COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers

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January 1985

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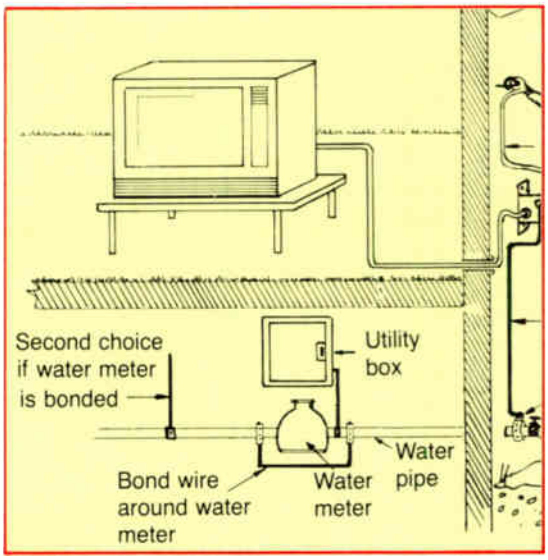

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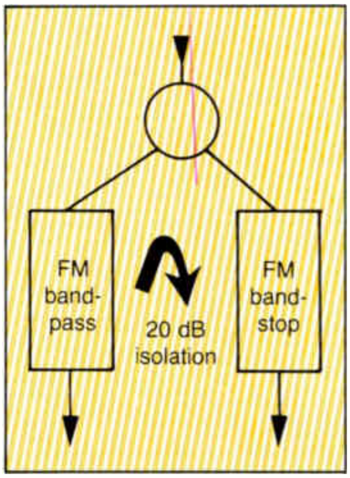

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On the positive side

The cable industry has always had its ups and downs. Cable has flourished by fulfilling a need, but at times has fallen short technologically. Then technology raced ahead of the demand, creating a surplus of developments. And so the fluctuations continue.

In looking back on 1984 we as an industry shouldn't complain too loudly. We haven't come close to exhausting CATV advancements, possibilities and profits; and have just wet out feet regarding other capabilities of cable, such as data.

Here at *CT* we feel very positive about the cable industry's continued progress and success in 1985 and beyond. We believe that astute and assertive performance pays off for those willing to put in the time. RT/Katek Communications Group exemplifies this way of thinking by achieving the "Inc 500" for the third consecutive year. RTK achieved #146 on the 1984 third annual ranking of the fastest growing privately held smaller businesses in the United States. Other cable entities listed in *Inc* were Comsearch (#431) and Cablevision Industries (#490). Hats off to these successful businesses and may their futures be as (if not more) prosperous.

On a sadder note, I'd like to take this opportunity to print Mike Shaughnessy's eulogy for Dean Bach, a friend not only to myself and Shaughnessy but the entire cable industry as well. Personally, I knew Dean for 12 years and he was one of the most honest and aggressive persons I've had the pleasure of working with—which, to me, typifies the caliber of personnel in our industry.

'A bit of Thanksgiving'

"Viewing the Detroit Lions football telecast on Thanksgiving has been a family tradition since I was very young. Over the years, the Lions haven't always won, but they have inevitably come through with a credible performance for the home team crowd. Of course, the Lions' new stadium has changed the game considerably. The controlled climate of the Pontiac Silverdome has replaced the hearty autumn chill and frequent sleet or snow of past years—elements which added character to the contest when played outdoors.

"The character of the cable television equipment business has also changed in recent years. Customers have become more discerning, product development more sophisticated, and the procurement and use of technology more than just an engineering concern. The sales approach of successful vendors has had to change accordingly.

"Dean Bach witnessed this evolution firsthand. As head of Oak's marketing effort during the late 1970s and early 1980s, Dean played a major role in bringing new technology to the industry. Although not an engineer by training, he excelled in promoting creative technical

approaches to Oak's customers. And in so doing, he changed the very nature of cable subscriber control from mundane traps and converters to the advanced addressable control systems in use today.

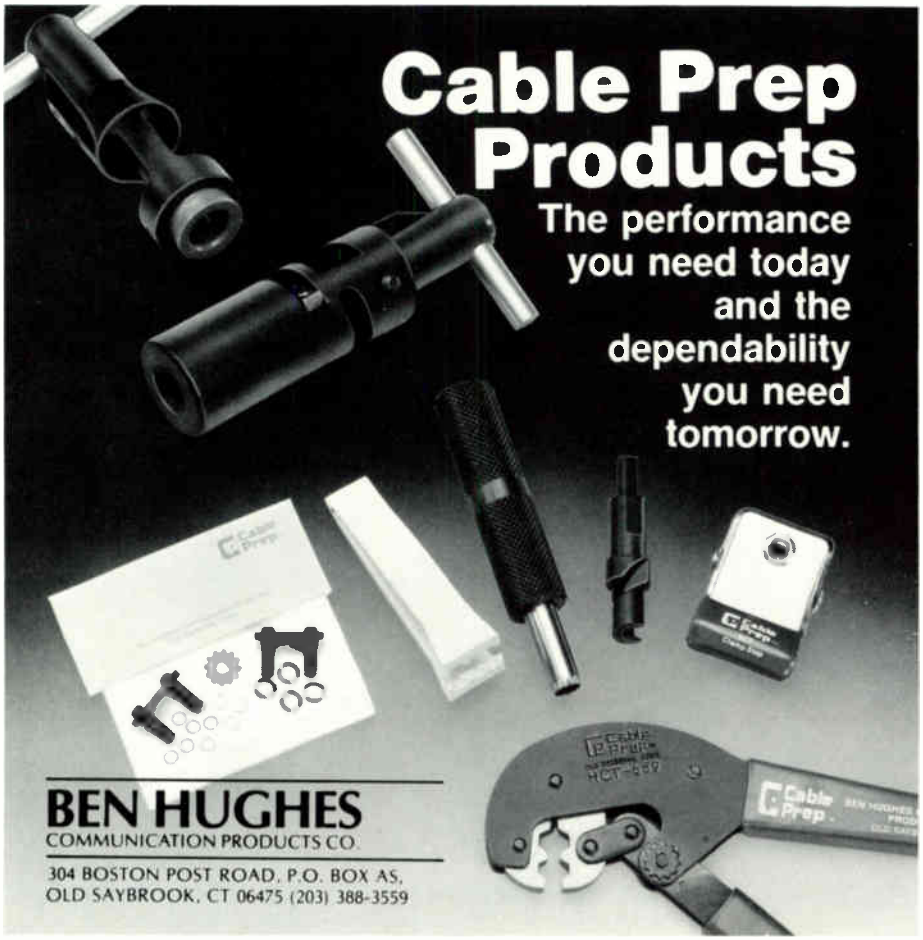
"Not that Dean was totally enamored with these changes. His interests, eclectic as they were, tended in the direction of the rough and tumble of cable's early days. An avid sportsman, he was far more likely to build a relationship with his customers in a duck blind in Wisconsin than a boardroom in New York. And, as a Michigan native, he loved nothing more than seeing his Lions knock heads with the other members of the NFL's "black and blue" division.

"Dean always believed in his product as much as himself. He took Oak's initial missteps in addressability personally, and steadfastly represented his customers in implementing corrective actions. Oak's ability to maintain a stable relationship with most of its customers during this troublesome period was largely his doing. Later, he eagerly accepted the challenge of assisting Racal-Oak in building a presence in Europe, despite the inherent risk, and his own lack of international experience.

"Above all, Dean enjoyed his work—and his company. He always maintained he was no better than average as a salesman. Yet his approach—always assertive, sometimes forceful, but never abrasive—endeared him to customer and colleague alike. And through all of the frustration and turmoil of a company and an industry in transition, he never abandoned his personal interest in the people around him.

"Dean passed away unexpectedly in early November. Though not a true industry pioneer, he did play an important part in the industry's most exciting period to date. His friends and associates note his passing with sincere regret—and many of those who didn't know him will be influenced by what he accomplished.

"After a rousing battle, the Lions won a close one over Green Bay on Thanksgiving. Dean would have been delighted by the outcome, but he would have been equally delighted with the competition and the caliber of play. Perhaps that's how he'd like to be remembered by those of us who remain in the game."



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NCTA urges FCC to adopt CARS licensing

WASHINGTON, D.C.—The National Cable Television Association has asked the Federal Communications Commission to adopt the rules the commission proposed concerning licensing procedures and reporting requirements in the cable television relay service (CARS). The NCTA also urged the commission to adopt other modifications to the rules submitted by Westinghouse Broadcasting and Cable Inc.

Noting that the FCC has acted in the public interest in proposing to consolidate the cumbersome two-step licensing process, NCTA requested that the commission extend to 18 months the term for construction of a CARS station.

NCTA supported FCC proposals:

- to streamline filing and recordkeeping for transfer of control procedures;
- to delete the requirement to list in the appropriate form all communities served by a CARS path; and
- to delete provisions requiring (1) 30 days' advance notice of a licensee's delivery of program material to other cable systems or operators or (2) to require the filing of additional information such as copies of contracts between parties.

The association endorsed a Westinghouse request that the CARS application filing requirement be eliminated where no actual change is contemplated in the identity of a CARS licensee or entity ultimately in control of a licensee. NCTA suggested simple notification by letter as adequate to allow the FCC and the public access to accurate information about CARS licensees.

The association further urged the FCC to adopt the Westinghouse proposal that eliminates the requirement for special temporary authorizations where short-term use of unlicensed CARS equipment or operations is for 30 days or less. It supported the Westinghouse proposal that excess CARS facilities be shared on a profit-making basis.

In addition, the National Cable Television Association and the Electronic Industries Association have agreed to jointly develop materials designed to provide consumers with information about "cable ready" television sets. The two trade associations formed a working group to prepare a publication that would help consumers better understand the relationship between the new generation of TV sets and the reception of cable programming.

"We believe cable operators, TV manufacturers and retailers should work together to provide consumers with reliable information about certain television receivers and their compatibility or lack of compatibility with cable systems," the group said.

Participating at the meeting were cable and consumer electronics executives, NCTA and EIA staff and representatives of the National Association of Telecommunications Officers and Advisors (NATOA).

SCTE announces tele-seminars

WEST CHESTER, Pa.—The Society of Cable Television Engineers will begin transmitting technical training sessions by satellite on a regularly scheduled basis beginning in February 1985. According to William Riker, the Society's executive vice president, the prerecorded programs will feature technical papers delivered at state and regional conventions, sessions hosted by local SCTE chapters, and training tapes produced by manufacturers.

The tele-seminars are made possible through funding from SCTE sustaining member companies and satellite transponder time donated by HBO and other programmers. One seminar (approximately 1½—2 hours in length) will be offered each month for cable systems to downlink and record for immediate and future training purposes.

Tele-seminar topics will include test equipment operation, preventive maintenance and new technology implementation. Exact dates, times and transponders for the February and subsequent monthly programs will be announced once final arrangements are completed.

ComSonics revamps organization

HARRISONBURG, Va.—Following the untimely death of vice president of sales and corporate development, C.H. Hensley, Jr., Warren Braun, president of ComSonics Inc., announced several changes.

Areas of major impact are those of Dennis Zimmerman as vice president of sales and marketing and product resales; Richard Shimp as vice president of advanced concepts and field services; and Mark Barber as manager of repair services and corporate development.

This is the first time in the history of the company that both sales and marketing have come under the same executive. Zimmerman was previously vice president of system services and marketing. The revamping of the Field Services department under Shimp is indicative of the continuing impact this section of ComSonics' work is expected to have on the CATV industry and other types of communications media in the future. He has most recently been vice president of new concepts. Repair Services has been a significant segment of ComSonics Inc. over the years and has been headed up by Barber for the past year. His new role includes the expansion of the company's business into other areas.

In making the announcement, Braun also advised that other changes would be made in the near future to keep the company organization aligned to the market needs. Hensley had been with ComSonics Inc. since its beginning in 1972 and was well known in the CATV field due to his wide experience in several segments of the company's business.

Five PTS employees buy the corporation

BLOOMINGTON, Ind.—Five key employees of PTS Corp. have purchased the entire company stock and equipment from President Roland Nobis. PTS is the world's largest independent electronics repair company. Over 1500 distributors in the country depend on PTS for repair of electronic tuners and modules, modular circuits, and electronic timing devices.

Involved in the buyout are new principle owners Jack Craig, Bob Gidcumb, Jeff Hamilton, John Rollinson and William Terrell. All five have been with PTS for several years.

Cox Cable and M/A-COM Cable Home Group complete testing

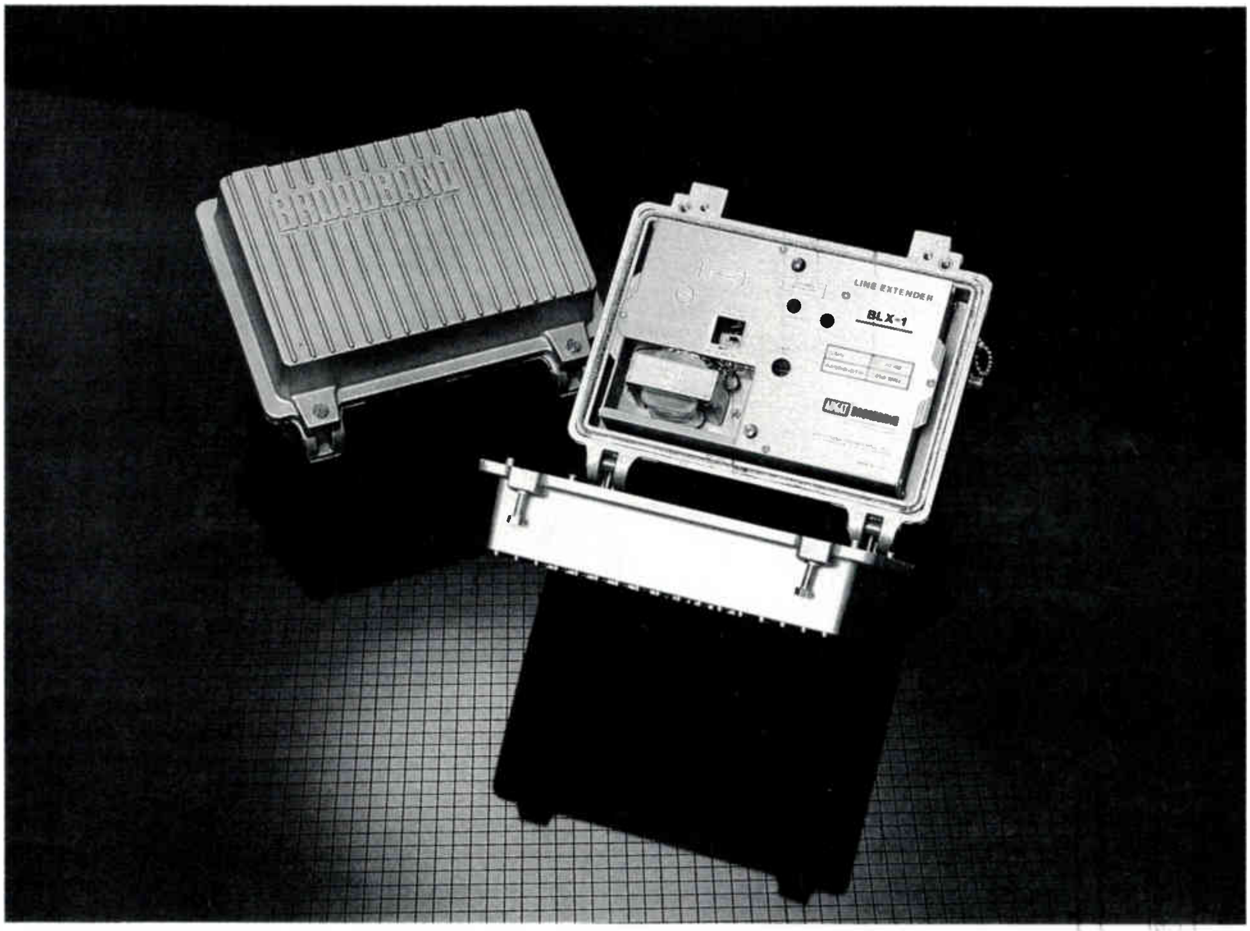
ATLANTA, Ga.—Cox Cable Communications Inc. and M/A-COM Cable Home Group announced jointly the completion of six months' field testing of M/A-COM's Model 3025 Addressable Converter System at Cox's Santa Barbara, Calif. system.

Terming the field trial a success, Dr. G.W. Gates, senior vice president of engineering and technology for Cox, said, "The test results are permitting us to move forward with our planned installation of the 3025 Model in our Lubbock, Texas system."

Cox Cable Lubbock serves more than 30,000 subscribers. Many will be provided with "a new dimension in service options" by the 3025 Converter Systems, according to M/A-COM.

