted through the average cable system. Even after the National Cable Television Association (NCTA) became actively involved, the problem was not solved and the FCC approved BTSC, causing a financial and image blight on the cable industry. Had there been a cable R & D laboratory in existence, it might have found a suitable system to satisfy both broadcast and cable needs.

Other booby traps for cable may appear. Cable should have its own "Bell Laboratories." Cable operators could contribute 1 percent of their gross income (Bell was 2.5 percent of the phone charges) to an R & D fund. This fund probably should be controlled by a semi-autonomous arm of the NCTA and primarily used to support R & D at the universities. All projects should have limited lifetimes to avoid creating a bloated, non-productive bureaucracy.

There is every reason to believe that the 1 percent R & D expense would increase the penetration and profitability of the cable industry. In addition, it has the considerable side benefits of long-range planning, cable image and blunting potentially destructive regulatory edicts.

Organization and implementation

By Robert E. Sturm
President, Communications Systems Design & Planning Inc

As a result of increased cable communication system technology, franchising pressure and commitments made to local governments, a new type of cable system has evolved. Cable construction has moved from the rural and less populated areas, to the suburban and urban areas. Now the state-of-the-art systems are comprised typically of multi-hubs, subscriber distribution systems, institutional systems and special interconnect networks.

These unique and highly sophisticated systems are consuming a greater share of the operations budget. In areas where competition from numerous off-the-air channels is strong, operators must deliver excellent quality pictures and services with a minimum amount of system outages. Executives and technical managers are taking a closer look at system maintenance and associated costs.

Organization and implementation are key to any successful maintenance program. The outside plant can be broken into individual subsystems for maintenance management purposes. In this article, four major subsystems will be examined—interconnect networks, subscriber trunk system, subscriber distribution system and power supplies.

The interconnect network is one of the most important subsystems to a cable system. Its performance and reliability are critical to the overall operation. Minor problems not corrected in the interconnect network can become major problems after going through the various hub sites and being distributed to the subscriber trunk and distribution systems.

The subscriber trunk system should be monitored on a continuing basis. Again, reliability and performance are key issues to the success of this system. Due to the number of potential subscribers being fed from a trunk and the potential for lost revenues, failures must be kept to an absolute minimum.

The subscriber distribution system is where the majority of outages may be expected to occur. Proper design and construction can help minimize these potential problems. The majority of coaxial cable connections and active components used are in the subscriber distribution system, so proper component selection, construction techniques and maintenance are of critical importance.

Power supplies feed AC power to all active components of the cable system. The proper selection and maintenance of these devices is absolutely essential. The power supply itself is a highly reliable device, but loss of commercial power can be expected to occur periodically. Standby systems are subject to failure and maintenance is a must.

'Keep in mind that maintenance starts the day the first subscriber is brought on-line and is an ongoing effort'

Maintenance of the subsystems

The following is suggested as a guide to maintenance as these methods have worked well for a number of operators. You may find other methods and procedures that work equally well, or better, within your own organization.

All trunk amplifiers should be swept at a test bench facility prior to installation. This will help isolate and eliminate any defective or substandard components prior to activation. As part of the preventive maintenance procedures, the trunk system should be swept on a continuing basis. The response of the amplifiers should be noted and logged for future reference. Input levels also should be recorded. Automatic gain controls may mask low input levels to an amplifier. Periodic review of the amplifier maintenance logs (see Table 1) for input levels could reveal this situation prior to failure. AC voltage to the power supply module should be measured and logged. The number and output levels of the feeder legs should be measured and logged. DC voltages from the internal amplifier power supply should be checked.

Bridging amplifiers and line extender amplifiers also should be swept prior to installation. After installation and activation, logs should be kept for future reference. With the number of line extenders used in today's cable communication system, it is usually impractical to test every line extender in the system on a regularly scheduled basis. However, service personnel in the area should make an effort to obtain up-to-date information for the amplifier log. This information should be reviewed with the initial activation log and any discrepancies or potential problems—i.e., low inputs, poor response or other related problems—noted for corrective action.

During the course of normal system maintenance, the reliability of the system passives may be determined. By the very nature of the devices being passive, they are not susceptible to catastrophic failure. That is not to say passive devices cannot be a source of problems. Low input levels to active devices, subscriber taps or other passives may be caused by passive devices that are not within specification. Low subscriber tap output levels may be caused by improper splicing (loose center conductor, subscriber taps that have been spliced in backward).

A regular maintenance program should be set up for power supply testing and maintenance. A recommended testing interval would be once a month, and these tests

Table 1: Amplifier maintenance log

AMPLIFIER NUMBER ________ DATE: ________
POWER SUPPLY NUMBER ________ CHECKED BY: ________

TRUNK INPUT LEVELS		TRUNK OUTPUT LEVELS	
CHANNEL 2	____ db	CHANNEL 2	____ db
CHANNEL R	____ db	CHANNEL R	____ db
CHANNEL AA	____ db	CHANNEL AA	____ db
CHANNEL NN	____ db	CHANNEL NN	____ db
BRIDGER INPUT		**BRIDGER OUTPUT**	
CHANNEL 2	____ db	CHANNEL 2	____ db
CHANNEL NN	____ db	CHANNEL NN	____ db

number of bridger outputs ____

OUTPUT LEVEL	HI	LO
1.	____	____
2.	____	____
3.	____	____
4.	____	____

AGC

HI PILOT LEVEL ________ db LO PILOT LEVEL ________ db

AC VOLTAGE ________ VRMS DC POWER SUPPLY VOLTAGE ____
% RIPPLE ____

RETURN INPUT ________ RETURN OUTPUT ________

POWER DIRECTOR PLUG DIRECTION ________

Table 2: Power supply maintenance log

POWER SUPPLY NUMBER ______ LOCATION ____________________

DATE __________ CHECKED BY: _________________

TOTAL POWER SUPPLY CURRENT DRAW: ____ Amps

BATTERY CHECKLIST

clean terminals _________
physical condition _________
specific gravity _________
output voltage _________

CHARGING CIRCUIT

charging voltage _________
charging current _________

FOR THE FOLLOWING TEST'S IT WILL BE NECESSARY TO SHIFT THE POWER SUPPLY TO STANDBY MODE.PLEASE REMOVE AC POWER FROM UNIT BY USING DISCONNECT. THEN TAKE FOLLOWING MEASUREMENTS.

TIME TO SHIFT TO STANDBY _______
BATTERY DC VOLTAGE (STARTING) _______ vDC
INVERTER OUTPUT VOLTAGE(INITIAL) _______ vRMS

BATTERY DC VOLTAGE (15 MIN.) _______ vDC
INVERTER OUTPUT VOLTAGE(15 MIN.) _______ vRMS

RETURN POWER SUPPLY LINE VOLTAGE AT DISCONNECT

TIME FOR UNIT TO RETURN TO LINE MODE ________

should include: charging voltage and current, inverter card and standby mode operation and batteries for physical and electrical conditions. The results of these tests should be logged into a power supply maintenance log (see Table 2).

All trunk cable should be swept on a periodic basis, and records kept showing response. These records, with periodic review, will help pinpoint sections where cable or equipment is aging, or performance is otherwise slowly degrading. It would be ideal if maintenance could be planned and organized so that the entire trunk system is being swept in a constant fashion.

System ride outs should be performed on a regular basis. Items that should be included in the visual inspection are broken lashing wire, loose and/or broken fittings, corroded taps, etc. Along with providing a visual inspection of the plant, they provide an excellent opportunity for testing for system egress. Records of leakage checks will prove valuable in the event of FCC inspection.

It is impossible to touch every aspect of cable plant maintenance and preventive maintenance in this article. I have only highlighted areas of primary importance. The reader should keep in mind that maintenance starts the day the first subscriber is brought online and is an ongoing effort, and that a well maintained system has already satisfied the goals of preventive maintenance.

Makeready or not, here we go!

By Anthony J. DeNigris
President, Nationwide CATV Services Inc

Frustration, frustration and more frustration! Anyone who has been around long enough in the construction phase of this industry knows well indeed, what the meaning of repeated frustration is, especially when it comes to dealing with makeready.

Problems abound in many construction projects that relate to existing utilities' having to literally make room on the poles for the new guy on the block. It would seem that in many situations, where what is already there is in such a state of shambles, the advent of a cable TV system is a grant from heaven as far as the utilities are concerned. For it is the last guy on the pole that pays for the work everyone else has to do. Many times the costs associated with the privilege of being there are stifling, and Cable TV is up against the wall. Can CATV do anything about it or are we to sit back and absorb, absorb and keep on absorbing?

Basic problems

When an organization undertakes the task of planning a cable system, one of the first directions of attention should be on makeready. The local utilities should be notified of intentions to build a CATV system long in advance, if possible, of the actual makeready work, in an effort to establish a rapport and commence a relationship that might turn out to be very valuable in due time. What is needed is a unique understanding with the proper liaison personnel at the pertinent entities having something to do on those poles.

Most of the time, last minute surprises for makeready work can be avoided if the ground work was completed and the various options were explored. For instance, I know of a system in which one particular pole was estimated at more than $12,000 for the cost of facilitating a CATV line. The engineer in charge of the CATV project was able to pull some strings and the whole problem was history. He simply got the power company to OK the aerial bypassing of the pole by installing 36-inch extension arms on each of the two adjacent poles. This solution did present a long cable span to deal with, but nothing that was too impractical considering the savings involved.

The basic theme of a makeready survey is to determine whether or not CATV lines can be attached to the pole considering a variety of options for attachment, while still maintaining accepted clearances from utilities already there. As stated earlier, the existing state that some of these pole lines are in is phenominal. I have seen systems so bad—especially in some of the small towns where municipal ownership of the utility is the case—that on the principal of esthetics alone, not to mention existing clearance violations, the utility should bear all the costs of cleaning up its own mess. But CATV comes along and is hit with the load for the whole situation, merely because it needs the attachment and there seems to be no choice.

Only a short time ago, a municipal utility presented an estimate for a 120-mile makeready facilitation in an amount exceeding $500,000. The cable company was baffled and as a result, the build came to a screeching halt. I believe that a cable company should bear the burden of procuring attachment space, but really now, where does one draw the line?

In the preceding case, it might be presented to the utility that since its system is already in violation, and it is inevitable that it can't stay that way much longer, it would be in the best interest of the utility to clean up its own act now, in order to avoid possible imposition of fines and/or mandates from whatever regulating authorities are in power. I would venture to say that asserting one's weight in a situation like this might just cause the utility to see the light and become more workable with the cable company.

I have experienced many situations where the cable company is dictated to by utility companies whose attitudes are extremely arrogant. What does the cable company do about it? Usually the project engineer goes out in the system with the utility representative to come to a reasonable compromise, only to return with the comment, "Yep, they got us by the . . . ." Many project controllers don't realize the real viability of certain options when it comes to makeready. Many times it is cheaper to place the entire system on extension arms rather than incur the cost of direct attachment.

A common example of an unjustified expense is when telephone lines are already at the minimum clearance from the ground; and the power lines are also at the minimum clearance above phone on a relatively short pole, which means there is no room to raise the power lines. The solution comes back calling for the cable company to pay for a new taller pole, which is viewed as a very expensive burden. Instead of readily agreeing with this proposition, why not recommend the installation of an extension arm mounted four inches above the telephone line attachment? The answer is simple—or is it? In this case, the power lines are mounted on a full cross arm looking like a true "T" at the top of the pole and thusly, any lines mounted even an inch above telephone on that pole will be closer to the power than is allowed. So the replacement of the pole is accepted. Guess what? Yes, there was another solution to all of this. No one thought of asking the telephone company to share a full cross arm, or even half of one, which is called a side arm. If this could be agreed upon, for a cost of about $50 instead of about $350 plus, the cable line and the telephone line could attach to a wooden arm at the same, original height of the phone line, thereby maintaining vertical clearance from power for both phone and TV, and horizontal clearance between them on the cross arm.

All of this is not to say that it is as cut and dry as was previously described. The parties have to agree on the solution in order to affect the result, and this does not always happen. There may be certain restrictions on the appearance of the pole in a specific area of the town; or simply, the phone people may not want to be bothered. It all boils down to how tight the cable people get with their counterparts in the appropriate utilities. If the power company owns the pole outright, it could mandate the sharing of that cross arm as proposed by the cable company. But it won't happen if what is thrown at the cable people the first time is accepted readily. All too often in a cable build, money is thrown out the window.

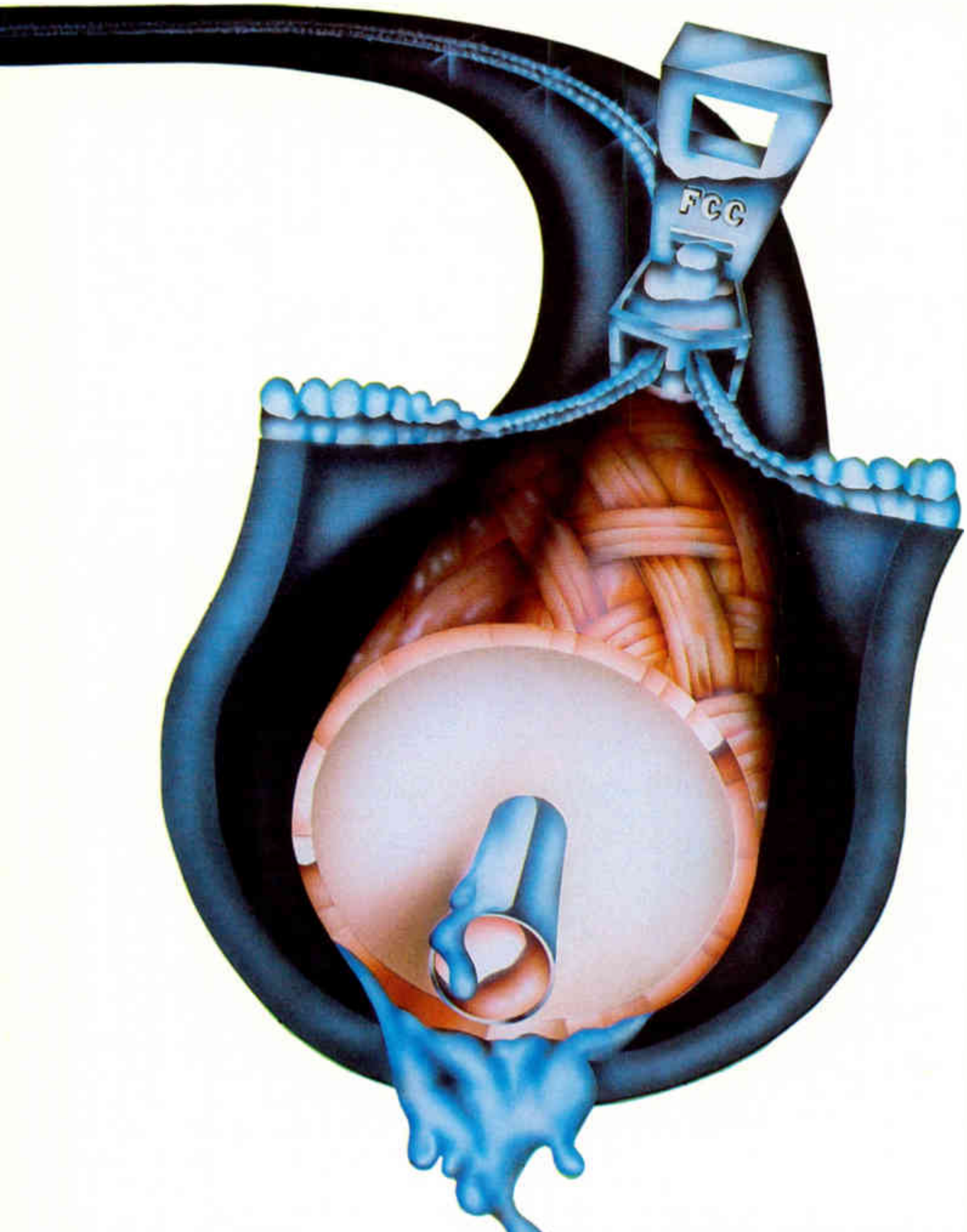
I know of another similar situation to the one previously described except the cost of the pole replacement was much greater due to the equipment on it. No viable solution could be agreed upon with the utilities involved although it should have been. So what did the cable company do? They went underground and completely bypassed the whole unreasonable mess.