The Lubbock installation is part of a 19 million dollar commitment Cox made to the 3025 Addressable Converter System earlier this year. Initial technology for the 3025 Addressable Converter was developed by the Cox Cable Science Center in Atlanta.

In other news, the M/A-COM MAC division announced the opening of its new West Coast service facility located in Orange, Calif. This organization will provide technical assistance, equipment repairs and spare parts to Broadcast, Common Carrier, and CATV customers.



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Both versions are available with one- or two-way transmission and with aerial or pedestal mounts. Cable powering is available for 30 or 60 volt systems.

For ease in installation and maintenance the amplifier module may be installed with the input on either the right or left of the housing. And the connector chasis may be replaced without removing the coaxial cable connectors in the housing.

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- Amp module can be installed with input on right or left of housing.
- System upgradable for different gains.
- Plug-in hybrids for ease of maintenance.
- Plug-in equalizers.
- Plug-in thermal network for temperature compensation.
- Optional plug-in gas discharge tubes for surge protection.
- Connector chassis replaceable without removing coaxial cable connectors in housing.
- 30 dB test points eliminate need for probes.
- Compact, durable die-cast aluminum housing.

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'To rectify...the decline of the American electronics industry...the (FCC should) be empowered to offer suitable awards to the inventors of new technology'

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

The Communications Act of 1934 gave the Federal Communications Commission jurisdiction over all radiated and wired communications on an interstate and international basis. Major departments within the FCC are the Mass Media Bureau, Common Carrier Bureau, Private Radio Bureau and the Office of Science and Technology.

As the average household has a television set operating for approximately seven hours a day, plus the time spent on the telephone, and listening to the radio, it is apparent that the FCC regulates more hours of the day than any other agency in Washington.

The growth of the Federal Communications Commission has paralleled the growth of the broadcasting industry. The first use of wireless was Marconi's ship-to-shore demonstration in 1896. In 1903, a conference in Berlin unified the ship-to-shore standards. In 1912, a London conference drafted pertinent international regulations. The era of radio broadcasting began in 1922. Because frequencies were used without coordination, the need for a watchdog agency became apparent. This led to the creation of the U.S. Federal Radio Commission (FRC) in 1927. As well, the International Radio Consultative Committee (CCIR) was established in 1927, and is essentially the voice for the European area in communications regulations. The Communications Act of 1934 upgraded the FRC charter and changed its name to the Federal Communications Commission.

The development of technology on the American scene, with our capitalistic system, relies upon individual inventors and corporations to come up with new technology and uses for communications. The inventors then present their ideas to the FCC for permission to exploit the resulting market. In contrast, most of the CCIR standards followed nationalistic objectives to support home industries.

A typical way in which the FCC obtained the necessary knowledge and industry coordination to set standards is exemplified by the National Television System Committee (NTSC), which was sponsored by the Radio Manufacturers Association in cooperation with the FCC. The following organizations were requested to appoint one representative to the NTSC: Bell Telephone Labs; Columbia Broadcasting System; Don Lee Broadcasting System; DuMont Labs Inc.; Farnsworth Television and Radio Corp.; General Electric Co.; Hazeltine Service Corp.; John V.L. Hogan; Hughes Tool Co.; Institute of Radio Engineers; Philco Corp.; Radio Corp. of America; Stromberg-Carlson Television Manufacturing Co.; Television Products; and Zenith Radio Corp.

A majority of all those present would be required for an agreement on any proposal. The members had one vote each. The first meetings commenced in 1936. The report was adopted in 1941—and TV was born. Other examples of FCC and industry studies are FM stereo, UHF, cable standards, satellite standards, BTSC and, most recently, ATSC.

Losing ground

Until the late '50s, most of the new technology originated in the United States, and American manufacturers profited from their ability to manufacture competitive products sold not only in the United States but abroad as well. Since that time, however, the Far East has entered the picture and virtually all entertainment television and most mass-produced electronic devices stimulated by FCC rulings are being produced overseas.

What is probably not apparent to the general public, and possibly even to the FCC, is that now a fundamental difference exists in the relationship between the FCC and the American technologists and manufacturers compared to their relationship of past. Along with the production, the engineering and creative talents have moved overseas. Innovations are now appearing abroad first. They are being approved there before the FCC is able to review the technology and issue permissive regulations to proceed with the changes. As one example, TV stereo sound broadcasting commenced in Japan a decade before it began in the United States. It began in Germany three years ago. High-definition television was fully researched by government funds in Japan 10 years before any funding was available in the United States. It is apparent from scanning the technical literature that this lead in the foreign laboratories will continue. Even cellular telephone, originated by Bell Labs, is now the province of foreign manufacturers. Virtually in every new technical area the FCC is considering, American manufacturing is in the unfortunate position of second-guessing the work done abroad, which, in most cases, is well done and already has covered the salient points of a new technology, leaving little for our engineers to invent.

Compensation lacking

If we go back to the NTSC activities and examine how the technology came to the commission for consideration, and how it was adopted (a practice still in use today), we can see immediately that the reward to inventors has been left out of every discussion. If and when there is any just compensation due the inventors, they find themselves having to battle in the courts for it, for years, usually ending on the losing side. (Major Armstrong, the inventor of FM radio, committed suicide Jan. 31, 1954, after five years in the courts without an end in sight.)

Also absent from the typical "Industry Committee" makeup, and that is true even today, is a voting presence by outsiders who may not possess the funds nor the corporations nor the laboratories to be admitted into the inner circle. Yet, it is well known that inventions come mostly from individuals, not corporations. To rectify and perhaps arrest the decline of the American electronics industry, I propose that the commission, through an act of Congress, be empowered to offer suitable awards to the inventors of new technology, either as a lump sum, or fixed fee—say 1 percent for 10 years—on the product produced for the new services as regulated by the FCC. The alternative may have to be a socialization of our engineering profession, as is common in other countries where most of the R&D funds are provided by the governments, rather than industry.

Additionally, the recent deregulation of the Bell companies may eventually eliminate Bell Labs as a major factor in pure research.

Our competitive decline is a problem crying for a solution. Will Congress act?

Maintenance testing

By Patrick McDonough
Corporate Chief Engineer, United Cable Television Corp

Cable television is primarily a service business. Our livelihood consists of delivering a service to our subscribers. This service can take the form of video and audio signals, data or any other type of signal that can be applied to a coaxial cable or fiberoptic line. Regardless of what is being sent over what medium, both the signals themselves and the transportation system must be set up and maintained to ensure continuous, trouble-free operation.

In order to provide a reliable system and also stay within FCC guidelines for cable system operation, a comprehensive preventive maintenance program is called for. To be effective, this program must meet several requirements. First, it must be comprehensive enough to cover all components of the system. Second, it must be applied on a regular schedule. Third, information obtained from the program must be detailed enough to allow the technical manager to foresee problems, and precise enough to satisfy record keeping requirements of local franchises and the FCC.

The schedule to be followed will depend upon the size and complexity of the system. A good rule of thumb is to schedule so that each trunk amplifier is visited twice a year. Line extenders associated with a trunk amplifier should be checked at the same time. End of lines should be checked randomly throughout the year in conjunction with a radiation detection program. Headend levels or microwave receive sites need to be checked daily prior to field maintenance work.

Assuring accuracy

Maintenance tests are not as rigorous as FCC proof type tests, but care should be taken in any case to assure accuracy. Equipment should be calibrated regularly according to the manufacturer's specifications. Calibration dates should be attached to each piece of gear by the technician doing the work. This ensures consistent readings throughout the system during all phases of maintenance. Care also should be taken with the transportation and handling of all test equipment. Padded enclosures and lock downs are necessary to prevent damage and the resultant delays to the maintenance schedule, as well as additional expense.

Since the main emphasis in maintenance testing is to confirm proper system operation, the tests are relatively simple. At United we usually do five tests at each amplifier location, sometimes a sixth is added depending on the circumstances. The five operations performed are: level readings on a representative number of channels (video and audio), system response, carrier-to-noise on two channels, hum modulation and radiation monitoring. Sometimes a subjective rating of picture quality is done for all channels using the TASO (Television Allocations Study Organization) code system.

With the proper equipment, these five tests can be performed quickly by any technician, with a minimum of set up time at each location. The test gear should be of good quality and each piece should be multi-functional if possible. For example, a good field strength meter, such as the SAM III by Wavetek, can be used to obtain the level readings, hum modulation percentage and carrier-to-noise ratio. Of course, the results will not be as accurate as those obtained by more sophisticated testing techniques. But as far as a maintenance program goes they will provide a fairly reliable indication of system operation.

Equipment requirements

The minimum equipment requirement for a maintenance program must include the field strength meter, a sweep receiver, a digital multi-meter and a polaroid type camera equipped with a hood and a radiation detector. The technician performing maintenance also will need to keep his vehicle stocked with the proper amplifier modules, extra pads and equalizers, drop cable with the appropriate connectors, test probes and system maps. In addition, the technician must have the right tools and required safety equipment. Finally, the tech must have a log book to record the test results. At United, we have a recording format that allows us to easily see the maintenance history of each amplifier in the system.

The importance of recording the test results cannot be over stressed. When filling out this information the technician must be accurate and legible. All information must be put down each time a station is done. In addition to the actual test readings and photographs involved, also note the amplifier number and cascade position, the pad and equalizer values, the AC and DC voltages in the station and time, date and temperature at each test site.

A program such as the one outlined will, in almost any system, provide reliable operation. Common sense and good test equipment are the only real requirements to give subscribers the service they deserve and pay for.

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Maintenance and service: Not such strange bedfellows

By Wendell H. Bailey
Vice President of Science and Technology
National Cable Television Association

Do you get mad when you take your car in for service and it doesn't get fixed right the first time around? Does it irritate you when the water goes out and the plumber promises to come a week from Tuesday? Have you ever scheduled an appointment with the furnace repairman, taken a day of vacation in order to be home when the work is done, and then waited in vain for a "no show"? If any of these things have occurred in your life (Could I see the hands of anyone who has *not* had one of these experiences? Ah ha, just as I thought!), then you surely can empathize with the cable subscriber who has had the cable equivalent of each of these failures in service. Your sympathy is appreciated and so is your empathy, but they alone are not enough to correct the deplorable "rap" that cable television has taken on the issue of service.

Maintaining service

In this issue of *CT* there are several articles on techniques and programs dealing with the on-going issue of maintenance testing and the resulting service. These two items are related; providing adequate service is more than just politeness and prompt response to customer calls, there has to be bedrock somewhere and that bedrock is maintenance. These things are not just important, they may be (in fact) the major elements influencing our customers' view of a cable company. It is an indisputable truth, however, that service technicians cannot provide adequate response or permanent, trouble-free repairs if the system is not maintained to a proper state of operation.

I feel just a bit uncomfortable writing about the need to improve our level of service and maintenance to the subscribers of this type of magazine, especially since you are the very people who are most likely to have a personal motivation to provide top-grade service and maintenance. Nevertheless, there are a few things that need to be said here and a few thoughts that need to be explored. If these thoughts and words serve no other useful purpose, perhaps they will at least get the creative juices flowing in the minds of people who can help improve the situation.

At this point, there may be a cynic or two out there who want to ask me why are the articles in this magazine important this month and what, after all, is the big deal about service. Surely companies' resources can be spent more efficiently on marketing or other activities as long as things do eventually get fixed and systems generally work okay. I would counter with a few facts: In a 1984 research project performed by International Communications Research for the National Cable Television Association, service related disconnects accounted for over 11 percent of lost customers. In another area of the study (poor reception) service is indirectly implicated to the tune of over 9 percent of all disconnects.

If you don't think that service to the subscribers has a direct impact on the bottom line, just ask the financial types in your company what those few percentage points may mean to the viability of your company and ultimately to your ability to hold a decent job in the community you've chosen to live in. When you take in to account the fact that the vast majority of the capital expense of a cable system is expended in getting its wire in front of the home, then each incremental subscriber who is installed (or, conversely, each subscriber who stays with a cable system after being installed) is worth their weight in gold.

Service and maintenance are situations that ultimately feed upon themselves. That is, if subscribers are kept happy then penetration improves, churn decreases and more money is available to the system operator. Funds for such projects as improvements in service programs, technical programs and research and marketing areas ultimately lead to a very stable and viable cable operation with good return for its investors. If, however, service is poor due to maintenance or poor attitude then churn is high, penetration drops and revenues are not sufficient to do much more than meet the basic demands of the creditors. As a result, no money is available to improve service or maintenance, to implement programs to evaluate and acquire new test equipment or to hire and train enough technicians and engineers to do a proper job. Good service feeds on itself and produces the resources to provide better service. Poor service and maintenance cuts down on the resources to improve the situation. This vicious circle can be corrected. It requires, however, a serious commitment by the technical forces of a company coupled with the proper management attitude.

'Service is more than just politeness and prompt response to customer calls, there has to be bedrock somewhere and that bedrock is maintenance'

Engineers/techs can set the tone

Of these two forces—technical and managerial (each of which is equally important)—we will be concerned with the technical discipline here. By this I mean the discipline and efforts devoted to those things affecting service that are directly under the control of the engineers and technicians in their day-to-day performance of assigned tasks. (Several of these items are covered in other articles in this issue of *CT*). Engineers and technicians involved in maintenance activities can do more to set the tone for how the service aspects of a cable system are perceived by a community than anyone else. The reasons are simple:

1) If the plant is being kept tight and the operating parameters are kept to close tolerances, then a large source of the nagging,

Handbook available on recommended practices

The first edition of *NCTA Recommended Practices for Measurements on Cable Television Systems* is a comprehensive volume providing informative, readily updated descriptions of good engineering practices required for the proper running and maintenance of a cable system. It covers four areas of concern: the distribution system, the headend, current satellite transmission practices and video facility testing. Updates will be provided as regulatory and/or technology changes occur.

The handbook is available at $35 for NCTA members; $40 for nonmembers. To order a copy, or for more information, contact the National Cable Television Association, 1724 Massachusetts Ave. N.W., Washington, D.C. 20036, (202) 775-3550.

intermittent, chronic type of complaint is eliminated or at least reduced. If you find yourself fixing a lot of troubles over and over again by doing things that careful routine maintenance could have prevented then you can bet that at least one aspect of the service burden in your system is unnecessary and could be reduced.

2) Outside of the initial contact by the sales personnel, the engineers and technicians are the ones that the customers in the community see most often professionally. The demeanor of these people makes a major impression (good or bad) on your community. This impression and its importance can not be minimized. While both of these issues should and probably will be carefully considered by each engineer/technician, those with the power to do so must be persuaded to implement systems and an overall attitude that is geared toward the bottom line importance of good service. One would hope that your management understands the need for this.

This task is sometimes difficult, the results frequently hard to recognize in the immediate time frame and the constant investment can look like an ongoing and unnecessary expense to shortsighted managers. But, *it is a fact* that testing, maintenance and service can directly affect your ability to get and keep customers. You have within your grasp a powerful tool for making sure that the sales effort is something more than just a keep-even proposition.

Why is service important?

Let me sum this up with a list (somewhat tongue-in-cheek) of several points about service:

1) It keeps more customers happy
- If they are happy, they stay.
- If they are happy, they tell.
- If they are happy, they pay.

2) It keeps you happy and proud
- Ex-customers don't sneer when they see you in the supermarket.
- Present customers don't try to run you off the road to get back at you.
- Future customers don't make you squirm when you explain company service policy.

3) It keeps the bookkeepers happy
- Churn drops.
- A given sales effort "nets" more customers.
- The bean counters would rather pay for a good service or maintenance call than a disconnect call.

4) It keeps the management happy
- The phone calls from the mayor taper off.
- The snide comments about the company in the local editorial page of the newspaper disappear.
- People are nicer to the wife and kids at community events.

5) The owners are happy
- They don't have to give up vacation time to placate irate mayors.
- They don't have to give up golf time to hire new management.
- They don't have to listen to new management whine about how hard it is to find good techs and engineers.

Service *is* important and the basis for a sound service policy is good maintenance. Engineers and technicians can do a lot to improve their company's bottom line. Believe in it, work to make your attitude and the attitude of your coworkers and your boss service oriented. You will see the results.

Table 1: Annual performance test requirements and other related technical rules

Test	Section
Tests completed once each calendar year at intervals not to exceed 14 months.	76.601(c)
Tests on file at the local business office for five years	76.601(c)
Tests required for systems with more than 1,000 subscribers	76.601(c)
Tests required for systems with less than 1,000 subscribers	76.601(f)
Tests include a description of instruments and procedures used in making the measurements	76.601(c)
Tests include a statement of the qualifications of the person performing the tests	76.601(c)
Tests apply to Class I channels	76.601(b)
At least three test points used for measurements	76.601(c)
Recommended test procedures	76.609
Tests include the effects of CARS equipment	76.609(a)
Degradation of visual signal quality	76.55(a)(1)
Visual carrier frequency tolerance (±25 kHz)	76.605(a)(2)
Converter stability (±250 kHz)	76.605(a)(2)
Aural carrier frequency tolerance (±1 kHz)	76.605(a)(3)
Minimum subscriber visual signal level (0 dBmV)	76.605(a)(4)
Visual signal level 24-hour test (no more than 12 dB variation)	76.605(a)(5)
Maximum visual signal level variation between adjacent channels (3 dB)	76.605(a)(5)(i)
Maximum visual signal level variation between nonadjacent channels (12 dB)	76.605(a)(5)(ii)
Visual signal level maintained below a level that will overload a subscriber's set	76.605(a)(5)(iii)
Aural carrier level maintained below visual carrier level (13 to 17 dB)	76.605(a)(6)
Hum and other visual signal variations (5 percent maximum)	76.605(a)(7)
Frequency response of a channel (±2 dB)	76.605(a)(8)
Maximum visual signal level to system noise (36 dB)	76.605(a)(9)
Maximum visual signal level to intermodulation products or discrete-frequency interfering signals (46 dB)	76.605(a)(10)
Minimum terminal isolation (18 dB)	76.605(a)(11)
Maximum signal leakage (20 uv/m at 10 feet from the cable for 54 MHz to 215 MHz)	76.605(a)(12)

'Basically, the performance tests should include all circuits between the pickup antenna and the subscriber terminal'

Annual performance tests: What the inspector expects

By Chris Papas
Federal Communications Commission

If a Federal Communications Commission inspector comes to your system and asks to see the most recent performance tests, are you giving him (or her) all of the information that is required? If you are not sure, then get your system's most recent test results and follow along to see if they provide all the necessary information.

Why do testing?

The performance tests also are known in the industry as a "proof" or "a proof of performance." To give an idea of why these tests are required by the FCC, we will go over Section 76.601(a) and Section 76.601(c) of the FCC rules. Section 76.601(a) states:

"The operator of each cable television system shall be responsible for insuring that each such system is designed, installed and operated in a manner that fully complies with this subpart. Each system operator shall be prepared to show, on request by an authorized representative of the Commission, that the system does, in fact, comply with the Rules."

Section 76.601(c) states in part:

"The performance tests shall be directed at determining the extent to which the system complies with all the technical standards set forth in 76.605."

This gives a little background on why the performance tests are required. For those that are not familiar with the FCC rules, Part 76 covers all the rules for the Cable Television Services, Subpart K covers the overall technical standards and Part 76.605 covers the specific requirements of the performance tests.

The proof tests

A list of the rule sections related to the annual performance tests is contained in Table 1. (You may want to keep this list for future reference.) At this point we will go through each item with a brief explanation.

Tests completed once each calendar year at intervals not to exceed 14 months—This is self-explanatory; every year you must do the tests and the dates between this year's and last year's tests should not be more than 14 months.

Tests on file at the local business office for five years—The test results should not be kept at corporate or regional offices, they should be at the local business office. Since they should be kept on file for five years, you should have at least four of them on hand at any one time. Do you?

Tests required for systems with more than 1,000 subscribers—If your system has more than 1,000 subscribers, you are required to do tests showing compliance with all of the technical standards in Section 76.605.

Tests required for systems with less than 1,000 subscribers—Systems with less than 1,000 subscribers and use frequencies other than the normal off-air FM and TV frequencies, must do the tests related to signal leakage noted in Section 76.605(a)(12). These other frequencies include pilot carriers, mid-band channels and super-band channels. A system that has less than 1,000 subscribers and uses only the standard FM and TV frequencies would not be required to do any annual performance tests.

Tests include a description of instruments and procedures used in making the measurements—Include information as to what equipment and procedures you used in making the system performance tests.

Tests include a statement of the qualifications of the person performing the tests—Include a brief statement as to who did the tests and what are his (or her) qualifications.

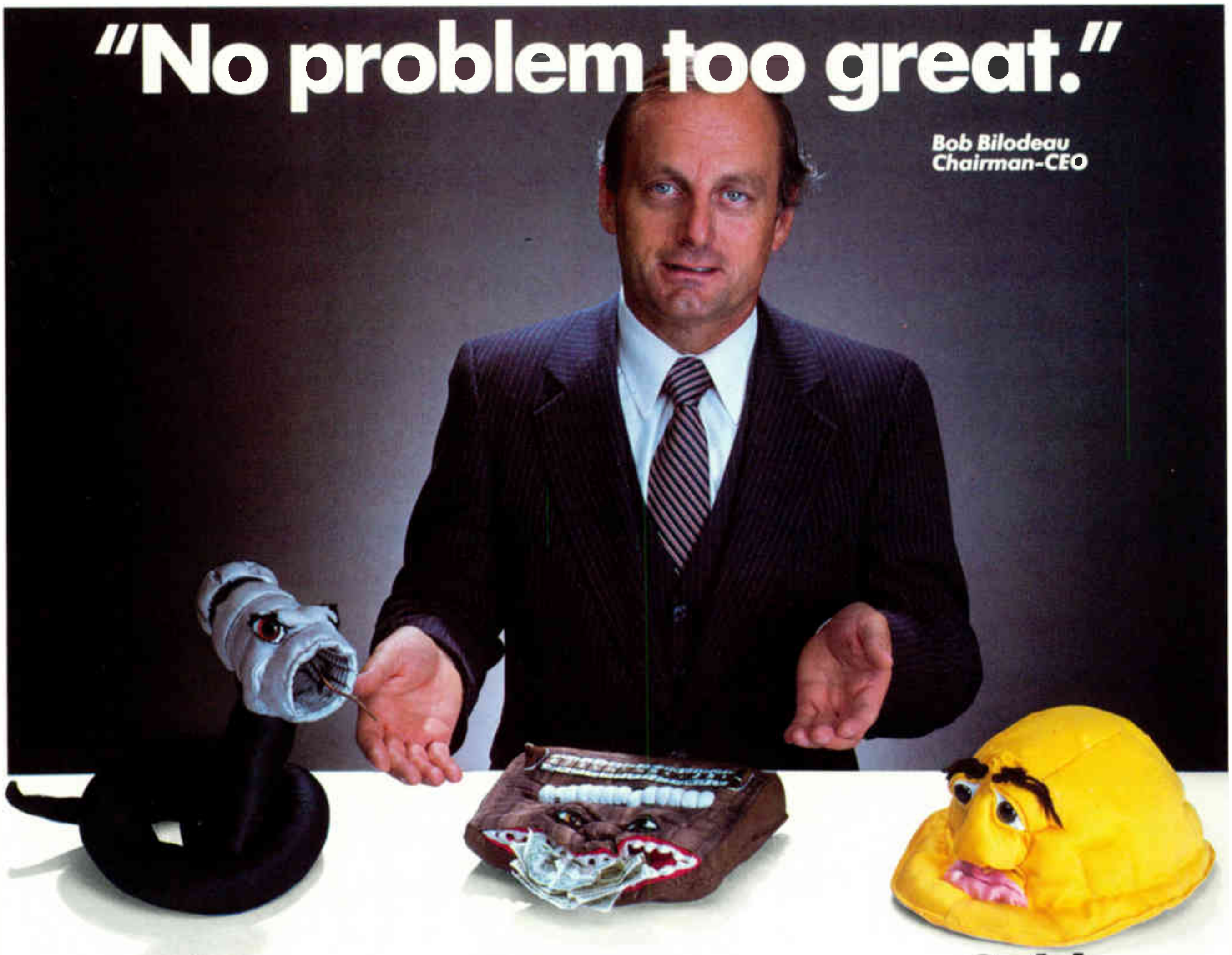
Tests apply to Class I channels—The technical specifications of Section 76.605 only apply to cable channels that are Class I channels. A Class I channel is one that contains a

TV broadcast originated signal such as your local TV station and TV signals received off a satellite, including WTBS, WOR and WGN. The method of delivery is not important here, the fact that it originated as a TV broadcast signal is the determining factor. Most systems will go ahead and do the measurements on all channels though.

At least three test points used for measurements—Each system that you measure must include measurements on at least three test points. One of the test points should be the farthest cable distance from the headend. For the purpose of this rule, a "system" is defined as a mechanically continuous set of cables. If you have several hub sites, then you would be required to do at least three test points for each hub site, since each would be technically a separate system. Measurements at only three test points do not relieve you from providing proper service to all subscribers. It only checks a portion of the system as a representative sample of the system as a whole.

Recommended test procedures—In Section 76.609 there are some test procedures that could be helpful to the cable operator when making the annual performance tests. You should spend a little time going over this rule section.

Tests include the effects of CARS (cable television relay service) equipment—All tests should include the effects of any CARS equipment, especially the sweep tests. Basically, the performance tests should include all



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If installs have you feeling snake-bit, our Installation Services Division is the solution. We're setting the pace in both residential and multiple dwelling unit installations. All of our crews and field supervisors must prove themselves capable *and* courteous on every job—or they don't go out. We also handle special projects (like audits, rebuilds, regrounding, converter changeouts and upgrades), and we specialize in MDU construction. Cable installs? No problem!

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RTK's Converter Services Division is the answer when converter repairs are eating your profits. We're showing the industry how repairs should be done. Our technicians check and re-check every component—not just those with obvious problems—so your subscriber gets back a unit that's as good as new. We stock parts and supplies for all models, and back our work with the most comprehensive guarantee in the business. Converter repairs? No problem!

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We build better cable systems—from the ground, up.

RTK's Communications Construction Division takes the hardhat pains out of the *entire* project. We handle site planning, electronics design, surveys and strand-mapping, make-ready, cable and materials purchasing, aerial and underground construction, debugging, and maintenance for the life of the system. We can design a system and provide full or modified turnkey construction to the most exacting specifications. Cable construction? No problem!

RTK™ The cable industry's problem solvers.™

RT/KATEK COMMUNICATIONS GROUP

Installation Services Division 201/678-2083 □ **Converter Services Division** 800/441-1334 Toll Free (In PA, 717/534-1161) □ **Communications Construction Division** 215/269-1946 circuits between the pickup antenna and the subscriber terminals.

Degradation of visual signal quality—Although this is not a specific performance test requirement, you should be aware that there is a rule requiring that all Class I must-carry signals be carried on the system without material degradation in quality. When it's time to do the annual tests, you may want to look at the pictures to see what your system is doing to the incoming broadcast signals. All the technical measurements mean nothing to a subscriber when the pictures are just plain bad. Picture evaluation is done using the Television Allocations Study Organization (TASO) scale. This is a subjective rating of the picture quality and is done at the headend and the test points. All locations are done with the same equipment and personnel. The TASO scale is as follows:

- TASO 1: Excellent reception; no perceptible faults.
- TASO 2: Good reception, faults just perceptible.
- TASO 3: Passable reception, faults definitely perceptible but not objectionable.
- TASO 4: Reception not quite passable, faults somewhat objectionable.
- TASO 5: Poor reception, faults definitely objectionable.
- TASO 6: Reception not usable.

Inspectors use this method of picture evaluation during cable inspections. The FCC has ruled that if there is a signal two or more TASO grades lower at the test points than the headend, the system could be issued a violation notice for signal degradation.

Visual carrier frequency tolerance—This is normally measured at the headend but could be measured anywhere in the system. You should check the frequencies again after a microwave hop to make sure they are still where they're supposed to be. The visual carrier should be 1.25 MHz above the lower frequency boundary of the cable television channel, ±25 kHz.

Converter stability (±250 kHz)—You will not have to actually measure this if the manufacturer of your converter has supplied you with adequate test data. This data indicates that the requirement has been met based on a representative sample of the converter. Include the manufacturer's data with your performance tests.

Aural carrier frequency tolerance—This test is usually made at the headend but could be made anywhere in the system. The center frequency of the aural carrier should be 4.5 MHz above the visual carrier ±1 kHz.

Minimum subscriber visual signal level (0 dBmV)—This is measured at the three test points on all channels, however you should be able to meet this at all subscriber sets.

Visual signal level, 24-hour test (no more than 12 dB variation)—This test is measured at the test points and for the best accuracy it should be measured at least four times during the 24-hour period. The four times should include the hottest and coldest part of the day.

Maximum visual signal level variation between adjacent channels (3 dB)—After you have measured all of the visual signal levels at the test points, then look at the recorded levels. If the signal levels of any two adjacent channels are 3 dB or more, then the system does not meet this requirement. If the adjacent visual signal levels differ less than 3 dB in all frequencies, then the system is okay on this test.

Maximum visual signal level variation between nonadjacent channels (12 dB)—Look at the visual signal levels at the test points. If the difference between the highest signal level and the lowest signal level is less than 12 dB, then you are all set here. Some systems have a normal tilt on the frequency spectrum to compensate for line loss at the higher frequencies. Still the difference between the highest level and the lowest level should be less than 12 dB.

Visual signal level maintained below a level that will overload a subscriber's set—There is not a specific measurement requirement here but you should be aware that different sets overload at different levels. Too much signal level into a subscriber's TV set will cause it to overload. Attenuators are easily installed in the line if you suspect overload. Also, some converters will not unscramble pay channels if they have too high a level going in.

Aural carrier level maintained below visual carrier level (13 to 17 dB)—After you have measured the visual and aural carrier levels at the test points, subtract the difference be-

tween the two for each channel. It should be in the range of 13 to 17 dB.

Hum and other visual signal variations (5 percent maximum)—This is normally measured on each channel at each test point. You also should check processors and modulators at the headend to see if they have an adequate low frequency response. This could add to any hum problem in the system. The total of these and any other visual signal variations from your system should not exceed 5 percent.

Frequency response of a channel (±2 dB)—This measurement is done at the test points and should include all the circuits between the antenna pickup point and the test points (including CARS equipment, processors and modulators). It may be convenient to do these sweep tests in two parts and add the results. First from the pickup antenna lead to a test point in the headend and later from the headend to the subscriber test points. The total variation should not exceed ±2 dB over the entire system. If you are using the automated sweep equipment to check the balance of the system at the test points, be sure to go back and check each channel. This will give you the necessary amplitude characteristics of each channel.

Maximum visual signal level to system noise (36 dB)—This measurement is made at each test point but only applied to certain channels. It applies to a channel if: 1) you get a direct video feed from the TV station, 2) the signal is picked up within the predicted grade B contour of the TV station, or 3) the signal is delivered to any subscriber within the predicted grade B contour of the station. The measurement also is called a carrier-to-noise measurement and the 36 dB limit represents a very poor picture.

A second part of this rule applies the 36 dB limit to the ratio of a visual signal level to any undesired co-channel TV signal. This particular section does not require any measurement, however, you must be able to meet the requirement in your system.

Maximum visual signal level to intermodulation products or discrete-frequency interfering signals (46 dB)—There is a note after Section 76.601(f) that eliminates the requirement to measure this specification on a routine basis, but it does not relieve the system operator from meeting it anywhere in the system. It would be wise for you to check for any intermod products or interfering signals when you are at the test points.

Minimum terminal isolation (18 dB)—You will not have to actually measure this specification if the manufacturer of your taps has supplied you with adequate test data. The data should indicate that this requirement has been met based on testing a representative sample of the taps. Include this data with your system's performance tests.

Maximum signal leakage (20 uv/m at 10 feet from the cable for 54 to 216 MHz)—Here we go again! You are expected to actually measure leakage from the cable system. There are some procedures that you should use in making the measurements listed in Section 76.609(h). This is in addition to the signal leakage requirements listed in 76.610, which applies when the system uses any carriers in the aeronautical bands.

This information should give you an idea of what an FCC inspector is looking for if he asks for your annual performance tests. The information given is admittedly a little brief. You should look up the individual section in the FCC rules for more complete information.

Not meeting the specs

The question that now comes up is: "What happens when I measure something and it doesn't meet FCC specifications?" Fine! Write it down as you found it, fix it and then make an entry showing what the measurement is now. If you can't fix it right away then make an entry in the performance tests as to what efforts you are making to bring the system into compliance with the rules. When the problem is repaired then make an additional entry showing the new measurements. This shows you are making an honest effort to do the performance tests and to take care of any problems that your system may have. If you make an entry in the performance test that is out of the specified tolerance and you don't show any corrective action, one can only assume that the system was and still is operating in noncompliance with FCC rules and regulations.

The views expressed are those of the author and do not necessarily reflect the views of the Federal Communications Commission.

Spectrum analysis, the spectrum analyzer and CATV measurements

'The spectrum analyzer is used to analyze the signal and display all components in terms of frequency and the relative power each contributes to the total signal'

By Ronald B. Adamson
Sales Applications Engineer Texscan Instruments

For everyone involved in the technical operation and maintenance of a cable television system, the application of spectrum analysis and the use of the spectrum analyzer can prove to be of great assistance in solving technical problems, aligning transmission hardware and measuring system performance. This article will cover the fundamental principles of spectrum analysis, review subject terminology, discuss the functional operation of the spectrum analyzer, and take a comprehensive look at CATV system measurements using the spectrum analyzer.