Working through it

One might believe that in today's world, when it comes to following the rules of accepted standards (refering to pole attachment regulations), it should be a simple allowable, or non-allowable situation. This isn't the case at all. In fact, there are many projects existing today that are in total violation as far as national accepted standards.

It's called building around makeready; and what it means is that either the utilities involved didn't care to enforce standards—and if this was the case, certainly the cable company didn't mind saving the cost—or that the utilities couldn't maintain a schedule of makeready completion in advance of the actual cable construction. When this happens, and it does, it seems that the rules are not important anymore and the contractor is told just to get it (the cable) up there somehow and we'll worry about how it's going to be finalized later. Much of the time, it never does get finalized. This type of thinking is the prime reason that so many systems exist in such a horrid state of shambles today. And what happens because of it? It gets worse and worse. Then, since the appearance is degrading, the system starts lacking maintenance and eventually becomes a candidate for rebuild.

If you criticize what I am saying here, and you know of an older system that is going to be rebuilt, do some research into the past. You might be surprised. It still happens today!



'There are now new and more stringent regulations... increasing monitoring requirements and necessitating the implementation of CLI'

Signal leakage: 85 style

By Robert V.C. Dickinson
Senior Vice President AM Cable TV Industries Inc

You thought you had it made when you were able to tame those trunk amplifiers and line extenders to give a flat response and maintain it. And it felt even better when the power supplies stopped going out during every lightning storm and now while you are struggling to balance your upstream system, look what comes along — CATV signal leakage. We have always had it but it didn't cause us too much trouble until recently. Now it seems that instead of getting better, it's getting worse. First it was the Federal Aviation Administration complaining about air communication and navigation interference, then it was the Federal Communications Commission demanding that tighter systems be maintained, followed by the radio amateurs and . . . well what's next? Probably, leaky cable systems someday will be a thing of the past. Perhaps not because we would have it that way, but because so many users of over-the-air spectrum and regulatory agencies would. For now, a new batch of regulation is nearly upon us.

The FCC has issued a second Report and Order in Docket 21006, which will become effective when the various administrative procedures are complete. Its requirements are in some respects a relaxation of the current rules, in other areas they are much more demanding. Two of the new provisions bear directly on leakage monitoring and leakage measurements. Paragraph 76.614 (new) requires that "all portions of" each cable television system shall be "monitored once every three months," and that the "leakage sources shall be eliminated within a reasonable period of time." Paragraph 76.611 (new) provides for "basic signal leakage performance criteria" to be verified "prior to carriage of signals" and "at least once per year" for the record. The results of this monitoring and measuring procedure are represented by a figure of merit called the cumulative leakage index (CLI) covered in 76.611(a)(i)(new). It will serve as a proof of performance for the leakage integrity of the cable system. This rulemaking also addresses other important subjects (not explored here) such as frequency offsets, CATV signal allowable power levels, notifications and grandfathering.

These specific federal regulations will soon be law and must be adhered to. In a more general sense, leakage control is *forever* since the world will not tolerate leaky cable systems. Conversely, ingress goes hand-in-hand with egress and cable systems cannot be expected to perform properly in the presence of leakage from outside.

Locating and monitoring leaks

Everybody can go down a list from the headend to the TV set naming the various sources of leakage. Experience shows that the largest number occur in connection with the drops and the subscriber installation. Bad F fittings contribute their share, and unfortunately interconnection of TV sets, VCRs and TV games is becoming a bigger nuisance. On the brighter side, the leakage from illegal connections is often the handle the cable operator needs to catch the offenders in the act. Here, we will focus on means of leak detection and measurement plus procedural optimization of repairs and records.

Realizing that leaks must be located before they can be repaired has led several manufacturers to develop leakage detection equipment. Leakage detection products must alert the operator when leaks over the threshold of 20 microvolts per meter at three meters are encountered (76.605(a)(12)). Since the majority of leaks center around the subscriber installation, the use of small portable monitors by installation crews has become popular with a number of cable operators. The rule is usually that the installer does not leave the installation site until it is clean from the leakage point of view and, furthermore, he is held responsible for the quality and leakage integrity of his work.

The more general approach to leakage detection is a mobile monitor carried in service vehicles. This receiver should be wired to the ignition switch to ensure that it is always operational when the vehicle is in service. Other measures may be taken such as, putting the instrument in plain view of the driver, setting minimum audio volume and adding audible alarms. These precautions make it difficult or impossible to miss or ignore a leak. The monitors are usually permanently installed in the service vehicles and calibrated on a daily basis at a fixed threshold level field-established by a special generator and antenna at the garage or other central location.

One question that is often asked concerns the polarization of the receiving antenna for the leakage monitor. The easiest approach is simply to install a vertical antenna on the service truck. This antenna must be tuned to the monitoring frequency. But what is the actual polarization of the leakage signal from the cable system?

The leakage current flows on the outside of the cable sheath. Because the cable system is, in effect, a long and complex antenna, the polarization is hard to define. True, the cable itself (and the leakage current that flows on it) is horizontal, but when you consider the drops, grounds, the shape of the cable system, plus the power utility system (which due to grounding, becomes part of the antenna), etc., it is very difficult to specify the polarization. Not only that but horizontal RF currents do not always produce horizontal polarization.

To illustrate, consider that the "cable antenna" is a straight horizontal wire of finite length. Looking at that cable from the side one would surmize that, due to horizontal current flow on the outside of the cable sheath, the polarization of the radiated signal is horizontal. If you were to move to a point in the vertical plane containing the cable, but beyond either end of the cable, the projection of the same horizontal current from your vantage point is totally vertical. Hence, the horizontal current to an observer from this vantage generates a vertically polarized signal. Looking directly upward from beneath the cable results in pure horizontal polarization for current flowing over your head, but only if your receiving dipole is parallel to the cable. The point of all of this is that polarization is not simple and dogmatic statements about leakage polarization are probably not in order.

A horizontal antenna mounted above the top of the service van also will detect leakage signals. It should be mounted along the direction of vehicle travel. Experiments have shown that the signal amplitudes received from a roof-mounted vertical quarter-wave monopole and a horizontal half-wave dipole are about the same. (A horizontal dipole mounted at the optimum position of about one-quarter wavelength above the roof actually gives about 2 dB more signal than the vertical quarter-wave.) The horizontal dipole antenna has a somewhat sharper response as the vehicle moves under the leak allowing a closer approximation of the location of the leakage source.

Pinpointing leaks

This is all well and good when it is possible to drive out the system with the strand essentially overhead; but what about the conditions where the strand is in the alley or easement, or when it goes vertically in the high-rise situation?

The answer is not totally clear. When the strand is further away a threshold level leak will produce a smaller signal at the monitor than if you were the traditional three meters away. In addition, as you move away from the strand your ability to determine the location of the leak rapidly diminishes. Some have experimented with direction finding methods[1] for more rapid leak location where the strand is close to the street. Less has been done where the strand is removed from the right-of-way. It would appear that use of a directional antenna to do monitoring sweeps in the easements, etc., would bear promise since a directional antenna will tend to recoup the signal level reduction due to distance and lend its directionality to localizing the source. Although the new FCC regulations demand monitoring of 100 percent of the system, there is no proven procedure for this now.

The lack of convenient means to monitor relatively inaccessable portions of the system have led to more innovative approaches which currently are being tested. If one could sense the local leakage at various places on the system and feed that information back to the headend on in-bound cable circuits, the whole matter of leak detection would be simplified and the costs reduced. Some have suggested receivers distributed about the system with their output information fed back on a data stream. Others are looking at the use of data controlled switches to section the system allowing at least approximate location of ingress (and hence leakage) points. Inevitably, a number of these systems will evolve in the near future and ease the burden of total system monitoring. It is our understanding that the FCC is interested in nontraditional methods particularly if they increase the quality or the frequency of the monitoring provided.

Monitoring usually isolates the leak to a small section of the cable, probably to within tens of feet. From this point it is necessary to find the exact location of the flow whether it be a cable crack, leaky housing, faulty connector, etc. To accomplish this, move a sensing antenna very close to the cable. Using a half-wavelength dipole it is quite difficult, in many cases, to pinpoint the leak. Some manufacturers offer near field probes or the equivalent. These can be laid against the cable and moved along while decreasing the sensitivity of the monitoring receiver until the location providing the maximum reading is found, and hence the source of the leak is located. Such a device is almost a necessity. In addition, it is far more convenient to be able to mount the probe on the end of a long pole made of a nonconductive material so that probing can be done from the ground without the need for a bucket truck to locate the leak.

Repairing leaks

Many operators prefer the use of a dedicated crew to pinpoint and repair leaks. This crew is given the leakage reports from the monitoring done in the routine travel of installation and service. Whether a separate crew is used or not depends upon the system size and logistics plus the normal modes of operation and service people.

The FCC requires that a record be made of the date and location of each detected leak that exceeds the threshold value. This means that the information gathered and forwarded to the leakage repair crew could be asked for by an FCC inspector. When that leak is repaired an additional and correlated record must be made of the date and nature of the repair (probable cause of the leak). This too is an FCC requirement. It is assumed that when the repair is made that the leakage level falls to below the threshold. If this is not the case the leak has not been repaired. The commission rules require that repair be made within a "reasonable period." These records will be the source of information for the determination of reasonable period if push ever comes to shove on the issue. Note that in the whole procedure it is not necessary to make a precise measurement of the leakage level in order to record same. The primary liability of the cable operator is to be able to prove that his method of determining the level of the leak relative to the threshold is reasonably accurate.

You really should fix all detected leaks even though some may be below the threshold. A leak of 20 microvolts per meter at three meters is a large signal to many land-based communications systems. It easily could be the subject of a complaint from an amateur radio operator or mobile communication service. The ultimate criterion is not the actual leakage level but the presence of harmful interference. Paragraph 76.613 of the FCC rules defines harmful interference as "any emission, radiation or induction which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs or repeatedly interrupts a radiocommunication service operating in accordance with this chapter." Therefore, in some cases the cable operator may be required to make his repairs adequate to eliminate harmful interference (or remove the signal if the repair is not effective). The other side of this coin says that where there are high effective radiated powers from amateur or other communications sources, significant ingress may be encountered even where the egress does not exceed the threshold of 20 mV/m at three meters.

What about measurements? So far we are not required to make any measurements. Unless you opt to do flyover measurements per 76.611(2) (new) actual performance of leak-by-leak measurements is required in computing the Cumulative Leak Index previously sited (flyover measurements by you or a contractor, may cost less in some cases). Paragraph 76.611(1) (new) requires that once each year at least 75 percent of the cable strand must be sampled and the actual level of each leak exceeding 50 uV/m at three meters must be recorded. The traditional way to make this measurement is simply to buy or build[2] a dipole receiving antenna that is tuned to the frequency where the measurements are to be made. Connect the antenna through a balun to a signal level meter through an amplifier, if necessary. Make the readings and apply the applicable correction factor for antenna gain and frequency. These factors are published in the handbooks of most CATV equipment manufacturers.

For instance, using a folded dipole cut to the length of 95 percent of a free space half-wave the field intensity in microvolts per meter is equal to microvolts as read on the SLM, times frequency in MHz divided by 48.3. The dipole must be horizontal, three meters from the CATV system components and three meters above the ground (if such position cannot be attained the height above the ground may be increased to maintain three meters from the system components) according to 76.609(h)(3) (new). This is a straightforward way and complies with the FCC requirements, but it is also cumbersome and time consuming.

Some have improved the technique by building structures of insulating pipe (such as PVC water pipe) that can be hung on the strand to simplify positioning. The sensing antenna actually may be built into the structure allowing for a quicker and "fixtured" way of doing the physical set up in compliance with 76.609. We are again led to believe that the FCC will accept alternate methods if the cable operator can show that his alternate can produce the desired results with good accuracy. On the other hand it would be inadvisable to develop a better method and use it for numerous measurements without assurance from the FCC engineer-in-charge that the procedure is acceptable. Inevitably the industry will develop better techniques that will allow more expeditious collection of this required data.

Cumulative leak index

What on earth is the Cumulative Leak Index? Since 1971 the FAA, FCC and hence the cable industry have been much exercised over signal leakage. After the "Harrisburg incident" in 1976 the wheels started turning, throwing off not only smoke and fury but leading to the monitoring regulations that we now live with, and the threat of ultimate forfeiture. In certain cases severe fines have been levied against those who did not take care of their leakage and/or records.

One of the big problems was that there was no specific engineering or scientific data that one could reference in an effort to quantify the interference effects of cable signal leakage. An effort was mounted by the FCC that did contribute a far better engineering base. The FCC formed what was known as the FCC Advisory Committee on Cable Signal Leakage. The committee included members from the commission, the FAA and cable industry, as well as observers from a wider range of communications interests. Besides a good deal of analytical work, there was a rather extensive flight test program that included flyovers of many operating CATV systems, even some where intentional leaks had been induced. These tests were designed to obtain real-life data and to attempt to correlate ground measurements with airborne measurements. It was realized early on that to require cable operators to do flyover testing usually was not an optimum solution and was expensive and not without hazard.

The final report of this committee issued in 1979[3] recommended three methods to assure that the leakage fields in the airspace above a cable system did not exceed the 10 microvolts per meter level that had been agreed upon as being a reasonable threshold of interference for air navigation and communication services. The first of these methods was to fly a prearranged pattern over the cable system and measure the leakage fields on the monitoring frequency.

The second method was to do a mathematical summation of ground leakage measurements at a hypothetical point 3,000 meters above the center of the cable system. This was called "I of 3000." In order to do this, every leak on the ground has to be located as to its distance from the center of the system. The distance from the leak to the summation point 3,000 meters in the air would be equal to the hypotenuse of the triangle formed by the radial from the center of the system to the leak and the vertical from the center of the system to the summation point.

To sum the powers at such a summation point it not simple since there are both phase and polarization unknowns. The decision was made to do a direct power summation. It can be shown that this gives a conservative answer, i.e., the actual field will probably be lower than the calculated field due to phase and polarization misalignments. The quantity I_{3000} is calculated based upon the summation of the field intensities of each leak of 50 uV/m or greater divided by the distance of the leak from the summation point in space, all squared. Since it was recognized that such a determination made on a fraction of the system could be reasonably extended to the whole system, a factor of the number of system miles divided by the number of miles driven was applied to the summation. The whole formula then became:

$$I_{3000} = \frac{M}{M_d} \sum_{i=1}^{n} \frac{E_i^2}{R_i^2}$$

Where:

n is the number of leaks equal to or greater than 50 uV/m at three meters.

i is the number of each of the n leaks.

E_i is the magnitude of the leak i in microvolts per meter at three meters.

R_i is the distance of the leak i from the center of the system in meters.

n is the number of each specific leak equal or greater than 50 uV/m at three meters.

M is the total miles of plant.

M_d is miles actually driven.

This is not a complex formula, however it does require calculation of the distance from the summation point for every leak and becomes tedious and time consuming.

The third method determined an index called "I of infinity." If the summation point is moved very far away then the distance to all points becomes the same and the calculation of the individual distances can be eliminated. This gives rise to the formula:

$$I_{\infty} = \frac{M}{M_d} \sum_{i=1}^{n} E_i^2$$

The FCC limits for system qualification are that 10 log I_{3000} = < −7 or that 10 log I_{∞} = < 64. According to the FCC regulations, leaks less than 50 microvolts per meter can be ignored in the calculation (but not in the monitoring and repair). The reason for this is that by squaring the amplitude of each leak the contribution to the summation of the small leaks is relatively insignificant. The qualification limits were derived by working backwards from aerial and ground data taken in various systems. These limiting values represent a good correlation between the contribution of ground leaks to integrated aerial measurements. Details of the derivation of the formula and determination of the limits is contained in the referenced report.

So there it is, CLI in a nutshell. The first time through sounds a little complex, however the mathematics are simple. There have been computer programs published[4] that take the entries, do the mathematics and conveniently present the results. Whatever means you use to calculate I_{3000} or I_x you had better keep the calculations handy along with the relevant data for inspection by an FCC representative.

On our toes

It is probably accurate to say that, to date, there have been more fines for poor or no records or other paper work than for actual leaks. Examine the other portions on Part 76, Subpart K (old and new) to make sure that your paperwork requirements for notification (form 325, etc.), are complete and up to date. Note that the second Report and Order adds many new twists including an entire frequency offsetting system and has some involved grandfathering provisions.

Before closing, two paragraphs from the second Report and Order in Docket 21006 must be quoted. §18: "The cable industry has alleged that its record of compliance with our interference rules is exemplary. However, the inspection program of the commission's Field Operations Bureau has discovered numerous systems in violation of the 20 uV/m standard of Rule 76.605(a)(12), noncompliance with notification requirements of Rule 76.610, or violation of frequency offset requirements. This indicates that many cable operators have been lax in their responsibilities in this area and that the cable industry's record of compliance is questionable. We believe the record supports strengthening, not relaxing, the present requirements, especially considering the potential for aviation disaster." And §19: "Based on the record at this time, we are unable to conclude that cable operators can be relied upon to maintain their systems sufficiently free from signal leakage as not to create risks of harmful interference in the aeronautical radio frequency bands. Many have not adequately complied with either signal leakage standards or monitoring requirements. Although no new cases of interference have been reported during the past four years, as the FAA begins upgrading its facilities and 'splitting' channels, conflicts become increasingly likely. Until such time as there is confidence that CATV systems are sufficiently closed transmission facilities so as to be incapable of causing harmful interference to services in these bands, it is necessary to continue with a regulatory solution."

Statements like this are a shame on the industry—so let us take this whole thing very seriously!

What have we said? First we have been operating under FCC regulations that require monitoring and maximum leakage levels for a number of years. There are now new and more stringent regulations that recently have been passed by the FCC increasing the monitoring requirements and necessitating the implementation of CLI to verify system cleanliness. These matters require our attention.

Clean systems are good for everyone. So we must: a) monitor, measure, fix, and record for the FCC lest you be fined or shut down; b) monitor, measure, fix and record for yourself and your customers since this leads to better cable system performance; and c) when you monitor, measure, fix and record, do it right or it will come back to haunt you.

Footnotes

[1]Robert Luff—United Artists CableSystems, San Angelo, Texas

[2]A simple plan for a horizontal dipole design for van top ladder rack mounting is available from Roy Ehman—Storer Cable, P.O. Box 4605, Miami, Fla. 33169

[3]Final Report of the Advisory. *Final Report of the Advisory Committee on Cable Signal Leakage*. This report is available—item number PB80-119605, National Technical Information Service, 5285 Port Royal Rd., Springfield, Va. 22161, (703) 487-4650.

[4]UA's Leakage Log: Keeping it Clean," *Cable Television Business* Dec. 1, 1983, pg. 40.

*The author is particularly indebted to the fine work on this subject by Bob Luff of UA Cablesystems and Roy Ehman of Storer.

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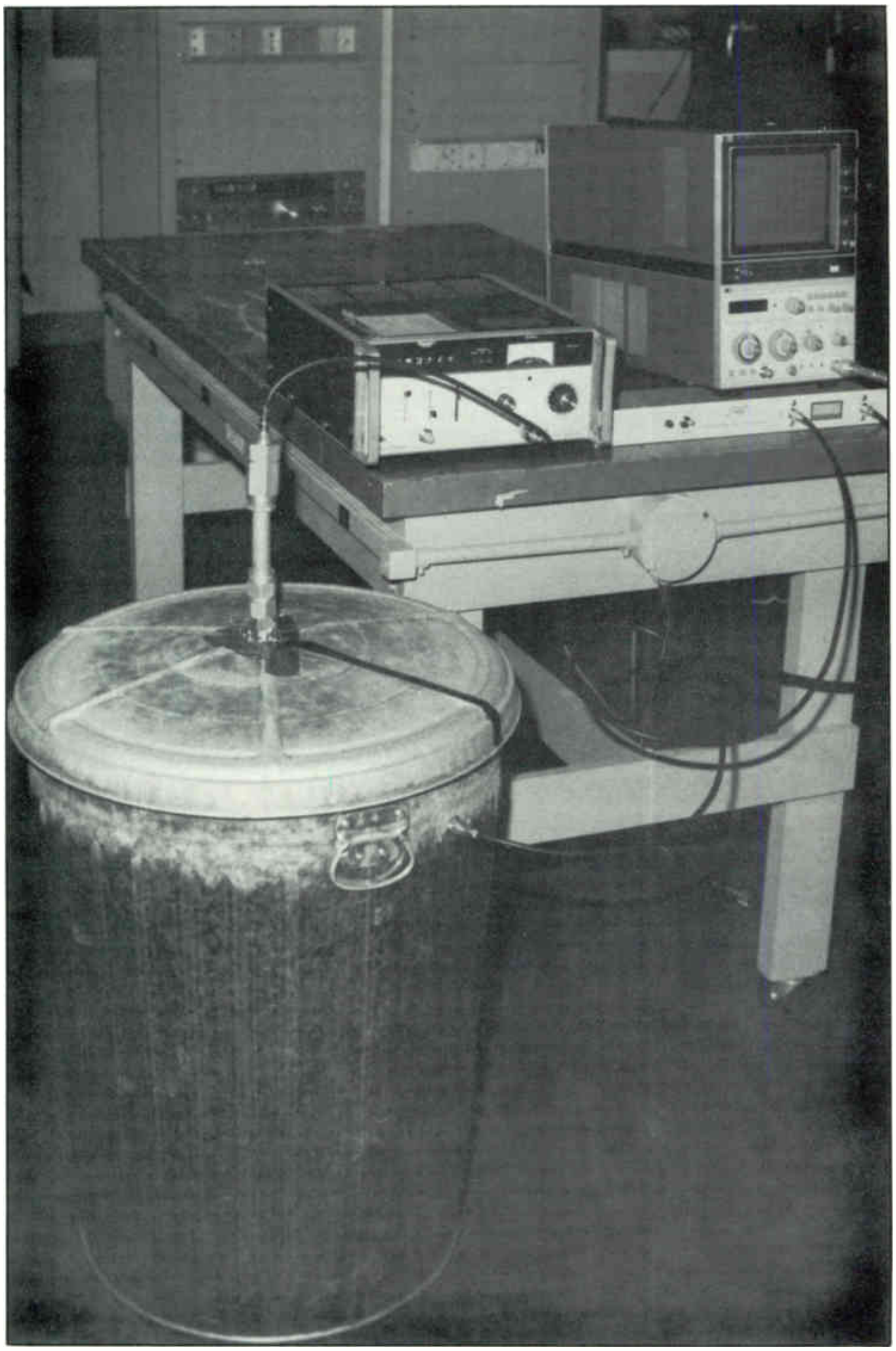
Getting active with passives

By Tom Hill
Assistant Director of Engineering Sammons Communications

Much has been written on the subject of signal leakage since compliance with the FCC rules and regulations came onto the CATV industry in the early 1970s. During those 10 years or so we have seen many changes in CATV technology and techniques. One thing that has not changed is an acute awareness that, FCC rules or no rules, signal leakage must be drastically limited in every cable system, if for no other reason than to minimize or eliminate ingress. With the prevalence of more powerful transmitters by other users (especially in the sub- and mid-bands), radio frequency interference (RFI) integrity from the headend to the subscriber's terminal is essential. Even the best signal leakage detectors available today are hard pressed to determine all levels of leakage that can exist from 5 to 500 MHz and beyond.

Compliance with signal leakage requirements becomes progressively more stringent with such things as the recent FCC policy for the usage of wideband and FM signal transmission and even more recently, FCC Docket 21006. Cable TV operators are just beginning to realize the ramifications of the measurement and monitoring requirement of system compliance with the cumulative leak index as outlined in Docket 21006. No longer can cable operators feel they have satisfied the FCC technical standards simply by conducting their annual FCC proof of performance tests. Signal leakage awareness must be an everyday, every person, every system endeavor in order to keep leakage and ingress down to tolerable levels.



A cable system is only as RFI tight as the quality of the hardware that goes into it, as well as the expertise of those putting all the pieces together and maintaining the plant. We depend on the distribution equipment manufacturers to provide quality electronics and passives, but our experience at Sammons has shown us that some passives still are prone to troublesome signal leakage. The splitters used on the subscriber's drop, in particular, warrant careful evaluation to ensure RFI integrity. Since these are relatively low-cost items, which are produced in very large quantities, some drop splitters do not achieve good signal leakage characteristics. Also, there does not seem to be an industrywide standard for passive signal leakage or even a standard method to test for that leakage.

The degree of signal leakage in a properly terminated drop splitter, as you might expect, is usually due to the way the cover plate is attached. Most of the cover plates are pressed on and then the joint is covered with an epoxy material for weather proofing. Many times the cover plate still does not contact the splitter body properly resulting in a poor RFI seal.

Taking action

To evaluate passives and other devices for signal leakage, Sammons constructed an RFI chamber where the devices are tested. A similar chamber, which has been described in various publications[1], is a variation of the "SEED" (shield effectiveness evaluation device), designed by Belden Cable for testing their shielded cable. The chamber permits

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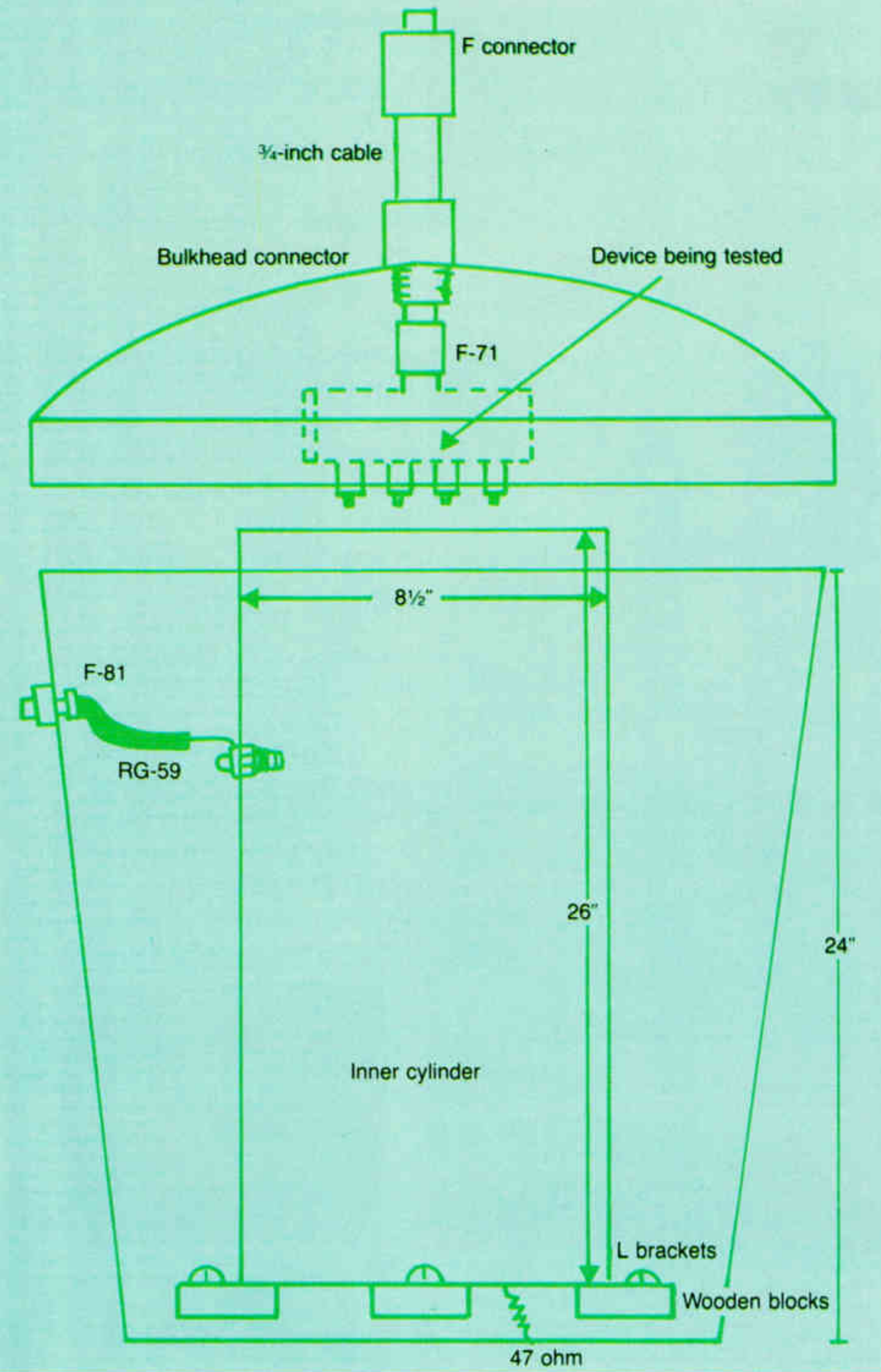
effective comparisons of various passives made by different manufacturers. but the absolute leakage numbers may not be identical from chamber to chamber because of fabrication variations

The RFI chamber used at Sammons was constructed from a 30-gallon metal garbage can (Figure 1). This was selected because it was a convenient size. was inexpensive and. with some modifications. became a relatively RFI-tight enclosure A hole. punched in the center of the lid. accepts a bulkhead connector that is attached to a piece of .500 aluminum cable with a 500 to F adaptor (Figure 2). An F-81 connector would probably serve as well The terminated device to be tested is thus fed a signal of 60 dBmV from a Wavetek Model 3000 signal generator. The leakage is picked up by a 12-inch diameter cylinder of sheet metal situated vertically inside the can. This inner cylinder is insulated from the outer can by wooden standoffs but is terminated to the outer can by a 47 ohm resistor An F-81 connector is placed in the side of the can and is attached to the inner cylinder by a short length of RG-59 cable with the center conductor bolted to the cylinder. This F-81 is the point where the signal leakage is sampled. Because of the extremely low levels at the sampling point. the output is amplified by a post amplifier with 40 dB gain. Though only one frequency is inserted at a time. it is helpful to monitor and measure the amplified output with a spectrum analyzer like the HP Model 8559. This way you can vary the input frequency and still constantly monitor the signal leakage output

Figure 2: RFI chamber cutaway



Sammons found an acceptable level of signal leakage to be in the area of at least 100 dB down from the signal input. Assuming a 60 dBmV signal is being supplied to the properly terminated device in the can and a 40 dB gain post amp. the amplifier output should be no higher than 0 dBmV. Testing has shown that a good drop splitter measures leakage around 125 dB down and the best strand-mounted taps and splitters measure at least 130 dB down.