Fundamentals of spectrum analysis

A radio frequency (RF) carrier, which is a sinusoidal signal with amplitude and specific frequency, can be observed in the time domain using an oscilloscope with appropriate frequency response, or in the frequency domain using a spectrum analyzer with appropriate frequency range. Both instruments display the amplitude of the signal on the vertical axis. The oscilloscope will be amplitude calibrated in volts (or millivolts, or microvolts), while the spectrum analyzer (for CATV application) will be calibrated in dBmV (0 dBmV = 1 millivolt).

Figure 1

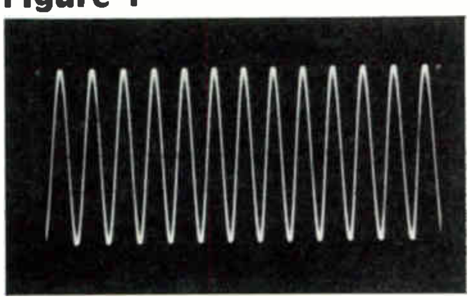
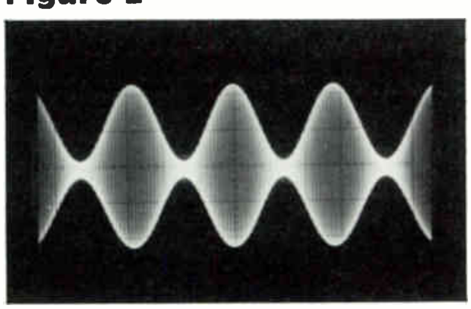


Figure 2



The relationship between time and frequency is expressed by:

$$T = \frac{1}{f}, \text{ and } f = \frac{1}{T};$$

where T = time period of one complete cycle in seconds (or milliseconds, or microseconds), and f = frequency in hertz (or kilohertz, or megahertz). Obviously, if either quantity is known, the other may be determined by calculation.

Figure 1 illustrates several cycles of a 10 MHz RF carrier on an oscilloscope display. The display conveys the following information: amplitude, waveform characteristic (an unmodulated, non-distorted sine wave) and the time period of each cycle (=100 nanoseconds). Frequency can be calculated using: f = 1/T with T = 0.1 microseconds, then f = 10 MHz.

Figure 2 illustrates the 10 MHz signal amplitude modulated. By slowing the sweep time (increasing the oscilloscope time base period), the time period of the modulation can be measured (0.33 milliseconds = 3 kHz) as well as the depth of modulation:

$$\text{percent} = 100 - \left(\frac{E_{PK\ min}}{E_{PK\ max}} \times 100\right),$$

where $E_{pk\ max}$. = maximum peak voltage, and $E_{pk\ min}$. = minimum peak voltage.

The spectrum analyzer is used to analyze the signal and display all components in terms of frequency and the relative power each contributes to the total signal.

Figure 3 illustrates the spectrum analyzer display of a 100 MHz RF carrier. The display conveys the following information: amplitude, frequency, and that no other signals are present in the frequency range observed. Also, by narrowing the range of frequency displayed (known as "dispersion"), which allows observation of frequencies close-in to the carrier, it would be determined that no modulation is present.

Figure 4 illustrates the result of amplitude modulation of the carrier using narrow dispersion in order to observe the carrier and the modulation sidebands. Since the horizontal axis is calibrated in terms of frequency, the interval between the carrier peak and first sideband peak is the modulation frequency (= 15.734 kHz). The depth of modulation can be determined by:

$$\text{percent} = 200 \times \left[\text{antilog} \frac{(E_{sb}-E_c)}{20}\right];$$

where E_{sb} = first sideband level in dBmV, and E_c = carrier level in dBmV (this method is based on the use of pure sine wave modulation). Based on the analyzer measurement, it can be calculated that the depth of modulation in Figure 4 is 87.5 percent (E_c = 0 dBmV, E_{sb} = −7.18 dBmV).

Terminology

1) *Frequency range:* the range between a

Figure 3

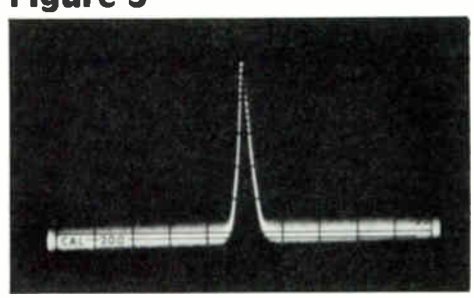
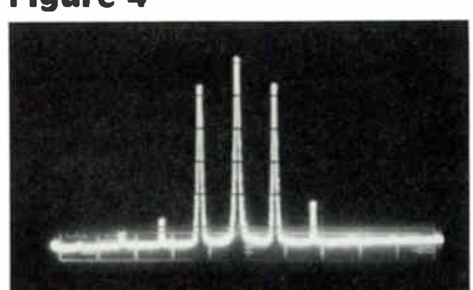


Figure 4



specified low and high frequency over which the instrument can perform RF analysis; 4 to 1,000 MHz for example.

2) *Center frequency:* the frequency at the center of a dispersion range, expressed in megahertz.
3) *Dispersion:* the amount of frequency range change displayed during a horizontal scan cycle expressed in kilohertz or megahertz per division.
4) *Resolution:* the bandwidth of the most selective IF amplifier, typically 200 kHz wide to 500 Hz narrow.
5) *Dynamic range:* the maximum ratio of two signals (typically 60-70 dB), which can be measured to a specified amplitude display accuracy (±2.0 dB, for example).
6) *Linear display:* the vertical axis divisions are a linear function of input signal voltage.
7) *Log display:* the vertical axis divisions are a logarithmic function of input signal voltage referenced to a standard value (0 dBmV = 1 millivolt).
8) *Sweep rate:* the frequency at which the CRT is scanned, typically .03 to 30 Hz.
9) *Scan loss:* loss of displayed signal amplitude due to excessive scan rate for a given dispersion preventing full signal energy passing through the bandwidth. Corrected by narrowing dispersion and/or scan rate.
10) *Phase lock:* used to achieve frequency stability in a local oscillator by maintaining a constant phase angle between the local oscillator and a reference source.
11) *Residual FM:* an undesired frequency modulation effect in the internal sweep oscillator causing frequency jitter in the signal display.
12) *Noise sideband:* an undesired response caused by analyzer internal noise that appears adjacent to the desired response.
13) *Video filter:* post detection low-pass filter used to average noise.
14) *Digital storage:* several voltage points sampled on the vertical and horizontal axis are stored as digital numbers in memory. Memory data is read out to the display to provide a flicker-free, updated or fixed (freeze mode) presentation.

The spectrum analyzer

Figure 5 depicts the functional diagram for a spectrum analyzer. In basic terms, the spectrum analyzer may be considered an electronically tuned, multi-conversion radio receiver with visual display.

The RF input attenuator is a passive device providing variable attenuation over a typical range of 70 dB. Assume the analyzer has a noise floor at –55 dBmV, a display range of 70

Figure 5: Typical spectrum analyzer block diagram

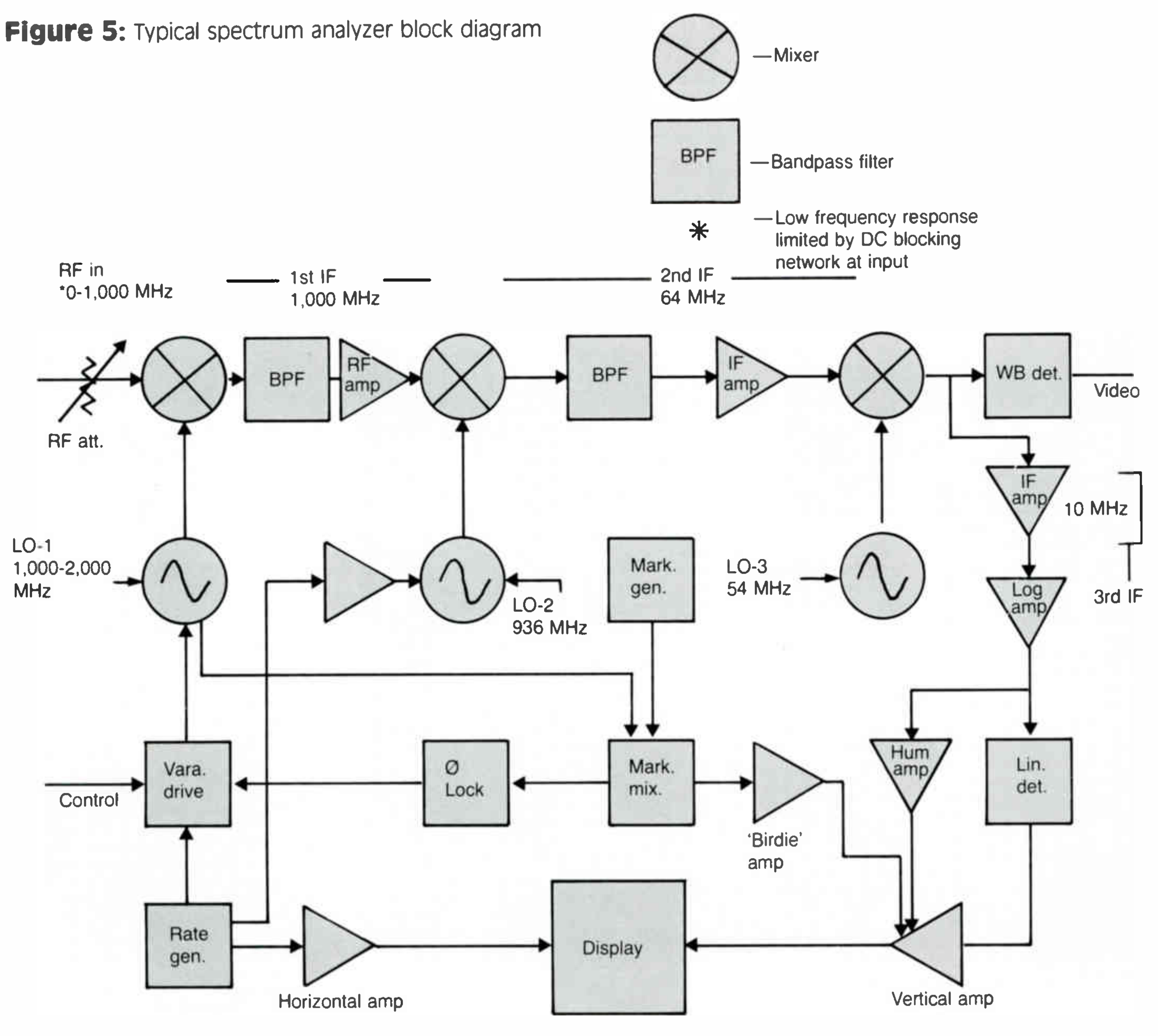
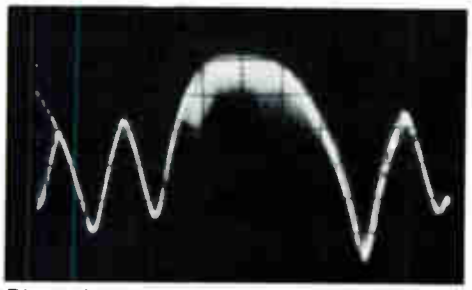
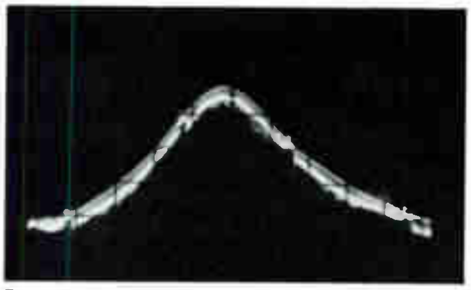


Figure 6: Single TV channel displaying visual carrier, color subcarrier and aural carrier (L-R)



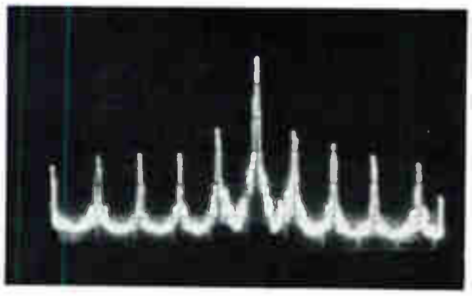
Dispersion: 1 MHz/division
Resolution: 200 kHz

Figure 7: TV visual carrier with sync and picture modulation



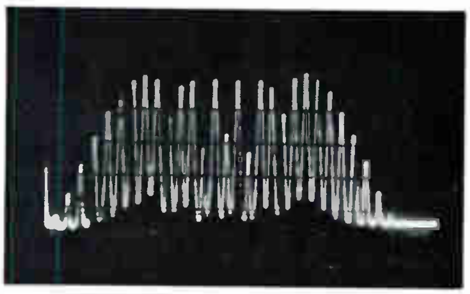
Dispersion: 200 kHz/division
Resolution: 200 kHz

Figure 8: TV visual carrier horizontal sync modulation sidebands



Dispersion: 15 kHz/division
Resolution: 10 kHz

Figure 9: TV aural carrier FM sidebands, 25 kHz deviation, 3 kHz rate



Dispersion: 15 kHz
Resolution: 500 Hz

dB, then the maximum input level before overload would be +15 dBmV. Limiting the level to +15 dBmV into the first mixer by using the available 70 dB attenuation, increases the maximum usable input signal level to +85 dBmV.

Broadband mixing utilizing a swept local oscillator and double balanced mixer is used to convert the RF input range to a first intermediate frequency. The analyzer is electronically tuned over the 0 to 1,000 MHz input range by a sweep oscillator (operating over the 1,000 to 2,000 MHz range) producing a 1,000 MHz IF. This particular mixing technique is known as up-frequency conversion. It is utilized to preclude interference from local oscillator harmonics (which would fall well above the first IF), and to place undesired image responses outside the analyzer range. Image responses result due to the following: $f_{LO} + f_{IF}$; where f_{LO} = frequency of local oscillator 1, and f_{IF} = frequency of first IF.

Signals at frequencies equal to this combination can appear along with the desired signals. However, due to up-conversion, the image frequency results are in the range of 2,000 MHz to 3,000 MHz. The double balanced mixer is used due to the high order of isolation it exhibits between input, output and local oscillator ports and the inherent characteristic of cancellation of odd order mixing products. The bandpass filter assures re-

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Instrumentation training program

Texscan's Test Instrumentation Training Program is a three-day session that includes theory and laboratory work pertaining to test instrumentation and measurements. For the first day and a half the student will study electronic theory and principles covering RF transmission instruments and measurements. The balance of the second day and all of the third is devoted to hands-on instrument operation and measurements in Texscan's training facility lab. The student completes the program with a final examination which covers both the theory and laboratory work. After successful completion of the program and the final exam the student receives a Certificate of Achievement.

In addition to classroom theory, the training facility offers a variety of cable plant components to facilitate the hands-on instruction. The facility includes a lab area that contains all test instrumentation utilized during this phase of the program, a CATV headend system, an amplifier cascade (5-mile equivalent cable system with operational trunk, bridger and line extender amplifiers), and an instrument test bench with complete sweep test instrumentation.

Each session is scheduled to accommodate 8-12 students, with classes conducted on a monthly basis. For further information on times, fees and student responsibilities, contact Texscan Instruments in Indianapolis.

Subject outline

A) *Theory and principles*
1) DC, Ohm's Law
2) AC, reactance, impedance
3) RF generation, propagation
4) Modulation—amplitude, frequency
5) The TV signal
6) Semiconductors—diode, transistor, varactor diode
7) Signal mixing, double balanced mixer, image rejection
8) Oscillators—fixed, tuneable sweep
9) Filters—bandwidth, lowpass, bandpass, trap, diplexer
10) RF amplifiers—linearity, distortion
11) IF amplifiers—selectivity
12) Detectors
13) The RF signal level meter
14) The decibel, dBmV, the logarithmic amplifier
15) Attenuators
16) The spectrum analyzer
   a) CRT display—intensity, retrace blanking
   b) Dispersion—wide/narrow, phaselock
   c) Resolution
   d) Sweep circuits—flatness, residual FM, scan rate, scan loss
   e) Markers
17) Return loss—mismatch, incident/reflected waves
18) The RF bridge
19) Coaxial cable—attenuation, impedance, return loss, structural return loss, fault finding

B) *The CATV system*
1) The functional system (training cascade)
2) Frequency spectrum, allocations
3) Terminology
4) Consideration of frequency response, carrier levels, carrier/noise performance, distortions, beat signals, signal leakage
5) FCC proof requirements
6) Measurement procedures, instrumentation used
7) Instrumentation performance—level accuracy, noise floor, dynamic range, flatness, temperature

C) *The bench sweep system*
1) The functional system
2) Measurement procedures—amplifiers, filters, couplers, taps, cable

D) *Laboratory*
1) Test instrument orientation/demonstration
2) Cascade measurements
   a) Signal level
   b) Carrier/noise
   c) Hum modulation
   d) Cross-mod, CTB
   e) Response
   f) Reverse (sub-split)
   g) Frequency
   h) Leakage
3) Cable measurements
   a) Structural return loss
   b) Fault finding
4) Converter measurements
   a) Tuning, bandpass performance
   b) Illegal drop connections
5) Bench sweep measurements
   a) Bandpass and diplexer filter performance—insertion loss, frequency response, bandwidth
   b) Trunk amplifier—gain, response
   c) Converter—frequency tuning, bandpass response, bandwidth response

E) *Final examination*

sponse only to mixing products at the first intermediate frequency.

The second and third mixing/IF stages provide gain and selectivity. Down-frequency conversion is used since gain/selectivity is of prime importance and image problems have been addressed in the first mixer/IF stage.

The output of the third IF stage drives a logarithmic amplifier. The output of this stage will be a signal that is a log function of the input. The log amplifier output signal is detected, resulting in a linear voltage change for each dB of signal amplitude change. This voltage drives the vertical deflection plates of the cathode ray display and produces a linearly divided vertical axis calibrated in dBmV.

The rate generator, which produces an output ramp voltage, drives both the first local oscillator tuning circuit and the horizontal deflection plates of the CRT display. The basic characteristic of the varactor diode, used for oscillator tuning control, is that the junction capacity decreases with increasing voltage. So, as the rate generator output ramp voltage increases, the local oscillator is tuned from its lowest to highest frequency and the CRT display sweeps the corresponding range (left to right). Frequency instability of the swept oscillator over narrow ranges (dispersion of 200 kHz/division and less) is corrected by a phase lock circuit. This circuit generates an error correction voltage for the varactor when the phase angle of the oscillator signal changes with respect to a stable reference source.

The marker generator provides harmonically related output signals that are shaped (producing a form known as a "birdie") and amplitude adjustable. These marker signals appear at harmonically related frequencies over the entire RF range of the analyzer and are extremely useful for identifying specific frequencies. Some operational examples of spectrum analysis are illustrated in Figures 6-9.

CATV measurements

The spectrum analyzer is an ideal instrument for alignment, maintenance and troubleshooting activities on a CATV system. Also, the majority of FCC proof of performance measurements can be accomplished using the spectrum analyzer. The operational ability of the instrument to display the complete cable RF spectrum (450 MHz for example), or to display a single TV carrier and related sidebands allows the user to analyze anything from the entire system spectrum to intermod beats close-in to the carrier.

Figure 10 depicts a CATV system spectrum with carriers occupying frequencies from 50-400 MHz (dispersion: 10 MHz/division, resolution: 200 kHz, log calibration: 10 dB/division). Total system operating level and tilt can be observed. Increased peak level resolution can be achieved by using a log calibration range = 2 dB/division.

Since the analyzer is a broadband instrument, all signals on the system will be present at the input. CATV measurements such as carrier-to-noise, cross-modulation or intermodulation distortion (like composite triple beat) must be accomplished using a filter

Figure 10

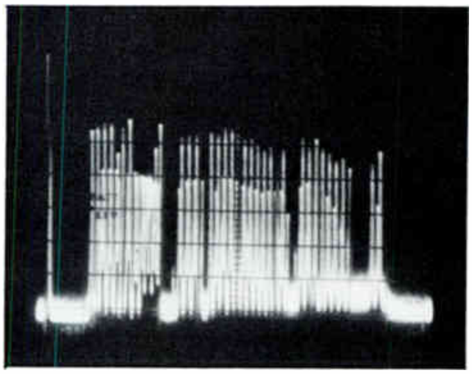


Figure 11

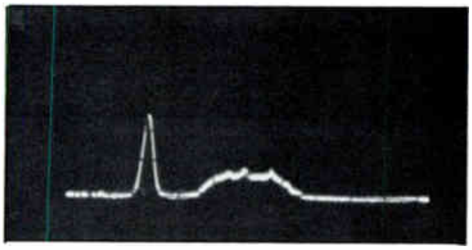


Figure 12

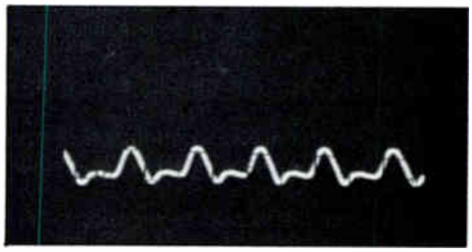
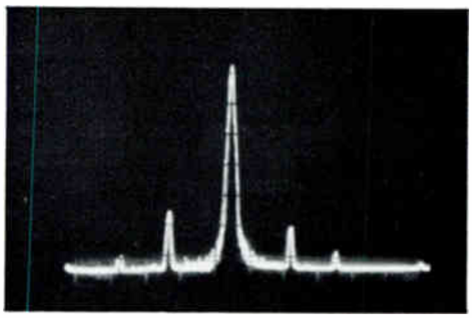


Figure 13



(tunable) between the system test point and the analyzer input. In practice, the sensitivity of the analyzer will be elevated to maximum (no input attenuation) when observing system noise, or beats near the system floor. The filter passes only a narrow band of the RF spectrum around the frequency of interest, and rejects all other carriers present that would otherwise cause overload, resulting in erroneous measurements.

Figure 11 depicts system noise level above the noise floor of the analyzer (dispersion: 1 MHz/division, resolution: 200 kHz, log: 10 dB/division). The shape of the display is created by the input filter. CATV noise measurements have to be made over a 4 MHz bandwidth (= bandwidth occupied by TV picture modulation). However, the spectrum analyzer samples only a bandwidth equal to the IF resolution (typically 200 kHz or less) at any instant during the sweep period. The amount of noise energy in this narrow bandwidth is significantly less, yielding a system noise level lower than when viewed over the picture bandwidth. To correct this effect a noise correction factor can be calculated:

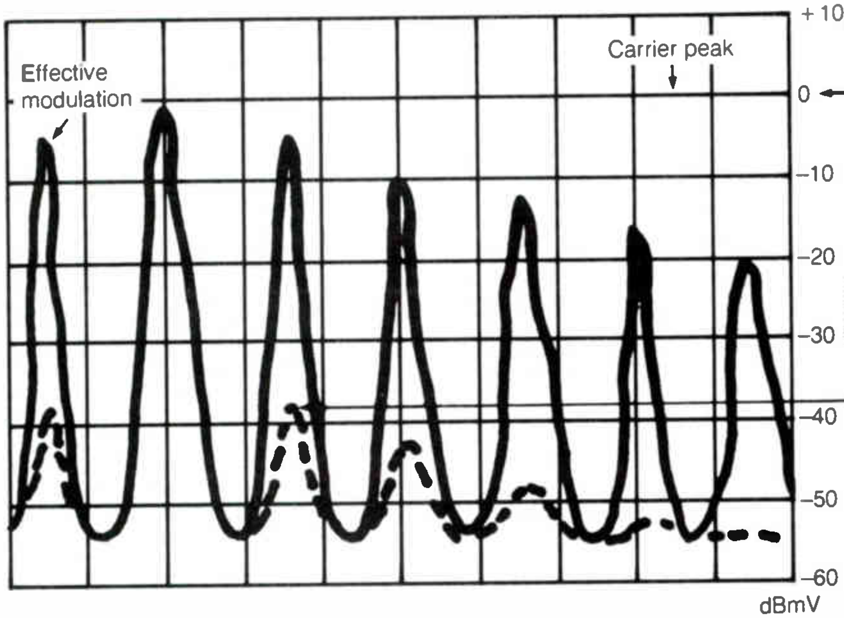
$$\text{correction factor (dB)} = 10 \log \frac{4 \text{ (MHz)}}{BW_{IF}}$$

where BW_{IF} = IF bandwidth of spectrum analyzer (MHz).

Also, the log amplifier averages noise and must be considered in the measurement correction. The log amplifier correction factor is usually specified by the manufacturer. An example of a corrected CATV system carrier-to-noise measurement is:

carrier peak level =		+30 dBmV
system noise floor =		–(–35 dBmV)
	=	65 dB
bandwidth correction factor (200 kHz) =		–13 dB
	=	52 dB
log correction factor =		– 4 dB
carrier/noise ratio =		48 dB

Figure 14



Cross-modulation (dB) =
carrier peak (dBmV) – cross-modulation
1st sideband signal (dBmV) –
effective modulation (dB = carrier peak – 1st sideband modulation peak)

Figure 15

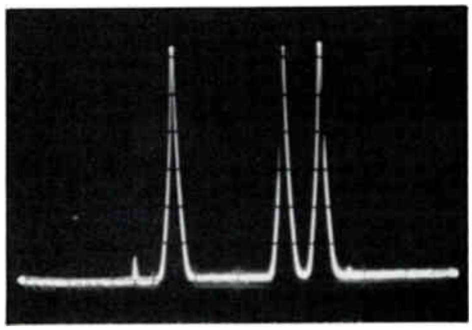


Figure 12 depicts a hum modulation measurement (dispersion: CW, resolution: 200 kHz). The percentage of hum is determined by vertical calibration (generally = 1 or 2 percent/division). The measurement must be made using an unmodulated signal (AGC pilots, for example) since the presence of any low frequency modulation (vertical sync frequency = 60 Hz) will produce an erroneous result. Since hum is a low frequency disturbance problem, it will be present across the entire signal spectrum.

Figure 13 depicts a cross-modulation measurement showing the carrier, and sideband signals caused by cross-mod. This measurement is a two-step process as illustrated by Figure 14. The analyzer set-up will be dispersion: 200 kHz (Ø lock), resolution: 500 Hz. With sync modulation present on the carrier, the effective modulation (peak carrier minus first sideband peak equals dB) is measured. Modulation is removed from the carrier under measurement only. Cross-modulation level (peak carrier minus first cross-mod sideband equals dB) is measured. Channel cross-modulation (dB) equals cross-mod level (dB) minus effective modulation (dB).

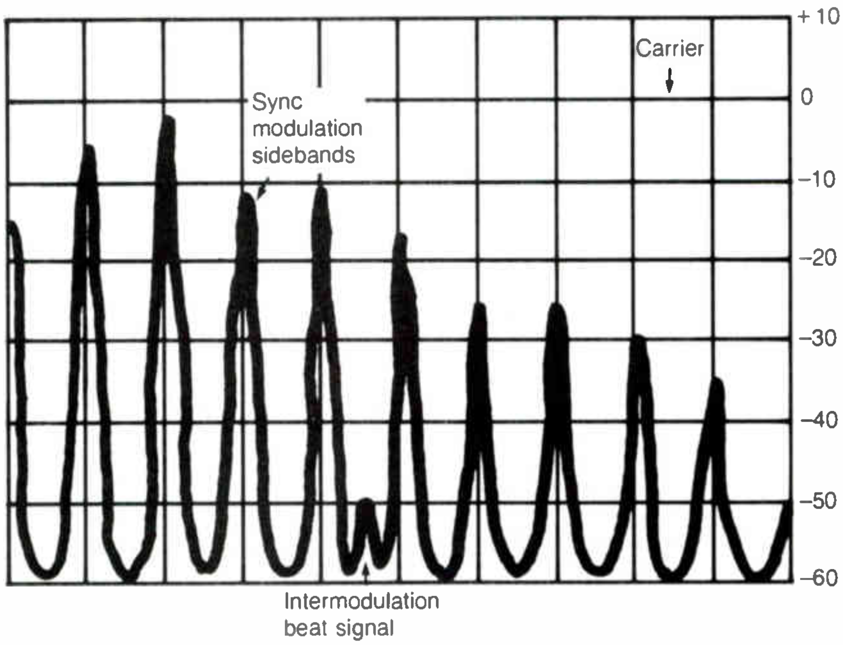
Figure 15 depicts the analyzer display showing a composite triple beat (low amplitude signal to left). The beat carrier was created from the signal combination shown: $f_1 + f_2 - f_3$ (187.25 + 205.25–211.25 = 181.25 MHz). Dispersion: 1 MHz/division, resolution: 10 kHz, log: 10 dB/division. For beat measurements close-in to the carrier dispersion is narrowed to 15 kHz (Ø lock) and resolution to 500 Hz. This type of measurement is illustrated by Figure 16.

The use of a 1 kHz video filter (typical in most analyzers), which averages noise, enhances absolute level measurements when performing carrier/noise, cross-modulation and intermodulation distortion measurements.

Since the analyzer is a signal receiver, it is extremely useful for making signal leakage investigations and FCC proof measurements. When used in conjunction with a calibrated dipole antenna and filter, precise leakage level measurements can be accomplished. The noise floor on the analyzer is –55 dBmV (for example) and the output from the calibrated dipole at 133.25 MHz (channel C or 16) is –42 dBmV, conforming to 20 microvolts/meter at 10 feet. Any leakage at the FCC minimum, or to greater than 10 dB below it would be measurable. The sensitivity of the analyzer can be extended by adding a broadband RF amplifier, of known gain, between the antenna/filter and the analyzer.

The technical manual that accompanies the spectrum analyzer should be thoroughly reviewed by the operator prior to using the instrument. Close study should be given to the section detailing applications and each procedure should be followed step-by-step. The operator will become familiar with all of the operational controls, measurement procedures, and will relate the operation and measurement applications of the instrument to the advantages of RF spectrum analysis.

Figure 16



Intermodulation = carrier peak (dB) – beat signal peak (dB)

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Headend testing

By Steven I. Biro
Biro Engineering

Headend interference testing is not an assignment to be taken lightly. Any interference incurred or generated at the headend shows up throughout the system on every subscriber's TV set. Given the number of channels processed in a headend, the special functions assigned to processors and modulators, the array of alphanumeric, computerized and security oriented services assembled in the headend electronics, the number and variety of interference possibilities are phenomenal.

Along with the many interference possibilities are numerous testing procedures, each one with its own particular measurements. This article focuses on four common interference areas:

- Power-line (AC) interference
- Spurious beats, generated in the headend
- Co-channel interference
- Terrestrial microwave interference

Power line interference testing

There are quite a few sources of electrical (AC) interference, such as power lines, neon lights, welding shops, electric fences and pump stations—to name some of the most prominent occurrences. The testing procedure, to determine the type of interference as well as the source of the disturbances, requires nearly the same approach for most AC interference sources. Because the most common and troublesome of all electrical interference sources are medium- and high-voltage power (transmission) lines, this section will focus primarily on them.

AC interference chiefly affects the low-band channels. It appears very seldom on high-band, and it is usually nonexistent on UHF. The 3.7 to 4.2 GHz satellite reception is never disturbed by electrical interference. Further, noise is always received by the off-air TV receiving antennas. Therefore, the source of interference must be near the headend site, or in-line with the reception of the low-band TV channels.

The equipment necessary for testing includes a large screen color monitor TV receiver, signal level meter (SLM), spectrum analyzer and all-band search antenna and/or portable survey antenna.

Power line noise appears on the screen of the TV receiver as slowly moving "bands of sparkies." The movement of the bands is significant. Namely, the TV pictures (frames) are not synchronized to 60 Hz. The frame sync frequency is 59.94 Hz. The 0.06 Hz difference causes the steady movements of the bands. The TV receiver also serves as an instrument to further identify the type of AC interference. A single-phase power line generates two moving bands on the screen. A three-phase power line is characterized by six moving bands.

Usually, the electrical noise has its peaks in a wide frequency range (Figure 1). Using a signal level meter as an indicator, and just listening for the noise, it is relatively easy to tune-in on the strongest noise level, and to use that peak for further direction finding and source identification purposes.

Neither a signal level meter, nor a TV receiver will provide any carrier/interference ratio reading in dB. You need a high quality spectrum analyzer, with a memory scope for that purpose.

Searching for the interference

The direction of the interference should be determined by the tower-mounted search antenna, if such a device exists. High directivity and a good front/back ratio (on low-band) from a search antenna is needed. Unfortunately, not all search antennas exhibit the necessary directivity, nor are they in good physical shape for reliable direction finding purposes. Inspect the design, the specifications and the mechanical status of the search antenna before accepting the test results at face value.

The search for the direction of the interference should use the TV receiver and a signal level meter for monitoring/measuring purposes. As mentioned before, the noise peaks (resonates) on certain frequencies.