As mentioned before. these leakage levels will vary from chamber to chamber. Although Sammons has determined that 100 dB is an acceptable level and good is around 125 dB down. others may disagree as to just what is acceptable or good. It is important that you establish your own standards based on measurements taken from the test chamber you have constructed.

The safety factor

Why it is necessary to have an RFI integrity of 100 dB or more for any drop passive? Since it would normally be fed a signal of around + 10 dBmV. this means any leakage would be in the area of -90 dBmV. If everything in the typical cable system never leaked more than -90 dBmV. would there ever be any signal leakage problems? Keep in mind we are talking about measurements of a brand new device fresh from the manufacturer. The seal around the cover plate and terminated ports will probably never be as good as they are now. By the time mechanical forces and environmental corrosion get to it before and after installation. it may have a struggle meeting even the 20 microvolt leakage requirements. If Company A sells a 125 dB device for essentially the same price as the 90 or 100 dB device of Company B. which would you choose? If the quality of CATV equipment is to stay at a high level. it is important that cable operators demand top quality and test that equipment to be sure they continue to get that quality. We need 100 dB or better RFI integrity to satisfy a safety factor We can control the level being fed to the splitter from a tap but we cannot control the signal level of a pager transmitter a few blocks away. We wouldn't expect a 160-pound man to climb a pole or tower with a safety strap rated at 160 pounds. Safety factor.

In summary. demand quality. demand a safety factor. then test often and rigorously to ensure you are getting the quality you'll need for the next 10 years

[1] Sandy B Livermore *Quantifying Signal Leakage How Do Current Methods Measure Up?* NCTA Convention 1984

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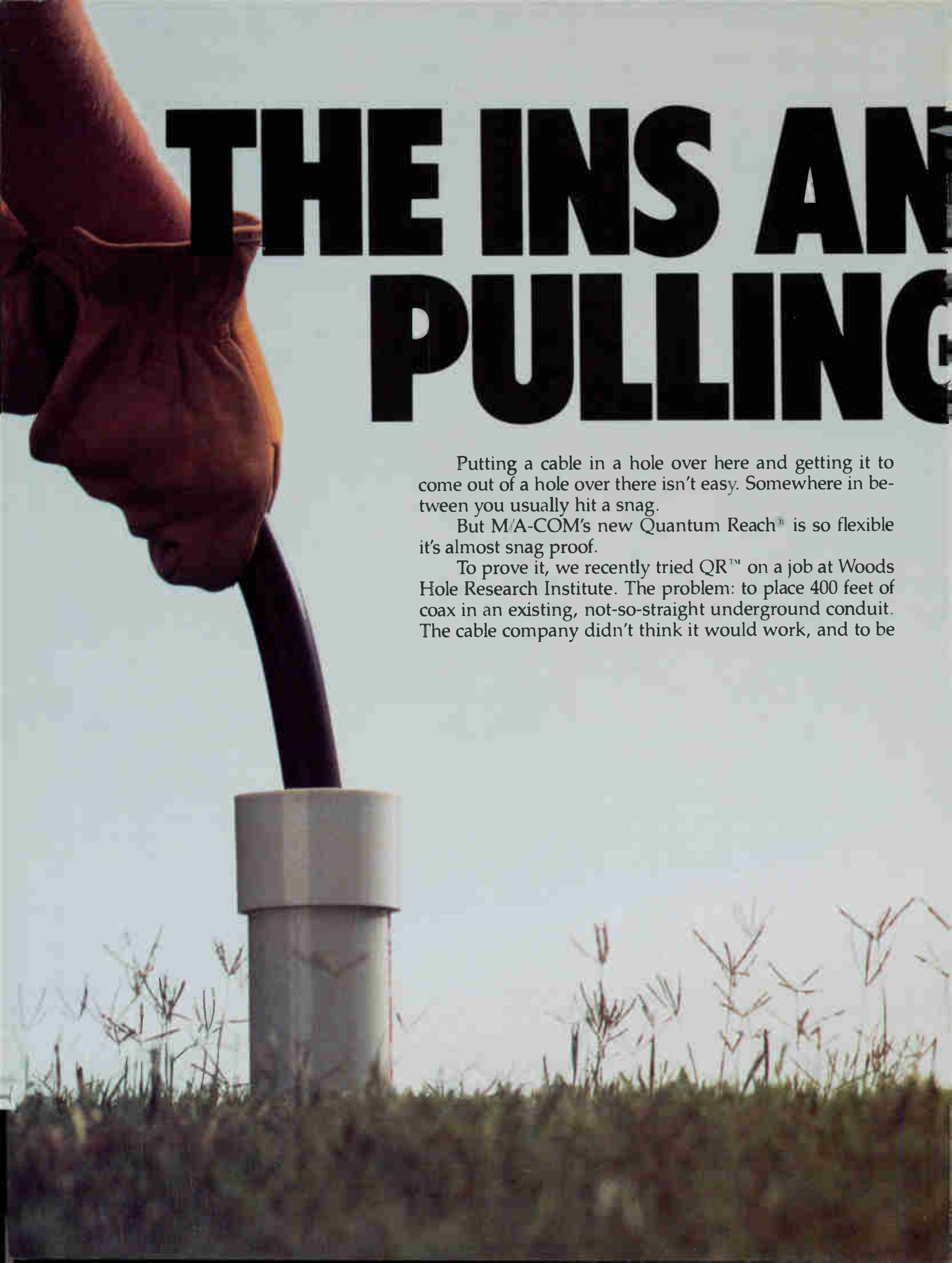
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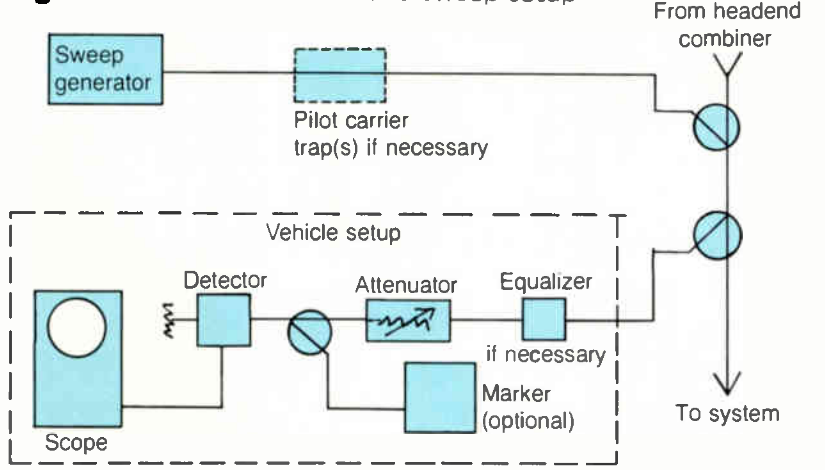
Figure 1: Standard broadband sweep setup



Frequency response: Distribution system

This is section F of the first part of the "NCTA Recommended Practices for Measurements on Cable Television Systems."

By The Science & Technology Department
National Cable Television Association

Frequency response of the distribution system is the variation in system gain versus frequency from the headend output to any point in the system. It is normally expressed in dB peak-to-valley representing the system gain variation from the highest point to the lowest point across the specified system frequency bandwidth.

Frequency response is potentially affected by any or all of the various components in a system. Of major concern are the active components, namely the trunk and distribution amplifiers along with their internal accessories, such as cable equalizers. The major cause is amplifier station repetitive response signatures, which add on a per station basis. Also, return loss interaction between closely spaced amplifiers and passive splitters or directional couplers can cause problems.

Included in this standard are five different techniques for making this measurement. They are:

- Standard broadband sweep
- Simultaneous sweep (high level sweep)
- Low level sweep (tracking sweep)
- Slow sweep
- Noise response testing

Standard broadband sweep

Procedure: The following equipment is needed: standard sweep generator; oscilloscope; detector; trap(s), at pilot carrier frequency; attenuator, 0-60 dB in 1 dB steps; marker generator (optional); and signal level meter (SLM).

1) Set up the equipment as illustrated in Figure 1.

2) Turn off all headend signals except the pilot carrier(s).

3) Establish the sweep generator output level (in continuous wave mode) with an SLM, at the headend test point, to be equal or about 6 dB above normal system carrier levels.

4) Temporarily connect the vehicle set-up to the headend test point.

5) Assuming a 60 Hz sweep rate from the sweep generator, the oscilloscope should be set for 2.0 ms/division and internal trigger. The oscilloscope trigger controls should be adjusted to trigger on the leading edge of the detected sweep signal.

6) The oscilloscope vertical sensitivity can now be adjusted to give a full screen display. The oscilloscope controls should not be adjusted after the above preliminary setup; instead the input attenuator should be capable of handling the various test point levels encountered in the field.

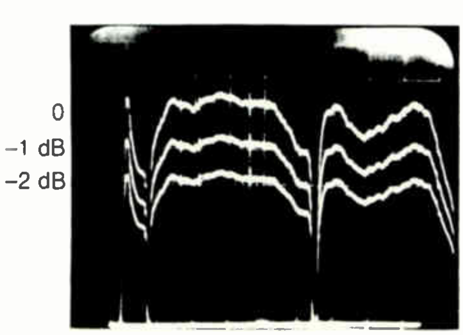
7) Multiple traces can be created on the scope screen by making use of the input attenuator to give one or several dBs of separation for calibration purposes.

This is the original approach to system sweeping, but cannot be done without interfering with the system pictures. Therefore, it must be accomplished when all system signals would normally be off-the-air. It is probably the most accurate of all the techniques as well as the least expensive from a test equipment requirement stand point. It is nothing more than an extension of standard bench sweeping, which most system operators are familiar with.

Simultaneous sweep

Procedure: The following equipment is needed: storage oscilloscope; sweep generator, capable of simultaneous impulse sweep; detector; signal level meter; video filter (optional); two-way splitter; and attenuator, 0-60 dB in 1 dB steps.

Figure 2: Broadband sweep display



Markers at 54, 150 and 300 MHz

Figure 3: Simultaneous sweep setup

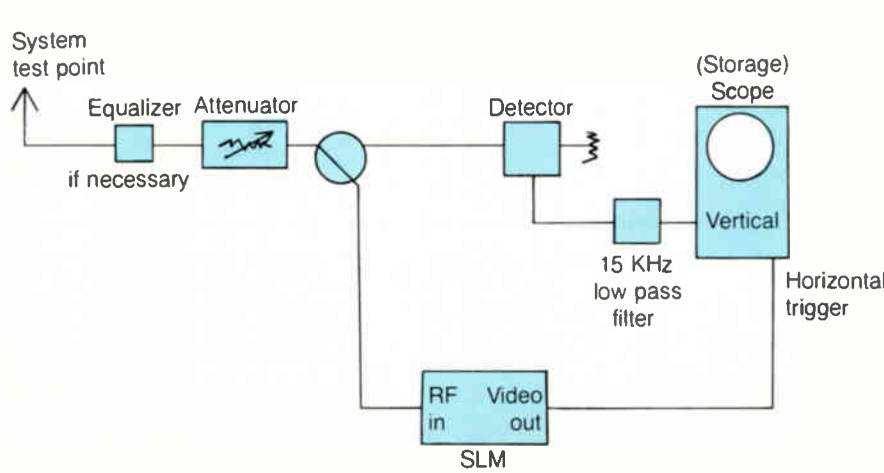


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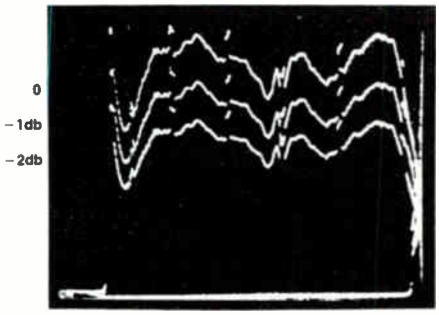
Figure 4: Simultaneous sweep display



Markers at 50, 100, 150, 200, 250 and 300 MHz

1) Set up the sweep generator in the CATV headend. Generally the sweeper can be inserted through a directional coupler (DC-8) ahead of the output test point. Establish a generator level 15 dB above the highest picture carrier. In cases where the sweeper cannot provide enough output to satisfy this requirement, it may be necessary to use a postamp or alternate sweep insertion technique. The sweep generator should be carefully handled at this point, as it can cause severe picture impairment if not properly set.

2) Establish the output level in the continuous wave (CW) mode monitoring with signal level meter on the output test point. Then set up the sweeper for a 2 ms sweep rate and select a 5 to 20 second "rep rate." The sweep should cover the 40 to 500 MHz range.

3) Observe a TV monitor in the headend and verify that the system interference is negligible.

4) Set up the service vehicle with the equipment as illustrated in Figure 3

5) Select channel 2 on the signal level meter and adjust the input attenuator until the meter indicates +10 dBmV. This step should be repeated at each test point to obtain the proper input attenuator setting.

6) The signal level meter video output jack can be connected to the "external trigger" on the oscilloscope. Select 50 MHz on the SLM. The oscilloscope should be set up for a 0.2 ms/division "horizontal sweep" rate. The trigger sensitivity can be adjusted so that the scope responds to each simultaneous sweep burst with a horizontal trace. Adjust the SLM if necessary to obtain a stable trigger.

7) The oscilloscope vertical sensitivity can now be adjusted to give a full screen display. As with the broadband sweep, the oscilloscope controls should not be adjusted after the preliminary setup; instead the input attenuator should be capable of handling the various test point levels encountered in the field.

8) Multiple traces can be created on the scope screen by making use of the input attenuator to give one or several dB separation for calibration purposes.

The simultaneous sweep system consists of two basic units: a sweep generator located at the headend, and the sweep receiver, which includes a detector, a video filter (optional), a trigger source (signal level meter) and a storage oscilloscope. A simultaneous sweep typically consists of a 2 ms burst sweeping from 40 MHz to approximately 500 MHz. This burst is repeated at an interval of 5-20 seconds. The RF energy is present for 2 ms and is carried at +15 dB to +20 dB above the highest carrier on a CATV system to permit the sweep to be detected with the system in normal operation. During the 2 ms interval, the interference to each channel is approximately 100 microseconds causing interference for 1½ lines. This interference is generally not noticeable to an untrained observer.

Low level sweep

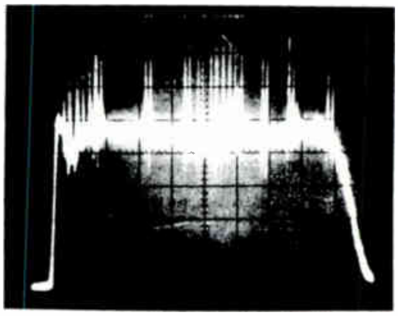
Procedure: The following equipment is needed: low level tracking sweep transmitter and receiver.

1) Set up the tracking sweep transmitter in the CATV headend. Generally, the sweep can be inserted through a directional coupler ahead of the headend output test point. Establish the recommended sweep operational level referenced to the picture carriers.

2) Observe a TV monitor in the headend and verify that the system interference from the sweep signal is negligible.

3) Set up the tracking sweep receiver in the service vehicle. Check the headend output test point to confirm proper operation of the

Figure 5: Low level tracking sweep display



Channels 2 through 13, B, H, M, Q, & W

tracking sweep transmitter and receiver combination.

The low level system of sweeping uses a wideband sweep inserted at a low level relative to the picture carriers. Typically 30 to 40 dB below pictures is sufficient to ensure that no visible interference will be observed in the picture during average program material and with typical noise present.