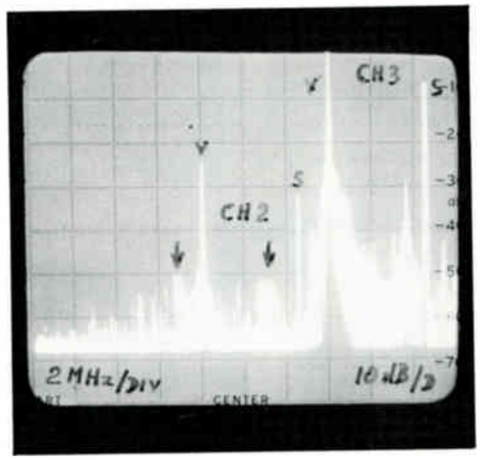


Figure 1

The power-line interference peaked within channel 2, as well as below the video carrier. On channel 2 the carrier/interference ratio was 26 dB.

Find those peaks and search for the direction on several frequencies, before accepting bearing results. Should the peak appear on Channel 2 (or close to it) where the search antenna's radiation pattern exhibits a wide main lobe, turn the antenna 90° and use the radiation pattern null for a more accurate bearing determination (Figure 2).

The next step is to transfer the information to a large scale (15 or 7.5 minutes) topographical map, plotting exactly the antenna-site location. Also, plot the direction of the interference (Figure 3).

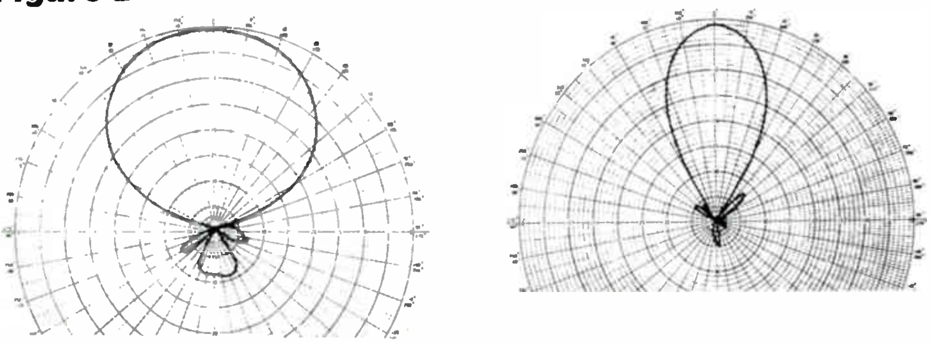
A compass, next to the steel tower, is very unreliable. The CATV engineer is well advised to relate the search antenna's direction to the existing antenna arrays on the tower, or to the TVRO dish directions. The exact antenna and satellite receiving dish Azimuth angles are available from computer runs.

The last phase of the procedure is the *triangulation*. This requires a test vehicle with a rotor-mounted or hand-rotated, multi-element antenna (not a dipole), conducting several measurements from widely separated locations. The bearings will converge on a narrow corridor, containing the source of interference. Then depending on the field conditions, one proceeds by vehicle or on foot, to track down the faulty insulator, the lightning arrestor, the broken cap, the leaky transformer or the corroded splice on the high-voltage transmission line, by listening to the steadily increasing sound from the speaker of the SLM, or the higher and higher readings from the meter.

The caveat

CATV technicians have a tendency to suspect major power installments 10 to 20 miles from the system. Although those significant sources of interference indeed exist, they also must realize that the intensity of the received interference is proportional with $1/D^2$, where D is the distance. Therefore, first consider (suspect) those sources that are in the immediate

Figure 2



Compare these two antenna radiation patterns. The pattern on the left side has very limited directivity. The right-side pattern is much more desirable. Also note the radiation pattern nulls at 90° and 270°.

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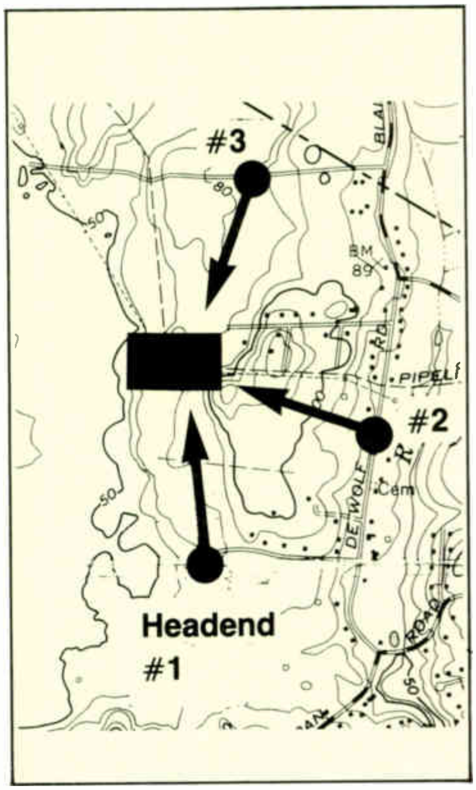

Figure 3

The three bearings converge at a certain section of the high-voltage transmission line. In this case the triangulation required no other test site.

vicinity of the antenna site, or not further than 1 to 2 miles.

A fast check, conducted with the car radio as an interference monitor, has some advantages. Do not use the AM section of the radio. Noise peaks found in the 500 to 1,500 kHz AM band may have no correlation whatsoever with 55 to 216 MHz conditions. FM car radios, working in the 88 to 108 MHz frequency range, are better suited. The limitation: The intensity of interference eminating from the car radio speakers cannot be measured. Further, car-radio antennas have circular radiation patterns or very wide dough shaped patterns. They are not suitable for direction finding purposes.

Not all electrical interferences are independent of weather conditions. High-voltage transmission line interferences (caused by dirt deposits piling up on those huge insulators) are particularly sensitive to the changing weather conditions. A strong rainshower can do an excellent cleanup job on the insulators, reducing or even completely eliminating the AC interference. A dry period of three days on the other hand, can create conditions very favorable for testing (source identification) purposes. The scheduling of the high-voltage line interference testing is critical.

Spurious beats

All carriers, at the headend output, which were not present in the original TV or FM transmission, are considered spurious beats. Tests and measurements to locate (identify)

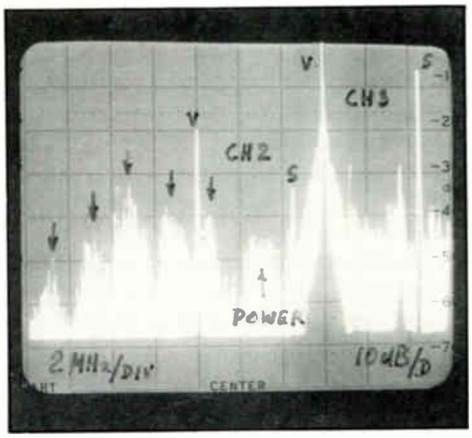

Figure 4

This picture illustrates conditions when the power-line interference was augmented by electrical motor disturbances. The arrows pointing down denote the interference peaks.

and eliminate the beats, are to be conducted in two steps:

1) Testing the output of the signal processors and modulators.
2) Checking the combined RF output of the headend.

A high quality spectrum analyzer, such as the Hewlett Packard Model 8554 L and a high quality large screen color monitor TV receiver,

(Continued on page 52.)

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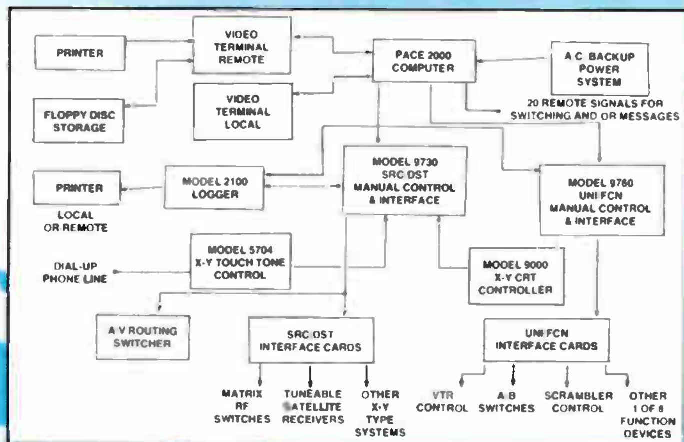

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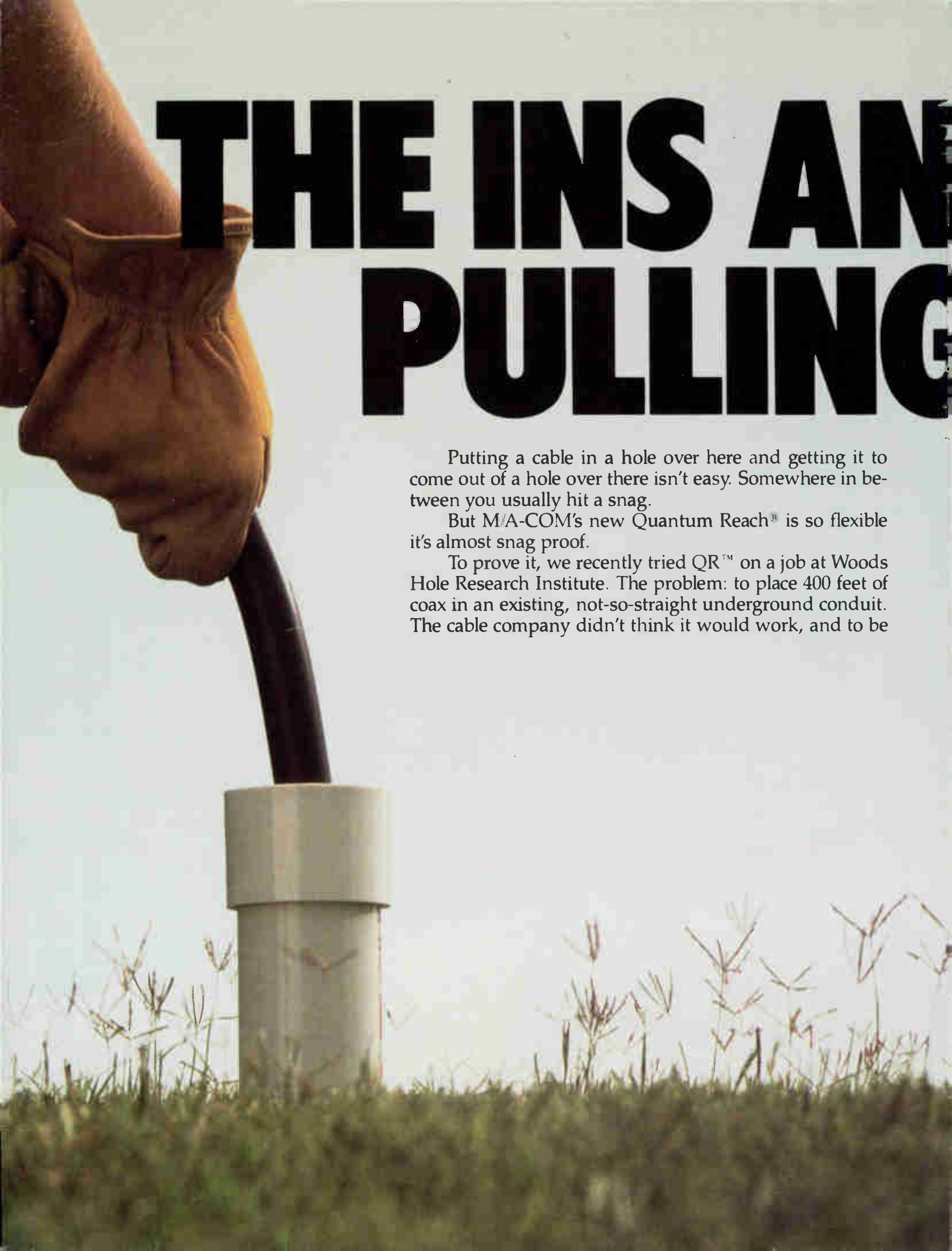
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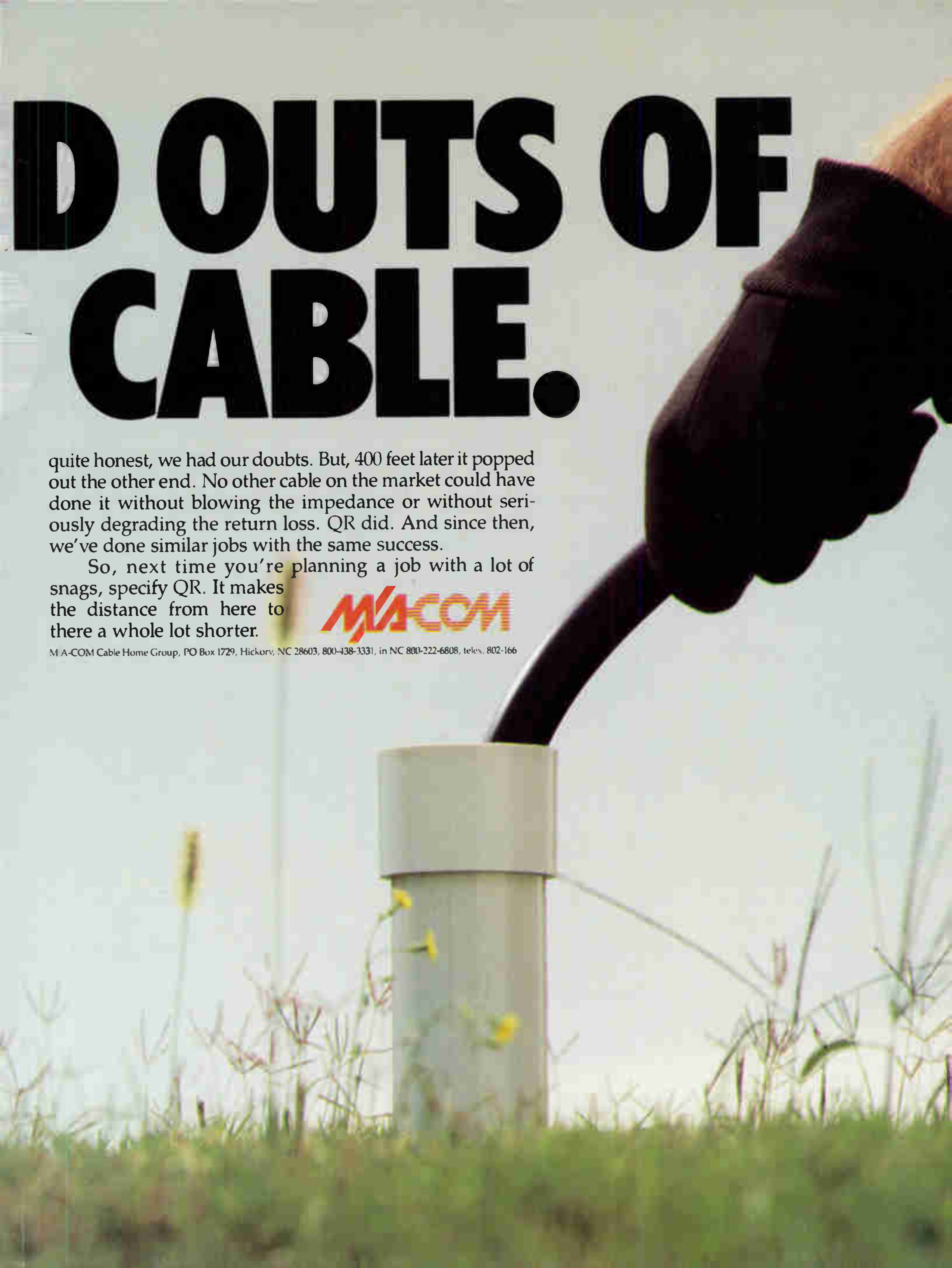
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(Continued from page 36.)
preferably with baseband capability are recommended for testing.

Operate all signal processors and modulators at their proper (rated) output level. Connect the input of the spectrum analyzer to the output of the signal processor. Make sure that the analyzer is not driven too hard (the proper attenuator setting was applied), thus not generating its own (false) spurious signals. On the other hand, make sure that the input signal is of reasonable amplitude (in the +20 dBmV range), allowing the 60 to 70 dB dynamic range of the analyzer to be fully utilized.

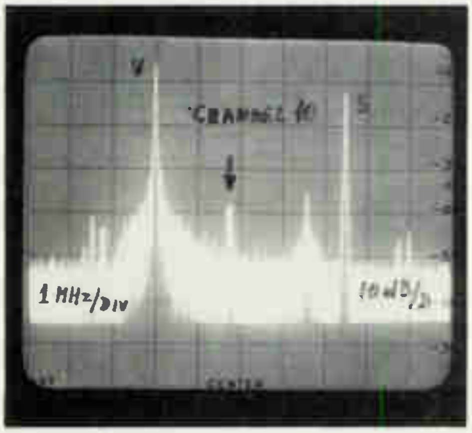

Figure 5

This is an illustration of second harmonic FM interference, caused by an improperly operating 97.5 MHz FM station. The spectrum analyzer displayed the frequency (195 MHz), and the level (–32 dB) of the interference.