The trick in using a low level sweep is recovering the sweep. A broadband detector will show nothing except the demodulated picture carriers. Required is a sychronous narrowband receiver that tracks the sweeping signal exactly. Even though there is picture information present, the low level sweep can be recovered intelligibly because at any given instant, the probability of the sweep and picture information being of the same frequency (other than picture and sound carriers) is very low. This function can best be handled with a spectrum analyzer. Synchronization is difficult, however, over the distances encountered in the normal CATV system from the headend to the field test points. A tracking generator normally associated with a spectrum analyzer would work and permit recovery of the signals, however, again the synchronization cannot be accomplished over the distance involved.

Slow sweep

Procedure: The following test equipment is required for this test: sweep generator capable of slow sweep; spectrum analyzer with storage display; oscilloscope camera; and 75 Ω to 50 Ω minimum loss pad if the spectrum analyzer does not have a 75 Ω input.

1) Set up the equipment as illustrated in Figure 6.

2) Temporarily connect the spectrum analyzer to the headend test point.

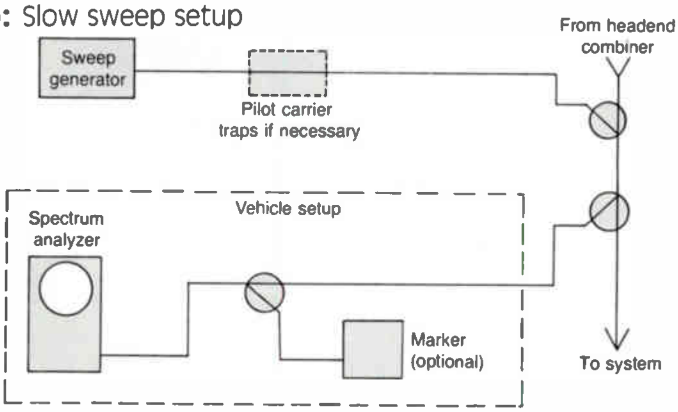
3) Set the sweep generator output to the CW mode—adjust amplitude to be equal to or slightly lower than the picture carrier level.

4) Set the sweep generator for a wideband sweep (40-500 MHz) with a slow sweep speed of about 2 MHz/sec. At this rate, it should take 250 seconds to cover the entire 40 to 500 MHz.

5) Use the single sweep trigger or the power switch for "on" time. Arrange to have someone stationed at the headend to control the sweep generator during field test measurements.

6) Set up the spectrum analyzer at a field

Figure 6: Slow sweep setup



test point. Select 5 MHz/division and 0.3 MHz resolution and center the low-band channels as indicated in Figure 7. Put channel 2 on the second graticule from the left.

7) Select the 2 dB/division mode and signal the headend to trigger a single sweep.

8) Increase the persistence or use storage to hold the display as in Figure 7.

9) As the low-band is completed, rapidly photograph the results and move to the high-band, centering the channel 7 carrier on the first graticule from the left.

10) Again, using 2 dB/division and storage, results will be obtained similar to Figure 7.

11) Additional channels in the mid-band and super-band can be handled in the same manner. It is recommended that the 5 MHz/division be used as each band or group of channels is swept.

This sweep test procedure when properly followed, is one of the most accurate sweep methods in existence. For CATV use, amplitude resolution in the order of ±.25 dB is possible. While this is an interfering sweep, the ease with which the test can be set up is such that only one sweep is made at each test point, causing an interference span of approximately one second. The headend sweeps can be performed with an out-of-service interval of approximately 10 seconds. Because of the extreme accuracy of this test technique, it is felt that the short customer inconvenience can be tolerated. This sweep procedure is only a test tool to evaluate performance and should not be considered for day-to-day maintenance and alignment.

Noise response testing

Procedure: The following equipment is needed: flat noise generator; spectrum analyzer with storage display; and 50 ohm to 75 ohm minimum loss pad if the spectrum analyzer does not have a 75 ohm input.

1) Set up the equipment as illustrated in Figure 8.

2) Temporarily connect the spectrum analyzer to the headend test point.

3) Set the noise generator to be about 30 dB below the level of the video carriers in the system.

4) Set up the spectrum analyzer at a field test point. Select 5 MHz/division, 300 kHz resolution, 100 Hz video filtering, and a scan rate of less than 0.5 sec/division. Put channel 2 on the first graticule from the left.

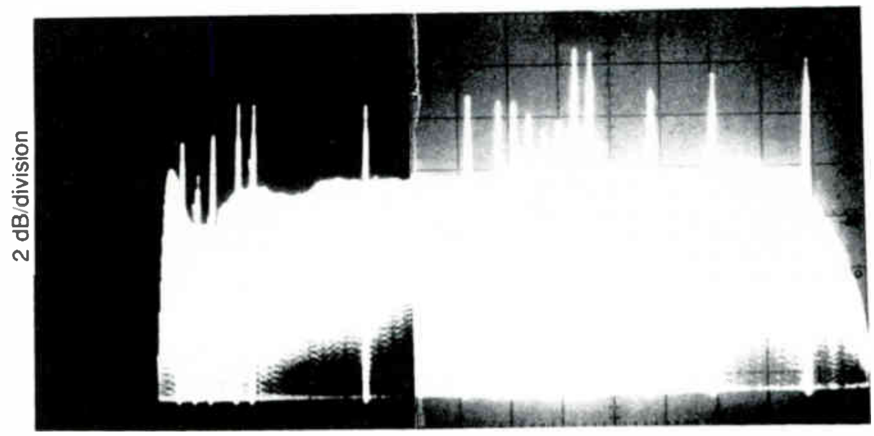
5) Select 2 dB/division mode (or linear) and single trigger the spectrum analyzer. Photograph this response.

6) The remainder of the system spectrum can be measured by changing the analyzer tuning to select other groups of channels.

7) The full system bandwidth can be accommodated by using different scan widths and a much slower scan rate.

Note: There are two general precautions that must be observed when using noise on a system. First, noise represents a lot of power than can overload amplifiers at even moderate levels. Second, response measurements can be in error if the noise inserted is too low in level. The noise should be at least 10 dB above

Figure 7: Slow sweep display



Channels 2 through 13, B, H, M, Q, & W

Figure 8: Noise response testing setup

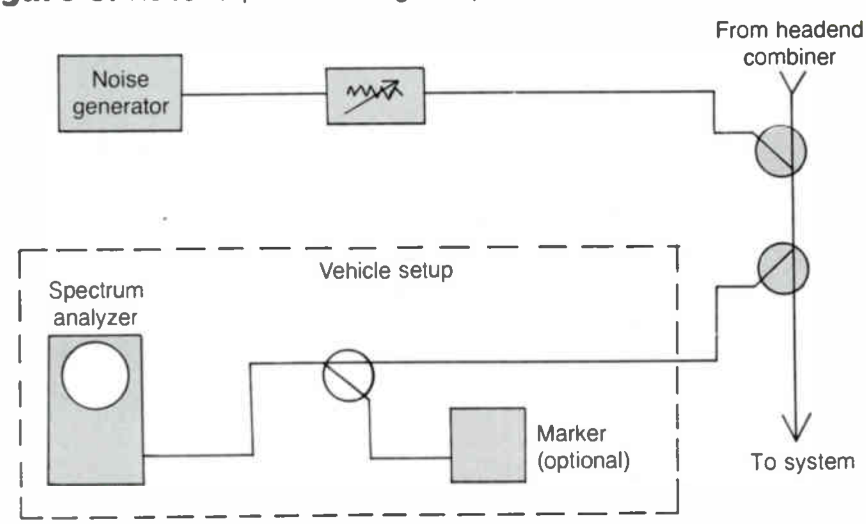
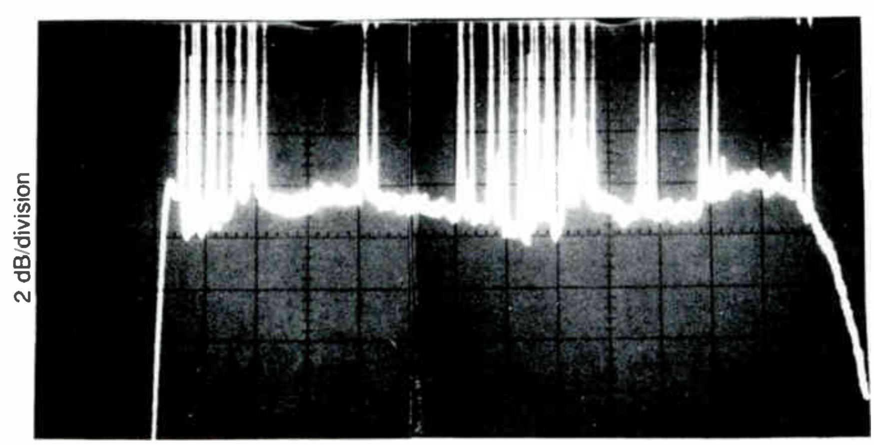


Figure 9: Noise response testing display



Channels 2 through 13, B, H, M, Q, & W

the system noise at the longest amplifier cascade.

A good flat noise generator can be thought of as a broadband signal generator instead of having an adjustable frequency output, however, the noise generator has a continuous output on all frequencies at once.

We all recognize that a field strength meter and a manually tuned signal generator can be used to make a point plot of the frequency response. If a flat noise source is substituted for the signal generator, the need to continuously reset the generator is eliminated. A noise source and SLM is probably one of the easiest and least expensive ways to verify system response.

A spectrum analyzer can be substituted for the SLM and the video filter used to filter the noise into a clean display. The spectrum analyzer permits a finer display than can be obtained with the point plot.

In-service testing can be considered since the noise can be inserted at a low level (provided it is above the system noise), with only slight picture impairment during the duration of the test.

Hints and precautions

The following are general in nature and may apply to any of the foregoing procedures.

1) The headend setup and vehicle setup should always be checked for flatness accuracy before proceeding to the system test points. This can be accomplished by connecting the vehicle setup drop cable to the headend final test point. Match problems in the various splitters, detectors, attenuators, etc., used in the setups can affect the accuracy at total test setup. These problems can usually be corrected by the use of better devices or the strategic placement of attenuator pads to improve marginal return loss.

2) Block tilt established in the headend should carry through the system unaffected; therefore, systems with block tilt should be aligned flat, even though block tilt exists between the high- and low-band levels.

3) In some instances, it may be necessary to either pre-equalize the sweep signal, or equalize the input of the vehicle sweep receiver setup. These situations involve special spacing between amplifiers of which a system operator with special designs will be aware.

4) In some cases the system automatic gain control (AGC) or automatic slope control (ASC) amplifiers may be affected by the sweep signal. If this problem is encountered it will be necessary to trap, band-stop, or blank the sweep signal around the pilot carrier(s) frequency.

5) When monitoring a system test point that is a resitive nondirectional type, an erroneous indication can be created. This occurs when the test point location is followed by a passive device closer than several hundred feet of cable. The response will show amplitude ripple caused by the reflected signal from the less than perfect passive device, which is absorbed by the output match of the device located at the test point location. This situation can be eliminated by using the bridger amplifier directional coupler, or by installing a directional coupler test point at the location.

Performance objectives

Good engineering practice results in a system frequency response in dB of N/10 + 1 for the trunk line, where N is equal to the number of trunk line amplifiers in cascade. When the feeder system is included in the measurement it should be N/10 + 2, where N is equal to the total number of trunk amplifiers plus the distribution and line extender amplifiers in cascade.

The FCC dictates that the frequency response be no greater than ±2 dB across the video pass band (of any TV channel). Since the FCC requirement includes the headend equipment, it is suggested that the system be no more than ±1 dB of the total ±2 dB for any given channel.

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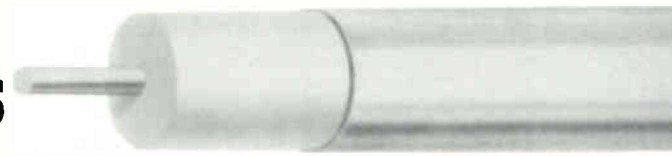


By Tom Saylor
Engineering Manager Caltec Cablevision

The explosion in consumer electronics has buried the public in a blanket of fallout like that accompanying volcanic upheaval. John and Jane Doe, smothered with options affecting the solid-stateness of their lives, find one product pick directly influences subsequent ones serving only to complicate matters. Buzzwords like "compatible," "capable," "ready," "complete," "automatic" and "expandable" assume fresh connotations. Previously independent units are now touted as partners in a system-oriented environment. With frightening frequency, however, these allegedly harmonious components assume the roles of the square peg and round hole. Such is the bittersweet existence of the cable-ready television.

What do the following have in common: maintenance-free batteries, self-cleaning ovens, no-wax floors, permanent-press fabrics, disposable butane lighters, disposable diapers, calculators, nuclear power plants, catalytic converters, cable-ready television sets? They are all products intended to solve problems. Each has gained acceptance (if not at least tolerance) by eliminating some unpleasantry or inconvenience.

Nature, ever true to form, seeks its own balance; what is removed from one aspect is reinforced in another. The maintenance-free battery is simply engineered to hold more electrolyte than may be predictably lost during its life. Self-cleaning ovens are energy gluttons. No-wax floors do eventually warrant a wax job. Permanent-press clothes still wrinkle if not laundered attentively. Disposable items create mountains of refuse. Calculators encourage people to forget how to perform basic mathematical operations. You fill in the blanks with atomic energy and catalytic converters. And what of the cable-ready set?

The cable industry has been engaged in a race against itself for the last decade or so. Twelve channels became 21; 220 MHz lept out to 300 MHz; 300 is stretched to 330; 330 is prodded to 350; 350 evolved into 400; 400 is tweaked to 440; 440 is left behind by 500. Now there's talk of 550, perhaps 600 MHz. Cable eventually may become rectangular as waveguide replaces coax on the poles. Seeking to deliver even more channels, the line-ware folks advance the art, solving problems in the process. Franchise requirements often can be met using a single cable of extended bandwidth as opposed to the stopgap dual plant. Up-front costs and maintenance are proportionally reduced. System support vendors keep the pace, with test equipment abreast or slightly ahead of the upper frequency limits. Black boxes are available to convert hyperband and beyond to the quintessential channels 2 or 3. And of course the consumer electronics industry stepped in to give us the cable equivalent of permanent-press, maintenance-free TVs.

Cable-ready sets—The solution

There is little argument that cable-ready sets do solve problems. Cable television sparked the improvement of tuner technology. Now predominantly digitally synthesized, today's TV front-end exhibits better stability and performance than its predecessor. Random access channel selection, jumping from one end of the spectrum to the other in a single bound, is a key feature. Fewer moving parts contribute to overall realiability. Adjacent channel rejection has been, by necessity, taken seriously by designers. User-oriented features such as remote volume and channel controls, baseband audio and video inputs, auto shut-off timers, integral RF source switching, multichannel sound decoders, and built-in FM tuners, are emphasized. Some manufacturers are offering sets that accept direct unmultiplexed RGB video.

By and large, however, the biggest selling point of this new generation of televisions is their channel capability. An unprecedented number of channels can now be tuned. If the public was staggered by the possibilities of 82 channels with the standard VHF and now partially obsolete UHF, imagine the positive response greeting this breed of cable-ready instruments. As well, the prospect of freedom from the unsightly, costly and inconvenient converter appealed to the consumer. Television manufacturers realized this before the first unit hit the market.

Jim Smart, an independent servicing television dealer for the last decade, offers more than half a dozen different makes in his efficiently cramped Baltimore County shop. "Cable-ready is the way to go," Smart says with knowledgeable enthusiasm. "For the 50 to 100 dollar price differential (over a set with a conventional tuner) you're buying a versatile item." Smart demonstrated several models, noting that the cable-capable tuners were of generally better design and quality.

A veteran salesman of Luskin's, a long-time Baltimore area television retailer, has a similar opinion of the latest hardware. "I've been in this business 23 years," states Jerry Grunberg, "and I've seen a lot of changes and growth in the industry. I would recommend that a person (considering the purchase of a new television) definitely go with a cable-ready model, especially in this (cabled) area." Luskin's has over 50 models from eight manufacturers on display.

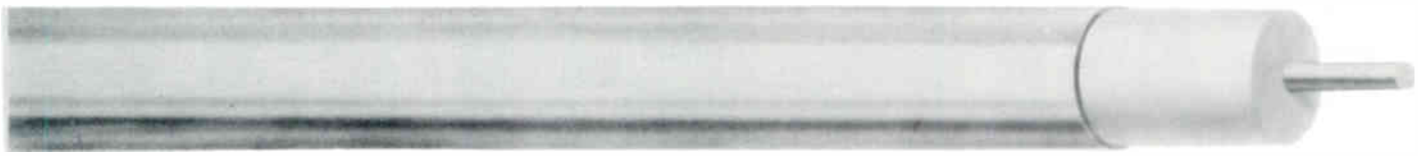
Prospective customers are told that they can eliminate the cable company's converter, and any rental charges, from their lives (which, in many cases, is true). And cable-ready sets are capable of good technical performance, often rivaling the converter itself. A statement of channel capability means different things to different manufacturers, however. In fact, each often has its own method of channel numbering or naming. Of the dozen or so sets informally investigated, channel maxima ranged from 105 in an Emerson and Hitachi, to a staggering 157 in a Zenith. Counts of 117 (Sylvania and Toshiba), 125 (Sony), 127 (RCA), 134 (JVC and MGA), and 136 or 142 (both Sharp) were registered. This summation is not complete, as there are other vendor's products unrepresented, but the objective was to obtain a typical profile of the industry.

How can there be that many channels? Many changes have occurred in CATV channel nomenclature; the venerable number/letter labels are being converted to a number-only system. The new convention indicates that channel 36 is the old W; 37 used to be AA. Jerrold's *CATV Reference Guide RD-14* lists the old FM-1, 2 and 3 designations as channels 57, 58, 59. Familiar tags like A-2 and A-1 become 60 and 61. Extending the logic past the guide's 400 MHz top-end, the channel following 53 (QQ) in spectral order is really 62, the old RR. This progresses out to ancient ZZ at 450-456 MHz, renamed 70. Continuing out from channel 71 to 120 (456-756 MHz), infrequently charted territory is entered. Even this line of reasoning is not universal among set manufacturers, however.

Study of the channel conversion charts provided in many of the sets' operating manuals reveals varying standards. Some manufacturers have built a hedge against obsolescence by creating tuners that exceed the present-day cable system's upper frequency limits by a substantial amount. As an example, the Zenith set's UHF capability was re-applied to CATV by tuning up to the previously mentioned channel 120 at 750 MHz. Others have numbered channels according to individual preference; one set's A-1 is accessed on channel 73, another's via 99, still another's on 69, yet another's on 00. Statements of total channel capacities also are relative. Some sets count UHF plus cable, others count cable only. Hopefully the future will bring standards accepted by both the cable and manufacturing industries. At present, however, it pays to review the operating instructions of each unit prior to purchase to gauge its true features; a rose is not always a rose by any other name.

Cable-ready sets—The problem

Thus the iceberg's uppermost extremity is revealed with the channelization quandary, implying that other vital concerns lie concealed. Under these conditions, consumers, *'Hopefully the future will bring standards accepted by both the cable and manufacturing industries'*



manufacturers and cable operators become antagonists. Despite the best intentions of each, a lack of standardization exists that exacts its toll in animosity and apathy. The vendor tells the salesman who tells the consumer who tells the cable company who tells the consumer who tells the salesman who tells who knows who. This real life version of the information-distorting game "telephone" squares off the combatants in a match that should instead be rife with cooperation for the common good.

What are some of the problems that cable-ready sets create? "PR problems caused by confusion over converter requirements," cites Ron Cotten, vice president of engineering for Daniels & Associates. "People are being told by their television sales representatives that they do not need a converter with a cable-ready set. This is not totally true as they still need a converter to descramble premium level services." This was the concern most often voiced by the cable operators interviewed. Consumers are ecstatic over the possibility of doing away with the cable's box, however, system channels secured by scrambling won't be received without the box.

Tom Gorman, a 10-year cable veteran and chief technician for Comcast's Baltimore County system, voices a similar opinion. "These sets create problems when we're scrambling; the converter is still required. When they (subscribers) hear that, the stuff really hits the fan." Don Dworkin of NTY Cable adds more credence to the argument: "We're a 300 MHz system with just our premiums scrambled, but the converter is still a necessity if the subscriber (with a cable-ready set) wants those pay channels."

One suggestion is that loops for external signal processing devices become the norm rather than a feature of a few units. Some sets on the market now have this loop as standard equipment, allowing the insertion of descramblers, videotex demodulators, telecaption decoders and similar devices in the tuner's signal path. This solves some problems, but cable equipment suppliers will have to develop specialized boxes for multichannel decoding to work in total harmony with the loops.

Gorman's job takes him out into the field regularly to tackle tough problems and smooth subscriber's feathers. He mentioned another anomaly generated by cable-ready TVs. "I see too much direct pickup of strong locals because of poor shielding in some sets. It seems that manufacturers are emphasizing channel capacity and not giving RF shielding the attention it deserves." An old problem, perhaps, but it still crops up despite progress in other areas. An increasingly hostile RF environment will require positive changes.

An additional concern is that not all CATV channelization plans are created equal. Incrementally related carrier (IRC) and harmonically related carrier (HRC) systems are out there. IRC doesn't present a big problem. Its main differences from standard are the shifting of channels 5 and 6 to new assignments at 79.25 and 85.25 MHz, and the creation of channel 4+ at 73.25 MHz. Some sets are equipped to deal with this. The rub occurs if the cable system uses an HRC plan. These systems generate carriers locked to a master comb generator at 6 MHz intervals, beginning with channel 2 video at 54 MHz. The end result is HRC assignments being displaced by 1.25 MHz from standard slots. This requires converters designed expressly for HRC signal conversion. Cable-ready sets have, to some extent, met the challenge.

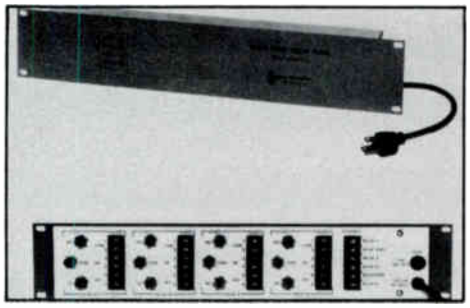
Jim Smart gives one example: "Sony sent me some instructions on how to get into the tuner and widen the fine tuning window. This'll let you pull over to the HRC assignments if necessary." A Sharp set in Smart's showroom had a switch-activated HRC option. The author discovered a Quasar model with a three-position switch allowing selection of IRC or HRC plans, as well as VHF/UHF. Other cable-ready sets not providing modifications or tuner altering switches may be capable of being fine-tuned enough to center HRC signals. This possibility was not thoroughly investigated; suffice it to say that manufacturers are aware of the existence of nonstandard frequency assignments and some have answered the call in varying ways.

Preparing for the future

What can be done to eliminate interface problems in the future? One obvious solution is cooperation between the cable and consumer electronics industries. By participating in joint committees, these separate but very interdependent groups can reach universally acceptable standards. The NCTA is involved in discussions with the consumer electronics arm of the EIA. This engineering subcommittee is under the stewardship of Walt Ciciora. Industry technique personnel interested in this committee's proceedings should either contact Ciciora through the NCTA or attend the bi-monthly engineering committee meetings sponsored by the NCTA in Washington. The effective representation of cable's interests at such forums depends on the direct participation of those being spoken for.

Cable-compatible equipment could take new forms in the future. Some have described the ultimate cable-ready set as having a tuner limited to channels 2 or 3. In this fashion, the set manufacturer is taken out of the standards loop, placing the burdens of compatibility and consumer-oriented features back on the CATV industry. This shouldn't be the final step, however. Later generation systems may use digital modulation to deliver baseband audio and video to a subscriber's monitor. Still other transmission formats, as yet unimagined, may be devised.

Whatever the blue-sky projections, cooperation between all the players on the team is a fundamental tenet. Doing this will guarantee the success and satisfaction of manufacturer, operator and consumer. Solutions to problems can be purified and refined, generating fewer negative side effects. Cable should not be satisfied with the current versions of disposable permanent-press standards.



Audio/video relay panel

Monroe Electronics Inc. announced a new product for CATV headend switching. The Model 3000P-14 audio/video relay panel provides four independent audio follow relay switches controlled from four buffered control inputs. Control can originate from Monroe program timers, remote controls, or CATV cue tone receivers.

Each relay switch will respond to a control closure or a transistor switch to ground, or a compatible logic level. The control inputs are buffered to eliminate high output current drive requirements of the controlling device.

Housed in a standard rack-mountable 3.5-inch x 19-inch panel, the 3000P-14 can be used for applications such as non-duplication switching, blackout switching or routing switching. Other features of the unit include front panel status indicators that show active switch outputs, switches powered from an integral power supply, barrier strip terminals for balanced audio connections—BNC connectors for video or RF and internal pull-up resistors on control inputs for operation from contact closures or transistor switches.

For complete specifications, contact Monroe Electronics, 100 Housel Ave., Lyndonville, N.Y. 14098, (716) 765-2254.

Stereo for Videocipher

Leaming Industries has developed the FMT615C stereo generator for use in cable TV operations that incorporate the M/A-COM Linkabit Videocipher system for HBO, Cinemax, Showtime and/or TMC. The unit enables the cable operator to provide quality stereo sound and possesses user-friendly features, such as full output frequency agility, directional output coupler and a fully shielded interference-free enclosure. Design and low power consumption allow for three such modulators to occupy a minimal (1.75-inch H) space in a standard (19-inch W) headend rack.

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

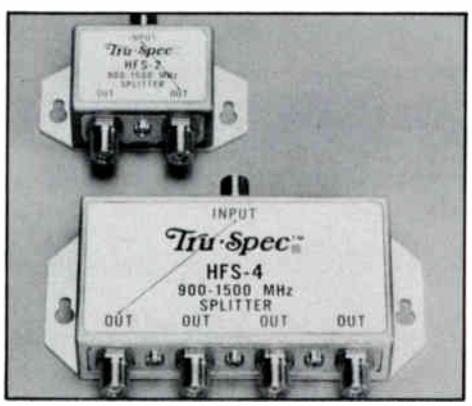
Cable stripper

Hi-Rel Products introduced the Port-A-Strip, a rechargeable nickel cadmium unit for RG-59 and RG-6 cable.

The Port-A-Strip is the answer to signal leakage due to improper stripping, according to the firm. While stripping, it rounds and slightly chamfers the foil's edge over the dielectric, improving connector alignment and insertion.

The Port-A-Strip can take up to 1,000 AC or DC charges and does approximately 300 strips per charge. It has a blade made of hardened spring steel that lasts through approximately 8,000 strips. Its cover material is ABS.

For more details, contact Hi-Rel Products, Executive Dr., Liverpool, N.Y. 13088, (315) 451-0110.



Power dividers and satellite amplifier

Macom Industries/OEM Enterprises announced the addition of the HFS-2 and HFS-4, 2-way and 4-way power dividers (splitters) for use with multi-receiver block converted satellite systems. The HFS-2 with 3.5 dB loss and HFS-4 with 6.5 dB loss, provide one power passive port for through powering of LNAs and down converters.

In addition, Macom announced a new low-noise, in-line amplifier for 900-1,500 MHz satellite receivers. The Model LA-915 provides 20 dB gain with a 3 dB noise figure and can be used to extend distances between the dish and receivers or overcome splitter loss when dividing signal for multiple receiver use.

For more details, contact Macom Industries, 8230 Haskell Ave., Van Nuys, Calif. 91406, (800) 421-6511 or (818) 786-1335.

Character generator

The Mycro-Vision Ernie, a new low-cost character generator with genlock and system-to-system communications features, recently was introduced by Mycro-Tek. Ernie has several new capabilities for use as a titler or telecommunications device. Its genlock allows characters to be superimposed over an external video source. Genlock meets RS-170A broadcast specifications, as long as its input meets RS-170A. It provides horizontal phase adjustment (±4 microseconds) and 360 degree subcarrier phase adjustment. Ernie will lock to a VCR or video editing system, has key output for downstream keying and can operate as a stand-alone device, generating its own RS-170A composite video signal.

Ernie includes a take key that lets the operator move video from a preview channel to the on-air channel. Combining the take key with genlock, the operator can add or delete the superimposed title without interrupting the main video signal.

Ernie has other titler features such as crawl, roll, user-definable regions and margins, roll within regions, pause control and manual or automatic sequencing. It has eight character colors and eight background colors and the 32K of RAM memory provides up to 250 pages of storage. The page memory is supported by a product-life battery, so information is not lost when the unit is turned off.

Automatic sequencing features let Ernie perform as an information display device. The system also can be programmed to operate unattended as a "channel filler" for CATV or LPTV channels.

All communication options can operate at either 300 or 1,200 baud, and Ernie has an advanced battery backup system (CMOS static RAM).

For more information, contact Mycro-Tek, P.O. Box 47068, Wichita, Kan. 67201, (316) 945-5087.

Supertrunk system

Pirelli Optoelectronic Systems has entered the CATV market with a new fiberoptic supertrunk system.

The 1300 Series system will carry up to 30 channels per fiber and over distances of 50 kilometers dependent upon system requirements and configuration. The system utilizes monomode fiber and laser technology giving it a life expectancy in excess of 20 years, according to the firm.

For more details, contact Pirelli Optoelectronic Systems, 300 Research Pkwy., Meriden, Conn. 06450, (203) 238-9665.

Block downconverters and addressable tap

Microdyne's C- and Ku-band block downcoverters are now available without an attached low-noise amplifier (LNA). They can be used with almost any LNA now on the market.

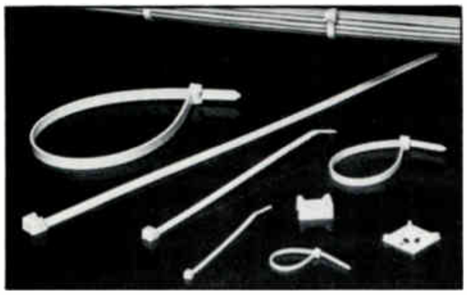
The 1100 BDC-L downconverts the 3.7-4.2 GHz or 10.95-12.7 GHz downlink signal to the 270-770 MHz range. The BDC-L is completely weatherproof, and can be antenna-mounted with the LNA, or mounted separately in close proximity to the antenna. The BDC-L uses a temperature compensated SAW resonator for frequency stability in any environment, from -40° to +70°C.

In addition, Microdyne announced the selection of Toner Cable Equipment Inc. of Horsham, Pa., to market its computer addressable tap systems.

The tap system permits a system operator to individually control a subscriber's television programming via a master computer linked to an on-premise tap controller. Each system consists of a tap controller Model TC1, data power supply DPS1 and the tap itself.

The software for the computer addressable tap system is a modification of the SMART™ software package written by Toner for the CATV market.

For more information, contact Microdyne Corp., P.O. Box 7213, Ocala, Fla. 32672, (904) 687-4633 or (800) 523-5947; or Toner Cable, (800) 523-5947.



Cable ties

A new line of flame retardant cable ties was introduced by Panduit Corp., Electrical Group. The ties, made of 6/6 nylon with a UL 94V-0 flammability rating, are used where customers require improved flame retardation.