The examination should focus on the channel of interest, as well as the entire frequency range of 5 to 500 MHz, or even beyond (higher), for possible future system expansion purposes.

For "in-channel" testing, operate the analyzer in the 1 MHz/division horizontal scan, 100 kHz resolution bandwidth, as well as in the full video bandwidth mode. Tune the center frequency of the analyzer to the center of the channel to be checked. Slow down the scanning rate, while looking for spurious beats in the –1 MHz to +4.5 MHz frequency range, as referenced to the video carrier.

For "out-of-channel" testing, increase the horizontal scan of the analyzer, step by step to 2-5-10-20-50 MHz/division, and watch for the presence of spurious beats.

These tests were conducted with operational output levels, which may very well be in the +53 to +55 dBmV range. Most manufacturers rate their signal processors and modulators at +60 dBmV output levels. Confirm that the processors/modulators work beat-free at full output power.

Let's assume that the signal processor exhibited a –45 dB spurious beat 2.25 MHz above the video carrier. Was the beat generated by the processor or was the beat already present in the over-the-air transmission? Connect the analyzer directly to the antenna downlead and search the received signal for a –45 dB spurious beat at 2.25 MHz. If the beat was there, you know the answer. If the beat was not present, the real detective work begins. To find the source of interference:

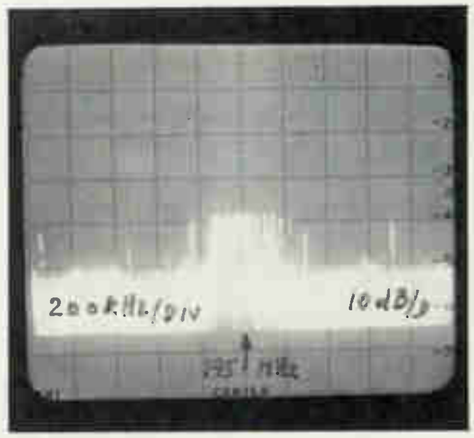

Figure 6

The horizontal scan was adjusted to 200 kHz/division and the center frequency tuned to 195 MHz. The picture clearly shows the FM-ing of the beat.

1) Check the level of the input signal. Was the signal processor driven very hard? UHF processors are extremely sensitive to high input signals.

Figure 7: Co-channel calculations (400-mile radius)

Location = Grundy, Va.
Coordinates = 37/15/59, 82/8/2

Channel	Call letters	Location	State	Ntwk.	Power	Offset	Haat.	Distance	Azimuth	Rel. Angle	CC spacing
Preferred station											
2	WSJK	Sneedville	Tenn.	ED	100.	+	1763.	84.19 MI	223.8		
Co-channel calculation										**Rel. Angle**	**CC spacing**
2	WFMY	Greensboro	N.C.	CBS	100.	–	720.	154.11 MI	120.6	103.2	3H = 329.4
2	WDTN	Dayton	Ohio	ABC	100.	0	1000.	204.62 MI	326.7	102.9	3H = 328.9
2	KDKA	Pittsburgh	Pa.	CBS	100.	–	990.	250.30 MI	26.2	162.4	H = 353.1
2	WSB	Atlanta	Ga.	NBC	100.	0	1036.	272.45 MI	208.3	15.5	H = 399.0
2	WNGE	Nashville	Tenn.	ABC	100.	–	1353.	273.51 MI	254.0	30.1	H = 212.9
2	WTWO	Terre Haute	Ind.	NBC	100.	+	950.	316.10 MI	297.6	73.8	3H = 333.9
2	WMAR	Baltimore	Md.	CBS	100.	+	1000.	329.69 MI	62.2	161.6	H = 339.2
2	WCBD	Charleston	S.C.	ABC	100.	+	790.	333.60 MI	156.8	67.0	3H = 348.3
2	WUND	Columbia	N.C.	ED	100.	0	992.	334.43 MI	104.1	119.8	3H = 369.4
Preferred station											
3	WSAZ	Charleston	W.V.	NBC	47.	+	1253.	86.01 MI	356.9		
Co-channel calculation										**Rel. Angle**	**CC spacing**
3	WBTV	Charlotte	N.C.	CBS	100.	0	1090.	147.42 MI	156.9	160.0	H = 282.0
3	WHSV	Harrisonburg	Va.	A/N	9.	–	2120.	211.89 MI	62.8	65.9	3H = 316.9
3	WAVE	Louisville	Ky.	NBC	100.	–	914.	215.61 MI	292.1	64.8	3H = 319.7
3	WRCB	Chattanooga	Tenn.	NBC	100.	+	1070.	229.31 MI	231.9	125.0	3H = 353.1
3	WKYC	Cleveland	Ohio	NBC	100.	0	1000.	285.63 MI	4.6	7.7	H = 723.1
3	WTKR	Norfolk	Va.	CBS	100.	+	980.	313.94 MI	93.4	96.5	3H = 291.1
3	WWAY	Wilmington	N.C.	ABC	100.	–	1170.	317.32 MI	132.6	135.6	H = 137.9
3	WPSX	Clearfield	Pa.	ED	100.	+	880.	331.68 MI	35.2	38.2	H = 155.8
3	WSAV	Savannah	Ga.	NBC	100.	+	1476.	362.91 MI	172.1		Use stagger stacking
3	WRBL	Columbus	Ga.	CBS	100.	0	1790.	372.96 MI	204.8	152.1	H = 206.1

Remote Revenues

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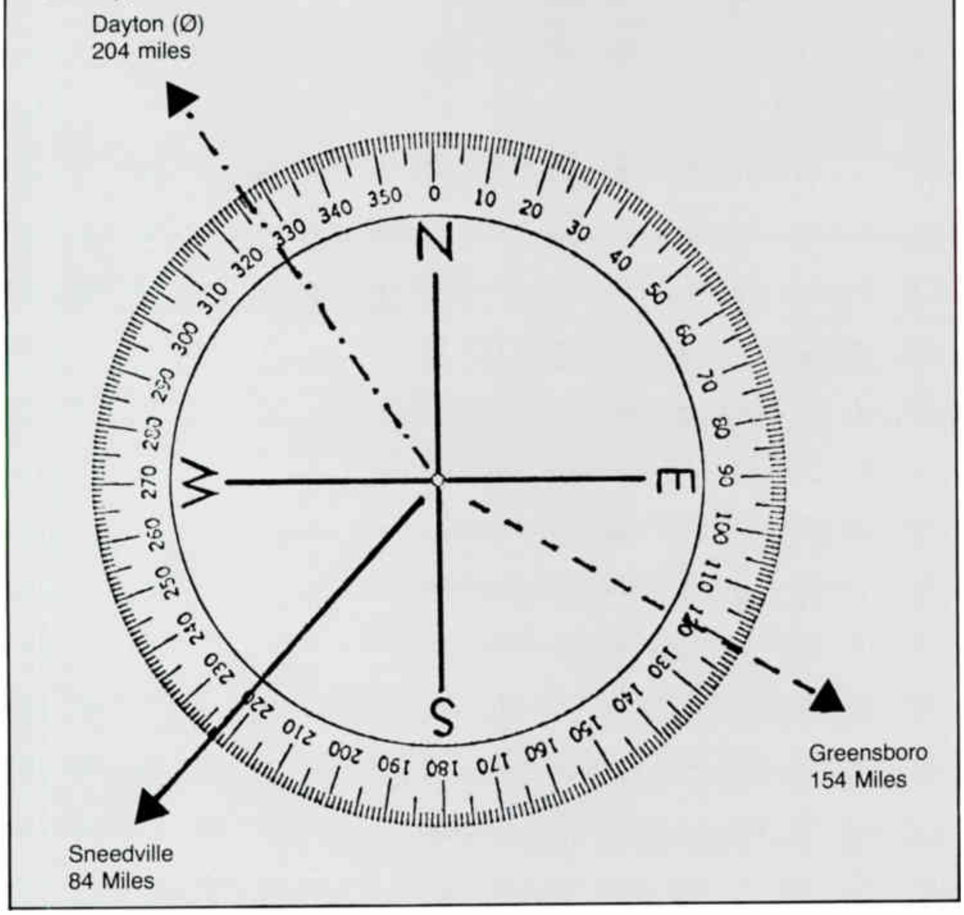
Figure 8: Channel 2 co-channel signal direction sheet, prepared for Grundy, Va.



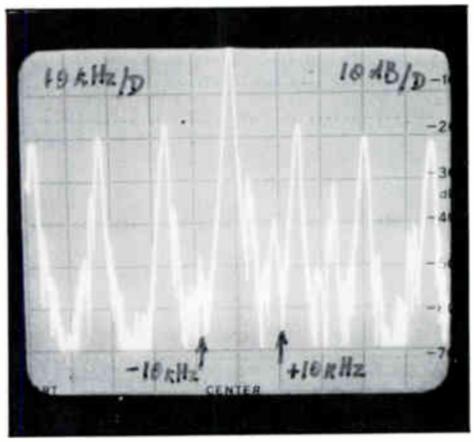


Figure 10

In this case two co-channel offenders affected the reception. Note how easily the -50 dB, -10 kHz beat could be detected and recorded.

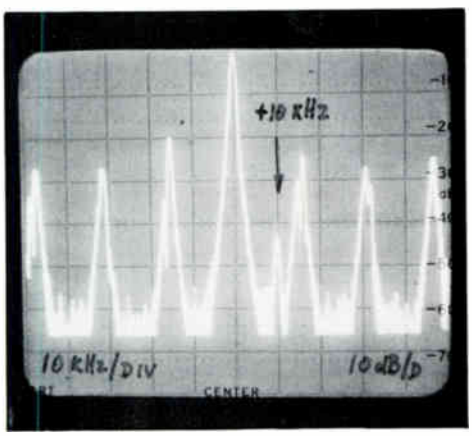


Figure 9

An illustration of the detection of a single co-channel offender. The +10 kHz beat was measured as -43 dB, in reference to the video carrier.

2) Check the spectrum for beats module by module, starting with the downconverter, followed by the IF stage.
3) An incorrectly working AGC module, or uncontrolled IF switching level conditions could be the answer to your difficulties.

Step two in eliminating the beats

The combined headend output spurious beat testing requires the application of the spectrum analyzer. Do not connect the analyzer straight to the headend test point. The analyzer is a sensitive instrument. When loaded with 30 to 40 video carriers, even at moderate levels, it may generate its own (false) spurious beats.

On the other hand, when the input levels are unreasonably low, in order to prevent the generation of false beats, the full 60 to 70 dB dynamic range of the instrument is not utilized. Apply a low/high filter, with a reasonably low (0.5 dB) insertion loss. The filter usually has a crossover around channel E. Operate the analyzer in the 1 MHz/division horizontal scan, 10 dB/division vertical deviation, as well as 100 kHz resolution bandwidth mode. Turn off the processor/modulator channel by channel. Watch for beats in the "open" channel.

To determine the active device in the headend that caused the beat: First, turn off the adjacent channel processors or modulators, and watch for the disappearance of the beat. Then turn off, one by one, every modulator/processor. Next, turn off the FM processors, then the UHF converters and preamplifiers and finally, the digital equipment in the headend, including any computer related electronics and weather channel accessories.

If the beat identification (elimination) was not successful, check the spectrum analyzer for false beat generation. Install a bandpass filter (BPF), for the channel under investigation, at the input of the analyzer. Even an inexpensive BPF will provide the needed overload protection.

Co-channel interference

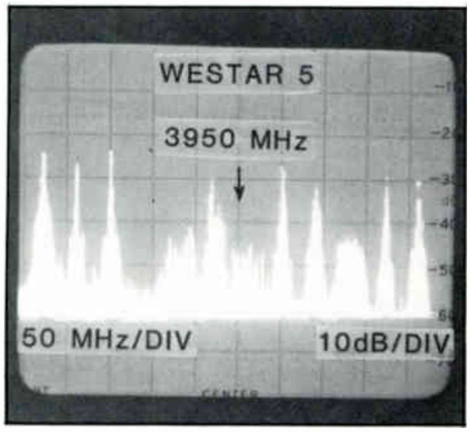
Co-channel interference occurs when the tower-mounted antenna receives two or more TV stations on the same channel. If both or all three video carriers reach the TV receiver, they mix on the detector circuit, creating very annoying beats (pairing of horizontal lines) in the pictures.

The FCC recognized early the danger of co-channel interference. To reduce the subjective effect of the interference, it offset the frequencies of the same channel adjacent station by 10 kHz. One third of the TV stations operate on-frequency, the second 33 percent with a +10 kHz offset, and the rest of them with -10 kHz offset.

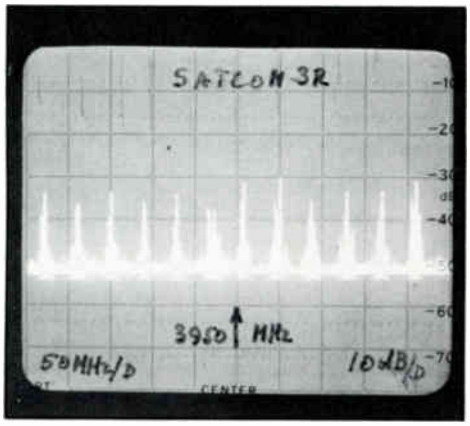
A good computer run, which lists the potential co-channel stations within 400 miles in increasing distance order, their major technical parameters, including co-channel offset, as well as precisely calculated distances and bearings, is a prerequisite (Figure 7). The computer also predicts the signal strength of the different stations. However, these are only predictions, considering such characteristics as average wave propagation, flat terrain and average soil conditions. To base the design, or to select a co-channel protective antenna-array, on the predictions of the computer, may bring disappointing results. The identification of the real co-channel offender (or offenders) demands antenna-site testing.

Positive co-channel interference identification work requires the previously mentioned items: a good computer run, a high quality spectrum analyzer, a monitor TV receiver and a tower-mounted search antenna. The computer run tells us which are the probable co-channel offenders. The spectrum analyzer enables the CATV engineer to make offset (+ or -10 kHz) and absolute level identification. The TV receiver is our instrument for 0 beat conditions where the resolution of the spectrum analyzer may not be satisfactory. And finally, the search antenna is the perfect tool for dis-

Figure 11



These pictures were produced wih a 4-foot diameter Prodelin dish, feeding a 63 dB gain LNA. Observe the tall Westar 5 carriers, versus the much lower amplitude Satcom 3-R signals. The view toward Satcom 3-R was somewhat limited.



criminating between identical + 10 or −10 kHz or 0 offset stations.

Co-channel interference testing should start with the preparation of the computer run. Next, study the printout. The CATV engineer must be absolutely familiar with the variety of offenders on the channels to be investigated, the distances, bearings, frequency offset network affiliation and other station parameters. In difficult situations the preparation of a co-channel signal direction sheet (Figure 8) is very useful.

Next, connect the spectrum analyzer to the headend test point, or to the output of the signal processor. Tune the center frequency of the analyzer to the video carrier. Operate the analyzer in a narrow scan (5 or 10 kHz/division) mode, while keeping the resolution bandwidth also at a reasonably low level, around 1 kHz. On each side of the video carrier you will see the second, third, etc., harmonics of the 15.625 kHz line-sync frequency. Disregard those peaks. Concentrate on the beats that appear exactly 10 or 20 kHz from the video carrier; those will be the co-channel interference beats. The video carrier/interference amplitude can be exactly determined (read) from the screen of the analyzer (Figures 9 and 10).

Let's assume that the analyzer exhibited a + 10 kHz beat, but the computer run listed two + 10 kHz co-channel offenders, and their distance, as well as the predicted fieldstrength was not much different from each other. Against which one should the antenna-array be designed or re-designed?

Connect the spectrum analyzer to the search antenna and point the antenna toward the co-channel offenders. Observe and record the amplitude of the interference. A 5 to 10 dB difference is significant enough to protect the reception against the stronger interference. Less than 5 dB difference suggests a need for protection against both offenders.

Zero-beat co-channel conditions do not occur too often. Unfortunately, the above described technique, basically developed around the spectrum analyzer, does not work. Very few analyzers have 5 to 15 Hz resolution capabilities. For zero beat interference testing use the TV monitor, and watch carefully for those rolling wide horizontal bars.

In the early '70s attempts were made to reduce/eliminate the co-channel interference with the aid of 10 kHz or 20 kHz filters, introduced after the output of the demodulator or at the video input of the modulator. True, the filter eliminated the co-channel beat from the picture, but the resolution (sharpness) of the TV picture also was eliminated. A significant portion of the video information cannot be filtered out without penalty. Furthermore, the mandatory demod-modulator combination, versus the customary heterodyne signal processor, was more expensive, less reliable and lowered the picture quality.