Three cable tie sizes and one tie mount are available in the flame retardant nylon material. The cable ties are PLT1M (miniature), PLT2S (standard) and PLT4H (heavy cross-section), for maximum bundle diameters of .87-inch, 1.88-inch and 4-inch, respectively. The tie mount is the TM3S8. Another mount, ABM2S, is offered in flame retardant polyester.

The new cable ties have the same tensile strength as the ties made of natural 6/6 nylon.

For further information, contact Panduit Corp., 17301 Ridgeland. Ave., Tinley Park, Ill. 60477-0981, (312) 532-1800

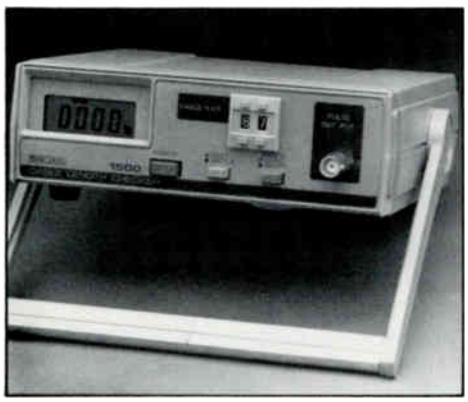
Digital audio

Toshiba introduced D-CAT, a 7-pound, 13-ounce digital cable audio terminal. It is a one-way, fully addressable product with digital signals that can be enciphered, reducing theft opportunities. Further, its digital signals are modulated for transmission over existing cable networks.

D-CAT has a frequency range of 88-120 MHz making 26 digital channels available with quadrature phase shift key (QPSK) modulation. It has a distortion of .01 percent, frequency response of 20—20,000 Hz and power consumption of 15 watts.

Each digital channel can carry one ultra high fidelity stereo signal or two super high fidelity stereo signals, providing a range of options.

For more details, contact Toshiba America Inc., 2900 MacArthur Blvd., Northbrook, Ill. 60062, (312) 564-5160



Connector gel, time domain reflectometer

An alternative to silicon grease is now available in gel and aerosol forms from CWY Electronics.

The new product, manufactured by Synco® Chemical Corp., is fiberoptic/CATV splice and connector gel, and is designed to protect splices, connectors, terminations and closures from moisture, mild acids and dirt. Splice and connector gel is waterproof and will not harden, melt or separate. It is a fully dielectric compound that meets or exceeds the requirements of MIL-S-8660B, Amend. 3.

Also available from CWY is a fortified version of splice and connector gel called Barrier Cote. Barrier Cote sprayed directly on the equipment prevents oxidation and corrosion and may be used to protect any kind of outside electronics or pedestal interior splices.

A cable length checker also is now available from CWY Electronics.

The Model 1500 cable length checker (time domain reflectometer) can be used to locate opens and shorts in any cable with a constant velocity of propagation, including 50, 75 and 93 ohm cable and paired cable. The Model 1500 is easy to use and requires no special training, according to the firm.

It features a four-digit display for the length of coaxial cable, from 5 to 2,000 meters, which indicates whether the cable termination is open or short. A conversion switch on the front panel allows the user to select readout in feet or meters. Also, two digital switches on the front panel allow operation of the cable nominal velocity propagation setting from .01 to .99.

The Model 1500 features rechargeable Nicad batteries, AC adaptor and can be powered by a 12-volt DC car battery.

For further information, contact CWY Electronics, P.O. Box 55191, Lafayette, Ind. 47903, (800) 428-7596

Hints for evaluating splitters

One of the most overlooked components in CATV and SMATV systems is the splitter (see Figure 1). It should be well constructed, radiation free, work indoors or out, have excelled electrical specs, and be one of the lowest cost components in the system. The quality and long-term reliability become even more important when you realize that the splitter is a series link in the distribution system. Its failure has the same catastrophic result as that of the most expensive devices—a degraded picture.

The following visual inspection tips will allow you to assess the basic quality of your chosen splitter, make choices between competitive models, look for long-term reliability features, and sample inspect lots for consistency. Without electronic sweep and return loss measuring equipment, these inspection tips also will allow you to determine the overall electrical quality of your splitter. Likewise, the tests are valid for passives similar in design to the splitter family, such as indoor directional couplers.

Connector material and alignment

The majority of splitters and taps on the market today are made with zinc diecast metal housings in order to provide low cost while maintaining acceptable quality. Always obtain a splitter whose threads on the connector ports have been machined over the diecast material rather than directly cast. The extra machining process will provide a high quality fit, ensuring long-term electrical and mechanical reliability. Determine the type you have by looking at the consistency of the thread at the molds' parting line on the port. Stainless steel housings are available, however, they are usually many times the cost of diecast and require the additional inspection of the seal between the separate brass connector and the case.

Zinc diecast material should be soft enough to wrench tighten a connector an additional 90 degrees beyond hand tightening without stripping the brass on the connector. This test should be performed on each lot of splitters for consistency.

After the seizing pin insulator is inserted, the top of the diecast port is staked (machine pressed) down to cover and hold the insulator in place. The edge should be inspected to be round, and not cracked on the inside circumference (see Figure 2). The insulator should be flush up against the staking point, not free to slide in its shaft. Movement side to side or up and down can cause poor contact with the cable center conductor.

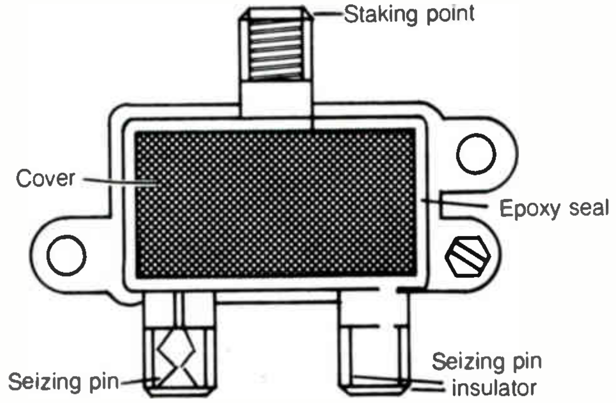
The seizing pin

When looking into the splitter's connector port you can see the insulator hole for the cable's center conductor. Some connectors have a small hole that only fits RG-59; some have a large hole for RG-59 and RG-6 and some have a tapered hole so that the center pin is guided directly into the seizing pin. This last type is preferable and will prevent a bent center conductor from bending further and shorting upon installation.

Another important area of inspection is the alignment of the seizing pin with the insulator hole. If this is offset slightly, it is possible the pin stamping was not consistent, the insulator mold was damaged, or insertion was poor. The result of using a splitter with any of these defects is that the cable center conductor can either bend the seizing pin and break it on the installation, or the cable can be making contact on the outside of the seizing pin causing potentially poor electrical contact over time. Both problems can cause system problems and costly service calls.

The tension of the seizing pin should be checked. If the seizing pin contacts are weak, long-term bending or movement of the cable can cause discontinuity as well as higher signal loss of the lower frequencies over time. A simple test of a two-way splitter is to insert a wire the size of an RG-59 center conductor into the splitter and hang it vertically. If you have a good quality spring contact the splitter should not fall from the wire. A shipment of splitters can be tested this way through the plastic bag, on a small percentage of the lot.

Figure 1: Typical splitter



The cover

Most high quality splitters have a weather-tight epoxy seal over the edges, where the cover meets the case. This epoxy should uniformly cover and seal all edges. Remove the cover of one splitter for inspection by hammering a screw driver through the center of the cover plate and bending carefully. The epoxy should not have seeped under the splitter cover, or between the cover edge and case. Seepage indicates poor cover fit and usually will result in an unacceptable level of signal radiation.

The thicker the cover material the tighter the fit will be initially, and over time. Thicker cover material also results in a lower level of signal radiation due to a more consistent electrical contact on all edges.

The contact of the cover against the case is the most critical area in preventing unwanted signal radiation. The most popular type of two, three, four-way horizontal port splitters all have a cover plate installed after the hybrid elements of the splitter are soldered in. The methods of cover plate installation fall into four main categories:

1) Plate pushed onto splitter ledge and epoxied—This will usually produce about 60-70 dB shielding. Sometimes the cover plate does not make electrical contact with the case if epoxy seeps through the seal. Check this with a simple continuity checker, or ohmmeter. This shielding method is not always suitable for splitters used on cable and SMATV systems using mid-bands.

2) Pressure pressed plate with notched diecast section holding down cover—By notching the case over the cover before epoxy is applied one ensures electrical contact over the life of the splitter and prevents the epoxy, which might have expanded during drying, from raising the cover to a point of electrical discontinuity. This method produces shielding of 70-80 dB and is suitable for cable systems. The inside edges of the cases are frequently angled outward allowing the non-staked splitter's cover to rise during the vibration of shipping.

3) Edge notched cases—Some splitters have cast ridges on the inside edge of the case. When the cover is pressed in, these ridges (every .1 inch) cut into the cover ensuring electrical contact. This produces shielding over 100 dB. Severe vibration can raise the cover reducing shielding slightly.

4) Double thick cover, pressed and staked case—The final type uses a double thick cover with specially serrated edges press-fit into a specially angled case, and then held down by four ¼-inch fold over points. This method also provides over 100 dB shielding and the added

Figure 2: Staking

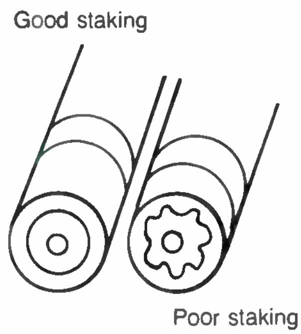
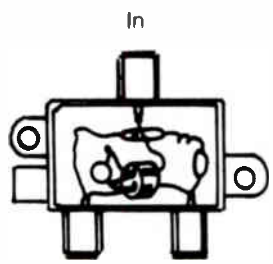


Figure 3: VHF splitter



protection of the bent tabs ensuring constant downward pressure on the cover. The third and fourth types of cover plate installation should be used for cable and SMATV systems where shielding reliability is required.

Remember, in all types, the epoxy should be applied after the cover is pressed on. To determine the cover method being used, scrape off the epoxy and remove the cover. Epoxy seepage on the shelf of the splitter under the cover can indicate a poor radiation seal.

The previously mentioned sealing and radiation levels apply to the traditional, and most popular horizontal port splitters. There are other types of horizontal and vertical port devices (of limited usage) that have a different sealing method and would require a more in-depth discussion to fully explain. Here, we have so far discussed physical features of the splitter; by inspecting its inner elements, some of the general electrical features can be checked.

Types and workmanship

There are two frequency ranges of splitters available: UHF/VHF (5-900 MHz) and VHF only (5-500 MHz). Cable and SMATV systems should use the VHF only type in that it provides a higher port-to-port isolation, and a greater return loss match (see Figure 3). Both of these specifications reduce the possibility of interference and ghosting.

The UHF/VHF splitter usually is a cheaper design, using a two-bead circuit rather than a larger single, multi-winding transformer (VHF type). Inspection reveals the type you have by the number of blackish gray ferrite cores present. The single core type provides better specifications and is worth a few extra cents. Be careful to check this, because many so-called cable quality splitters are actually lower cost UHF/VHF type devices with a 5-500 MHz printed label. It also should be noted that the larger cores usually have a higher resistance to saturation from 60 Hz hum induced into distribution systems by poor grounding.

When inspecting the splitter check for loose parts or cuttings, good solder connections, and elements not pressed against the case. The core windings should be tight to provide a good flat electrical response, but not so tight that the wire enamel is scraped off, shorting the winding to the core. This consistent winding becomes more critical with three- and four-way splitters in providing equal characteristics to all ports. Most high quality two-way splitters have a balancing resistor between output ports. This will usually be bent or coiled slightly to produce a flat return loss and isolation over the entire frequency range. It should not be construed as a poorly installed component.

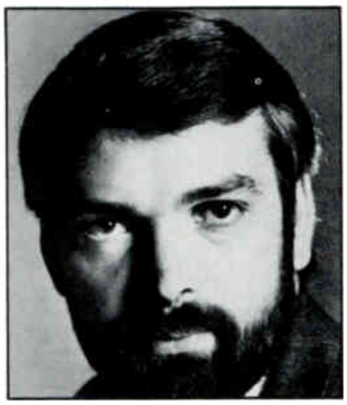
After a brief examination of the areas discussed, you will be able to quickly choose or inspect your passive devices and improve your overall system reliability.

Michael Holland
Vice President, Macom Industries

Flaherty

General Instrument Corp. has made two executive reassignments within its Broadband Communications Group. **William Flaherty** has been promoted to executive vice president of TOCOM. Most recently, Flaherty served as vice president and general manager of Administration and Far East Group Operations. Before joining GI, he was president and general manager of the Dexter Lock Division of Kysor Industrial Corp.

Also named was **Hal Krisbergh**, vice president and general manager of the Jerrold Subscriber Systems Division whose responsibilities have expanded to include Administration and Far East Group Operations. Krisbergh has been with GI since 1981. He came to General Instrument from W.R. Grace where he served in various senior management positions. Contact: 2200 Byberry Rd., Hatboro, Pa. 19040, (215) 674-4800.



Hooper

Harry Hooper has been appointed vice president of marketing and sales for General Instrument Corp.'s Toronto-based Satellite Systems Division. He was previously employed by General Electric Co. for more than eight years in their Information Services Division. Most recently, he was responsible for marketing and sales efforts in the Management Services groups of the division. Contact: 70 Wingold Ave., Toronto, Ontario M6B 1P5, (416) 789-7831.

Laurence Harris, former president and chief operating officer of Metromedia Telecommunications, has been named president and chief executive officer of **CRICO Communications Corp.**, a newly formed telecommunications affiliate of CRI Inc. Prior to joining Metromedia, he was Mass Media Bureau chief of the Federal Communications Commission. Before that, he served as vice president for regulatory and carrier relations of MCI Communications Corp. Contact: One Central Plaza, 11300 Rockville Pike, Rockville, Md. 20852, (301) 468-9200.

Oak Industries Inc. has named **E.L. McNeely** as interim chief executive, filling in for recently retired Chairman Everitt Carter, who had been with Oak for 25 years. McNeely was formerly chairman of Wickes Cos. Carter will remain with Oak for an unspecified amount of time as chairman emeritus. Contact: 16935 W. Bernardo Dr., Rancho Bernardo, Calif. 92127, (619) 485-9300.

Scientific-Atlanta Inc. has named **David Eggers** a vice president of the company. He had been general counsel and secretary of the company since joining it in 1978.

Scientific-Atlanta Inc. announced the appointment of **Basil Kehoe** as national sales manager for the Broadband Communications Group. Kehoe joined S-A in 1979 and has been promoted to

Kehoe

national sales manager from his position as regional sales manager. Contact: 1 Technology Pkwy., Box 105600, Atlanta, Ga. 30348, (404) 441-4000.

John Dieckman has joined **Burnup & Sims Cable Products Group** as national director of turnkey marketing. Most recently he was vice president of sales, for both construction and cable products for AM Cable. In his new capacity, Dieckman will be involved with three of the company's divisions: Capscan Cable, Lectro Power Supplies and Cable Com Construction. Contact: P.O. Box 36, Adelphia, N.J. 07710, (201) 462-8700.

Jadz Janucik has been named vice president of association affairs and **Barbara York** has been named vice president of industry affairs at the **National Cable Television Association.** Janucik has been director of membership services at NCTA since October 1980. She joined the association in January 1977. Prior to that she was an administrative assistant at the National Trust for Historic Preservation.

York was vice president of administration at the association from September 1981 until August 1984. Previously, she was director of internal operations/media relations for the Grocery Manufacturers of America Inc. Contact: 1724 Massachusetts Ave. N.W., Washington, D.C. 20036, (202) 775-3629.

Regency Cable Products, a subsidiary of Regency Electronics Inc., has announced the appointment of **William Robinson** to the position of southeastern sales manager. Robinson, a 20-year veteran of the cable industry, was formerly employed at Jerrold Electronics as southeastern regional engineer. He later formed his own cable system in Georgia, which he operated from 1978 to 1983. Contact: 4 Adler Dr., East Syracuse, N.Y. 13057, (315) 437-4405.

Robinson

David Erikson, former general sales manager of BLH Electronics, has joined **M/A-COM MAC** as the manager of customer service. Erikson will be responsible for overseeing the operations of MAC's Customer Service Group, Product Support Administration, the West Coast Service Center and the Burlington-based repair facility. Contact: 63 Third Ave., Burlington, Mass. 01803, (617) 272-3100.

The appointments of **Thomas Green** and **Joseph Saucier** as sales representatives for the Cable Television Division of **Times Fiber Communications Inc.** was announced recently. Prior to joining TFC, Green was program manager for marketing and development training programs at Essex Corp., San Diego. Saucier has been with Hitchiner Mfg., Milford, N.H., in the capacity of line manager. Contact: 358 Hall Ave., P.O. Box 384, Wallingford, Conn. 06492, (203) 265-8500.

What is 3.579545 MHz?

By Michael Jeffers
Vice President, Engineering, Advanced Development Broadband Group, General Instrument Corp.

When the Federal Communications Commission authorized color television, it required that color television transmission coexist with the established black and white television service. The broadcast specification for the aural carrier frequency in a black and white transmission system was 4.5 MHz ±5 kHz above the visual carrier. Because of the millions of existing black and white television sets in the field, the FCC did not want to change the aural carrier frequency.

The color television system, in order to prevent interference to the luminance component from the color information, required that the color subcarrier and its sidebands fall between multiple sidebands of the luminance component. The frequencies of these luminance sidebands are at integer multiples of the horizontal line rate—for black and white television 15,750 Hz. Tests showed that best overall performance was achieved when the color information was carried at the highest frequency of the video passband. This determined that the color subcarrier frequency should be approximately 3.6 MHz above the visual carrier.

The choice was made to place the color subcarrier at a frequency halfway between the 227th and 228th sidebands of the luminance information. It is a basic fact of television that distortion is less visibly apparent when the frequency interference is halfway between frequencies of the sideband components of the desired signal.

Determining the frequency

To determine precisely the color subcarrier frequency for optimum system performance the following equations were used. If 15,750 Hz were to continue as the line rate, the color subcarrier would be:

15,750 Hz x 227.5 = 3.583125 MHz

However, the intermodulation distortion beat between the color subcarrier and the aural subcarrier would be:

4.500 MHz – 3.583125 MHz = .916875 MHz (916.875 kHz)

This beat would fall in the luminance band near the 58th multiple of the line rate rather than halfway between the 58th and the 59th sidebands and would result in visible distortion.

Therefore, the color subcarrier was recalculated to give a higher quality system by minimizing the effects of this color/aural carrier difference beat. To accomplish this, a modified line rate was determined by the following equations:

Color carrier = new line rate x 227.5
Aural/color subcarrier beat = new line rate x 58.5
Aural subcarrier – color subcarrier = aural/color carrier beat
4.5 MHz – (new line rate x 227.5) = new line rate x 58.5

Solving for the new line rate:
4.5 MHz = new line rate (227.5 + 58.5)

$$\text{New line rate} = \frac{4.5\ \text{MHz}}{286}$$

$$= .0157342657\ \text{MHz}$$

New line rate = 15.7342657 kHz

Now that the new line rate is established, we can derive the color subcarrier.

Color subcarrier = .0157342657 MHz x 227.5 = 3.579545 MHz

To check the beat interference:
4.5 MHz – 3.579545 MHz = .920455 MHz or 920.455 kHz

To determine if this rate causes the beat to fall between sidebands of the luminance carrier:

$$\frac{15734.27\ \text{Hz}}{525} = 58.5$$

which is the proper multiple

To determine vertical rate for a 525 line picture:

$$\frac{920.455\ \text{kHz}}{15.73424\ \text{kHz}} = 29.97\ \text{Hz (frame rate)}$$

29.97 Hz x 2 = 59.94 Hz (field rate)

When the FCC established final specifications for the National Television System Committee (NTSC) color system, it also tightened the aural carrier tolerance to 4.5 MHz ±1 kHz above the visual carrier. This was to ensure optimum performance by accurately controlling the absolute frequency of the 920 kHz beat to ±1 kHz. The color subcarrier frequency tolerance can easily be held to less than ±50 Hz.

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CT 2/85

February

Feb. 4-6: American Federation of Information Processing Societies Inc. annual Office Automation Conference, OAC '85, Georgia World Congress Center, Atlanta. Contact Helen Mugnier, (703) 620-8926 or (800) OAC-1985.
Feb. 5-6: Arizona Cable Television Association annual convention, Hilton Hotel, Phoenix. Contact ACTA, (602) 257-9338.
Feb. 6-8: Magnavox CATV training seminar, San Jose, Caif. Contact Laurie Mancini, (800) 448-5171; in New York, (800) 522-7464.
Feb. 11-13: Magnavox CATV training seminar, San Jose, Calif. Contact Laurie Mancini, (800) 448-5171; in New York, (800) 522-7464.
Feb. 14-March 2: American Federation of Information Processing Societies international shipboard computer exposition, Tokyo to Singapore. Contact Ann-Marie Bartels, (703) 620-8926.
Feb. 20: SCTE Delaware Valley Chapter meeting on system design, George Washington Motor Lodge, Willow Grove, Pa. Contact Bruce Furman, (215) 657-4690; or John Kurpinski, (717) 323-8518.
Feb. 26-28: Baer Enterprises' CATV technical training seminar, Harley Hotel, Atlanta Airport, Atlanta. Contact Howard Plattner, (703) 823-6522 or (800) 321-2323.
Feb. 28-March 1: Washington Program of the Annenberg Schools seminar, "The Cable/Telco Interface." Contact Yvonne Zecca, (202) 484-2663.

March

March 4-6: Society of Cable Television Engineers annual convention, Cable-Tec Expo '85, Sheraton Washington Hotel, Washington, D.C. Contact (215) 692-7870.
March 6-8: Arkansas Cable Television Association annual convention, the ArkanShow 1985, Statehouse Convention Center, Little Rock. Contact (501) 374-3892.
March 11-12: Waters Information Services Inc. conference on stereo television, Hyatt Islandia Hotel, San Diego. Contact, Dennis Waters or Merrill Oliver, (607) 770-1945.
March 12-13: The Yankee Group seminar on "Data Communications in the Factory," Chicago. Contact (617) 542-0100.
March 13: QV Publishing seminar on "Two-Way Tomorrow: Planning Today for Tomorrow's Services," The Yale Club, New York. Contact Barbara Freundlich, (914) 472-7060.
March 13-15: Magnavox CATV training seminar, San Antonio, Texas. Contact Laurie Mancini, (800) 448-5171; in New York, (800) 522-7464.
March 15-16: SCTE South-Central Chapter first official meeting, NBC Annex Building, San Antonio, Texas. Contact Larry Flaherty, (512) 648-4903.
March 18-20: Magnavox CATV training seminar, San Antonio, Texas. Contact Laurie Mancini, (800) 448-5171; in New York, (800) 522-7464.
March 19-21: C-COR Electronics technical seminar, Columbus, Ohio. Contact Debra Cree, (814) 238-2461 or (800) 233-2267.

April

April 9-11: Canadian Cable Television Association annual convention, 'CABLEXPO,' Toronto Metro Convention Center. Contact Christiane Thompson, (613) 232-2631.
April 10-12: Magnavox CATV training seminar, Denver. Contact Laurie Mancini, (800) 448-5171; in New York, (800) 522-7464.
April 16-18: Magnavox CATV training seminar, Denver. Contact Laurie Mancini, (800) 448-5171; in New York, (800) 522-7464.

May

May 1-3: Magnavox CATV training seminar, St. Paul, Minn. Contact Laurie Mancini, (800) 448-5171; in New York, (800) 522-7464.
May 6-8: Magnavox CATV training seminar, St. Paul, Minn. Contact Laurie Mancini, (800) 448-5171; in New York, (800) 522-7464.
May 21-23: C-COR Electronics technical seminar, Dallas. Contact Debra Cree, (814) 238-2461.

Planning ahead

March 4-6: Society of Cable Television Engineers annual convention, Cable-Tec Expo '85, Sheraton Washington Hotel, Washington, D.C.
April 9-11: Canadian Cable Television Association annual convention, "CABLEXPO," Toronto Metro Convention Center.
June 2-5: National Cable Television Association annual convention, Las Vegas (Nev.) Convention Center.
June 17-19: Community Antenna Television Association, CCOS '85, The Opryland Hotel, Nashville, Tenn.
Aug. 25-27: Annual convention of the Southern Cable Television Association, the Eastern Show, Congress World Center, Atlanta.
Sept. 18-20: Atlantic Show, Atlantic City, N.J.

June

June 2-5: National Cable Television Association annual convention, Las Vegas (Nev.) Convention Center. Contact (202) 775-3629.
June 16-18: New York State Cable Commission annual "Northeast Cable Television Technical Seminar," Lake George, N.Y. Contact Bob Levy, (518) 474-1324. SCTE endorsed.
June 17-19: Community Antenna Television Association annual convention, CCOS '85, The Opryland Hotel, Nashville, Tenn. Contact Ruth Williams, (703) 823-6522.
June 24-26: Online Conferences' Videotex '85 conference and exhibition, New York Hilton. Contact Online, (212) 279-8890.

July

July 9-11: Online Conferences Inc. satellite and cable TV conference, "The Cable '85 Exhibition," the Brighton Metropole, U.K. Contact (212) 279-8890.
July 10-12: Magnavox CATV training seminar, Detroit. Contact Laurie Mancini, (800) 448-5171; in New York, (800) 522-7464.
July 23-25: C-COR Electronics technical seminar, Boston. Contact Deb Cree, (814) 238-2461 or (800) 233-2267.

Embarassment or opportunity?

By Bob Luff
Vice President, Engineering, United Artists Cablesystems Corp

The FCC has issued new signal leakage rules to the CATV industry. This time it is no April Fool.[1] On Nov. 9, the commission released its "feared" Second Report and Order in the signal leakage proceeding—Docket 21006.

Why do these new rules require tougher documented leak patrolling of 100 percent of our systems, four times a year? Why do they require that a Cumulative Leak Index (CLI) be measured and maintained annually for FCC inspection? Why do these new rules forbid extensive plant expansions or activation of new (aeronautical) mid-band channels unless, the system has a passing CLI? And, why does the Second Report and Order require that all cable systems offset within five years to special frequencies in the aeronautical band allocations?

An industry embarrassment

The reason for the Second Report and Order should be an embarrassment to all of us. The FCC was forced to release its tougher second set of signal leakage rules (despite the best efforts of NCTA and many dedicated cable operators and engineers) because the CATV industry by-and-large continues to ignore the "honor system" provisions of the First Report and Order.

Let's briefly review the events that led to our predicament. There remains a significant number of cable operators that have continued to ignore the important requirements of the signal leakage First Report and Order. Of course signal leakage programs cost money. But instead of facing up to the responsibilities, or seeking appropriate waivers or extended compliance plans, much of the industry tried to ignore the rules and their growing leakage problems. Even though the commission's attitude became increasingly harsh and more than $200,000 in fines were assessed for individual noncompliance, the industry resisted full and willing compliance. We tried to hide behind the skirt of "there have been no actual CATV cases of life threatening interference to safety-of-life services."

Now we must stop hiding and face today's reality. Is your system doing what it should to improve its signal leakage performance? Do you really think that your system leaks have no chance of causing interference to safety-of-life radio service? Cable systems are not as leak free as they should be and we must address the situation before our hundreds of thousands of miles of maturing plants with millions of connectors create an out-of-control problem, solvable only by abandonment of significant CATV spectrum.

The commission's Second Report and Order states that the ongoing inspection program of its Field Operations Bureau indicates numerous systems in violation of leakage levels, notification requirements and required offsets. The commission concluded that much of the industry has been "lax in their responsibilities." Accordingly, it stated that "the record supports strengthening, not relaxing, the present requirements, especially considering the potential for aviation disaster." The commission further stated that "based on the record at this time, we are unable to conclude that cable operators can be relied upon to maintain their systems sufficiently free from signal leakage as not to create risks of harmful interference in the aeronautical radio frequency bands."

Past excuses

So why did a portion of normally law abiding system operators ignore important signal leakage rules? A review of the historical "regulatory indifference" of many cable systems regarding the commission's First Report and Order suggests that it resulted from years of little or no regulation and the technical simplicity of personnel and equipment in the early CATV years; also the diversion of franchising during the later "post-leakage regulation" years.

Note that the majority of the cable industry, inlcuding technical performance, was not "officially" regulated by the FCC until 1972. Accordingly, the cable industry was hardly out of diapers when the commission issued its first set of widespread signal leakage rules in 1978. Also, to be fair, these rules were unique to the rapidly growing industry. They required special equipment and techniques not familiar to the technical personnel.

Likewise, while the cable chief engineers and technicians were excellent field personnel, the industry was largely vacant of professional or graduate engineering talent even at the corporate level, and much of the early application of the commission's intent in leakage rules was lost in translation. Also, the cable industry was the only regulated technical group in which the commission did not require FCC First or Second Class Commercial License holders to be in control. Consequently, the early cable technician often lacked the special status to "get things budgeted." And since the leakage problems were largely invisible to management, they received little attention.

To make matters worse, the test equipment available at the time was marginal. Even the best efforts often resulted in disappointing accomplishments due to lack of industry calibration techniques and poor sensitivity. And lastly, the FCC added to the problem by failing to maintain visibility on the leakage rules through additional releases, convention addresses or enforcement.

Unfortunately, as the industry technically matured, rapid system growth and new franchising dominated the technical community. For many of the post-First Report and Order years, technical departments were under tremendous stress to expand channel capacity and develop new "star wars" systems at the expense of day-to-day operations. Despite an industrywide boom period, system maintenance, training, seminar attendance and test equipment budgets were at all time lows.

Changing environment

The post-franchise era CATV industry is in the midst of a significant maturing process. Previously overlooked or misunderstood issues are now receiving their fair analysis. And in the analysis, the underlying causes of signal leakage are turning out to be the root of many system problems. Further, the regulatory and day-to-day costs of not addressing these problems are immense. The recurring costs of leak detection equipment and personnel are obvious, especially under the requirements of the Second Report and Order. Less obvious are the hidden costs of revisiting drops to correct leakage problems, and the cost of outages caused by unaddressed poor workmanship and materials.

Additionally, the larger franchises and recent consolidation of companies have greatly increased the complexity of typical system operations.

An opportunity

While the industry's development may be too late to prevent the embarrassment of the Second Report and Order in the signal leakage proceeding, it may have come at the right time to stimulate an opportunity to address the underlying causes of signal leakage and other operational problems. It is time for the cable technical community to get tough on signal leakage and turn this industry embarrassment into an industry opportunity to solve not only leakage problems, but all problems.

There is no doubt that the FCC is serious about reducing the threat of harmful interference to its other radio licensees from cable system leakage. The recently adopted new rules make FCC enforcement much easier. Violators are likely to be harshly dealt with and will receive little sympathy from the at-large maturing cable industry. But more important, if cable is to continue to be competitive in the second half of the '80s, it must improve its quality and quantity of services to subscribers. We must achieve our "closed system" goal.

[1]Luff, Robert "Surprise FCC Signal Leakage Action," *Communications Technology*, April 1984.

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