Satellite interference testing

You may call it frequency analysis, frequency coordination study, spectrum coordination—all of these are theoretical attempts/terms used to convince the CATV operator/engineer that satellite reception at the proposed earth station will/won't be exposed to terrestrial microwave interference.

There is only one sure way to determine actual conditions: test it; perform an on-site survey. Have on hand a portable receiving dish, a high-gain, low-noise LNA and a high quality microwave spectrum analyzer.

The larger the diameter of the dish (3- to 5-meter) the more reliable interference test results can be expected. However, the transportation of a large dish is expensive and the proposed site seldom lends itself to large diameter antenna installation. Top of the mountain situations, the rooftops of a building, the majority of field conditions require the application of a much smaller, portable dish. How far can we reduced the size of the dish? The dish plus the LNA shall produce 12 to 15 dB high transponder carriers on the screen of the spectrum analyzer. Why is that requirement so important? Because we need to relate the intensity of the interference to the amplitude of the nearest satellite transponder (Figure 11).

In cases of severe interference conditions, the survey engineer is advised to operate the analyzer in the 10 MHz/division or 20 MHz/division horizontal scan mode. Thus, the presence of terrestrial microwave carriers, always 10 MHz offset from the satellite carrier frequency, can be positively identified. It also must be noted that in the majority of the cases the terrestrial carriers are very narrow; they look like CW carriers.

Figure 12

These pictures were taken to prove that the antenna cleared the buildings and trees in front, when receiving Satcom 3-R, as well as to pinpoint the exact dish location for the proposed small earth station.

The combination of a 4-foot diameter dish and high-gain LNA, mounted on the back of the survey vehicle, permits the fast and efficient movement of the survey vehicle in a wide area. That, in turn, enables the engineer to search for interference-free spots in the area, using man-made objects (buildings) or terrain features (hills) as shielding against the interference (Figure 12).

Take a Polaroid picture of the test setup from two different 90 degree angles. Show the test antenna oriented toward Galaxy 1. In the northeast, where the Galaxy 1 elevation angle can be as low as 12 degrees or less, a picture is the best proof that the TVRO dish will clear the vegetation, the fence or the apartment building in the front. The picture also helps the installers of the 5-meter dish to find the satellite in the sky. It is amazing how much time can be wasted to find 243.2 degrees azimuth angle with the aid of a compass.

A gratifying experience

Headend interference testing and elimination: it's a headache, a burden, a nightmare, an almost impossible task. However, when the interference disappears, the pictures become crispy and clean, it's a joy, a pride, a most gratifying engineering experience.

Figure 1: Grounding at the water pipe

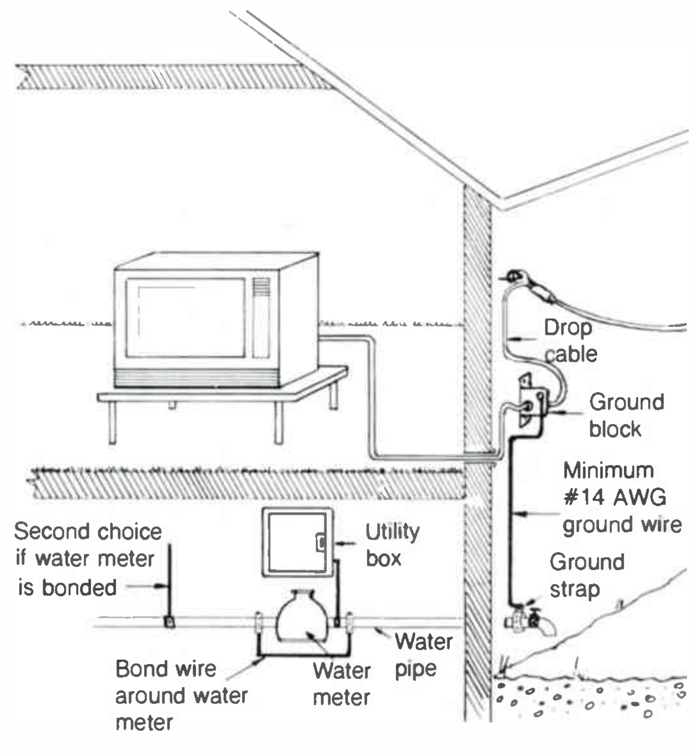
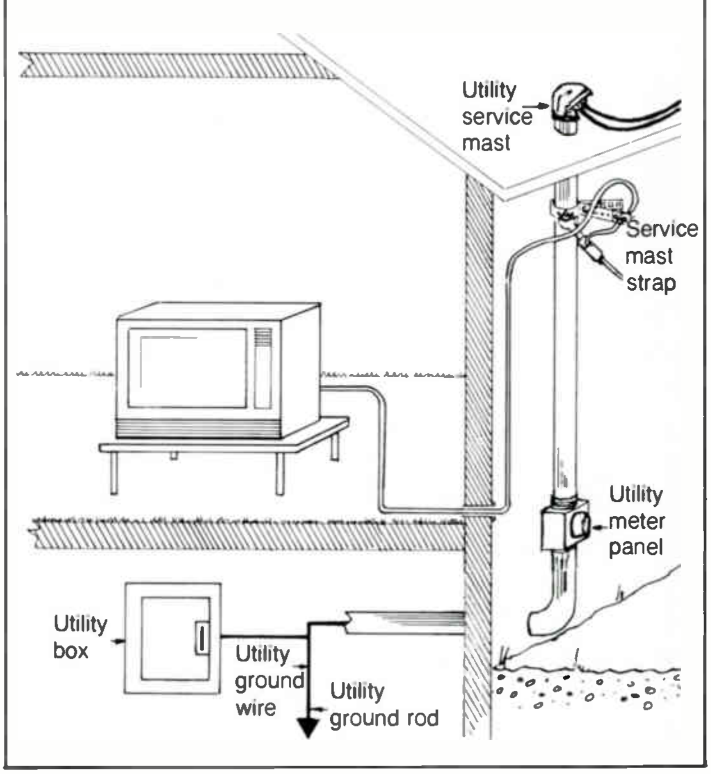


Figure 2: Grounding at the service conduit



Grounding drop lines

By Robert Girard
Director of Marketing, Sachs Communications Inc

Independents and multiple systems operators have different opinions concerning grounding. Engineers, technicians, installers, even administrators have their own opinions or evaluations as to the worth of grounding subscriber drop lines. Some states, New York for one, are very strict about the procedures. Most states, however, are more tolerant and suggest that systems comply with the National Electrical Codes for the United States, or the Canadian Standards Association (CSA) for Canadian system operators. Enforcement of standards, guidelines or compulsory procedures also vary from state to state.

The following is a compendium of "official text" that can be referred to, plus industry feedback and criteria that should be considered before making a final decision as to the system policy of grounding drops.

Reasons for grounding

Grounding is a procedure implemented to protect persons and property from the possible hazards that arise with the use of electricity. Although CATV does not work directly with electricity, particularly at the subscriber drop line level, there are times when CATV cables could be in contact, or affected by, electricity:

- Natural causes (lightning)
- Accidental difficulties with the electrical utility such as loads (live wires) falling, etc.

Failure to provide proper grounds could result in legal action because of real danger if such events should occur. Estimate how much it would cost if:

- A customer's house caught on fire?
- His television set was damaged?
- Personal injuries occurred?
- A loss of life?

We have heard many statements in the field such as, "My main line is grounded, this is sufficient," or "I have been operating for X number of years without ground and I have not had any problems, why change? Why add new costs?" Responses like these are logical but do not satisfy the requirement of security that is now emphasized in any plant construction. It is not the quantity of events that counts, one is sufficient to be expensive, especially in the case of fire or loss of life.

Foresight and precaution warrant the additional investment of protective devices and procedures to guarantee that proper grounds are installed at each subscriber drop. Foresight, because of the two-way transmissions that soon will be available in most systems and more important, the transmission of data that is highly sensitive to any electrical interference. Precaution, because of the possibility of legal action as a result of damage to property or persons, due to noncompliance with local/state electrical requirements. Grounding procedures at the subscriber house level is warranted and financially justifiable.

Effective grounding

Many operators have utilized different types of grounding components and procedures over the years. Was the grounding effective, partially effective or inadequate? Let us review some definitions as specified in the 1984 edition of the *National Electrical Code* (*NEC*). We have seen that grounding is a necessity to protect persons and property. There are seven major definitions that reflect the nature and importance of grounding procedures. Quoted from *NEC*:

1) Ground—A conducting connection, whether intentional or accidental between an electrical circuit or equipment and earth, or to some conducting body that serves in place of the earth (a situation that you want to avoid).
2) Grounded—Connected to earth or to some conduction body that serves in place of the earth (the options available will follow).
3) Grounded conductor—A system or circuit conductor that is intentionally grounded.
4) Grounding conductor—A system or circuit conductor that is intentionally grounded.
5) Grounded electrode conductor—The conductor used to connect the grounding electrode to the equipment grounding conductor and/or to the source of a separated derived system.
6) Grounded efficiency—Permanently connected to earth through a ground connection of sufficiently low impedance and having sufficient amperage that

ground-fault current which may occur, cannot build up to voltage dangerous to personnel (or environment).

To summarize the content of these definitions; grounding is a method of assuring yourselves that electricity, whatever its source or amplitude will go directly to earth before causing any major damage. Therefore, the next logical question is—How do you make sure that you are permanently connected to earth?

- Drop cable should be grounded upstream of all splitters and subscriber terminal equipment and as near as practical to the point of entry (typically within 10 feet of 3 meters).
- The ground wire should be attached to the drop cable by the use of a ground block or other approved attachment device. Here, one must be very selective in the component used for proper security installation.
- A minimum of #14 AWG insulated copper wire should be used for single drops. The ground wire should be run as straight as possible to the ground point. The ground wire should have rubber or thermoplastic insulation and should be protected against abrasive damage.
- The ground block should be tagged with a notice indicating that the ground must not be removed.

Where to ground

There are options regarding location of grounding, however, some are better than others. The following grounding points are listed in order of priority, i.e. from the most desirable to the least desirable:

A first choice should be an electrically conductive cold water pipe, if and only if, it can be established that it is and will remain part of a continuous electrically conductive system approved for use or used by the local electrical power utility as the subscriber premises grounding electrode (Figure 1).

Evidence of this would be the presence of a ground wire connected between the utility electrical box and the water pipe system. If the new grounding wire cannot be connected before the water meter, the continuity of the ground should be ensured by a bond across the meter or other insulating section. If in doubt as to whether or not a water pipe is a suitable grounding electrode system, the second alternative should be used. It is the power service ground conductor, service equipment enclosure or conduit, providing a suitable fixed clamp or strap (Figure 2).

A third option (Figure 3) is an effective grounded metallic structure or an approved configuration ground rod or pipe driven into permanently damp earth. A driven ground rod shall be at least 2 meters from any other electrode and must reach moist soil when installed. In addition, a copper conductor not smaller than #6 AWG, shall be connected between this ground rod and the utility grounding electrode.

Note that artificial electrodes, such as driven ground rods, are the last preferred choice for obtaining a ground. The *NEC* also states that rod and pipe electrodes shall not be less than 8 feet (2.44 m) in length and consist of the following materials, and shall be installed in the following manner (#250-81):

A) Electrodes of pipe or conduit shall not be smaller than ¾-inch trade size and outer surface galvanized or otherwise metal-coated for corrosion protection.

B) Electrodes (rods) of steel or iron shall be at least ⅝-inch (15.87 mm) in diameter. Nonferrous rods or their equivalent shall be "listed" and shall not be less than ½-inch (12.7 mm) in diameter.

C) The electrode shall be installed such that at least 8 feet (2.44 m) of length is in contact with the soil. It shall be driven to a depth of no less than 8 feet (2.44 m) except where rock bottom is encountered, the electrode shall be driven at an oblique angle not to exceed 45 degrees from the vertical or shall be buried in a trench that is at least 2½-feet (762 mm) deep. The upper end of the electrode shall be flush with or below ground level unless the above ground end and the ground electrode conductor attachment are protected against physical damage as specified in Section 250-117.

Obviously, ground rods are least recommended. If there is no alternative they should be ⅝-inch to ½-inch in diameter and at least eight (8) feet in length.

As you can see, there are many ways of grounding subscriber drops. It is up to the company to decide which procedure and equipment to choose. Just make sure that the components will give effective grounding.

I also would like to acknowledge and thank the Cable Communications Research Institute and the National Fire Protection Association, who publishes the *National Electrical Code*. Hopefully, the comments and excerpts from these sources will give more insight as to the importance of effective grounding for the subscriber drop line.

Figure 3: The utilization of ground rods

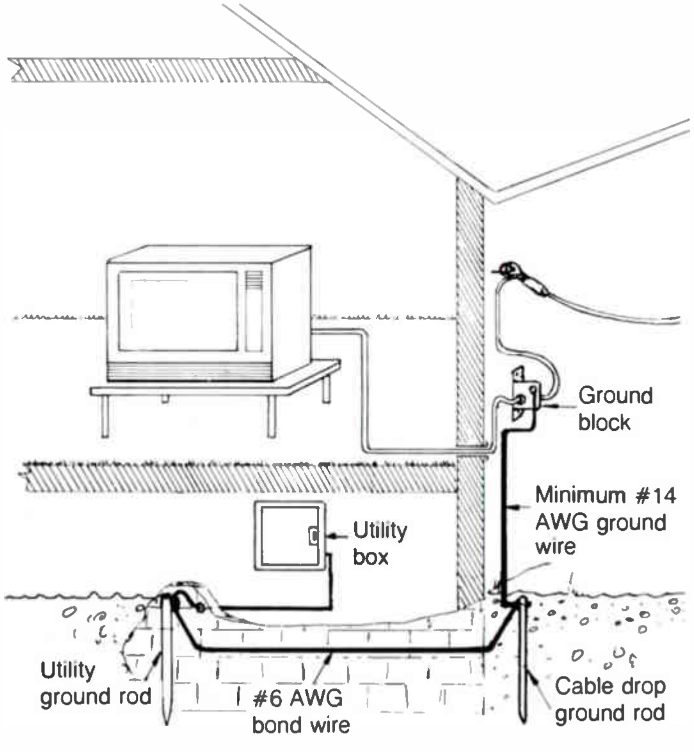
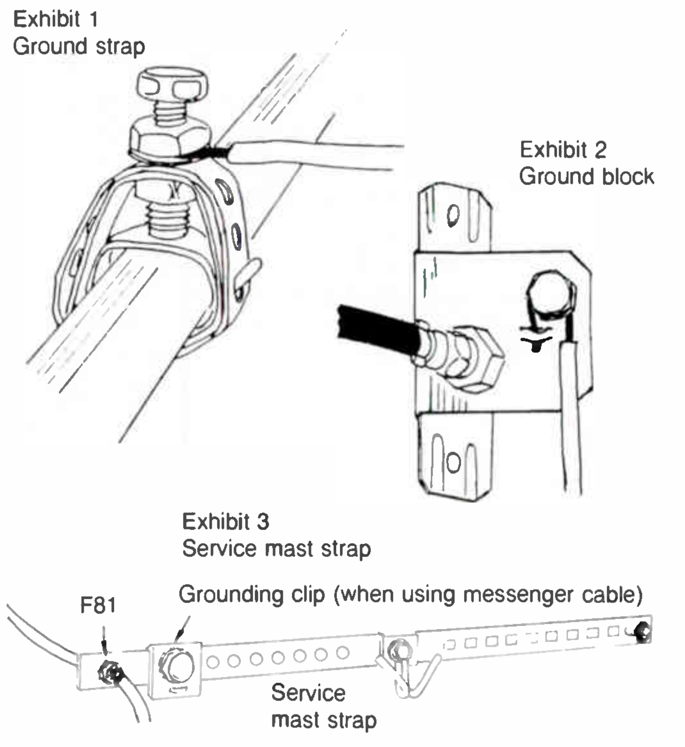


Figure 4: The components of a grounding situation



Tracking those 'Tennessee Valley Indians'

By Roy Ehman
Director Technical Services Storer Communications

Television interference (TVI) problems come to us in two flavors. First, there are the TVI problems we create ourselves by leakage from cable system coax or equipment. This type, the radio hams have dubbed CATVI; we in the industry simply refer to it as leakage. The word leakage should be used rather than radiation because in the mind of the public today the word radiation seems to be inextricably associated with "hard" or ionizing radiation, which in turn conjures up thoughts of human biological damage.

This problem of semantics is very real and several years ago resulted in the denial of zoning permission to put in an AML link because a respected member of the community stated in the press that the AML link would be damaging to the health of the citizens. While using the word radiation is technically correct, it is better to school ourselves into the habit of saying leakage instead.

The second kind of TVI problem is of the non-cable related type. This type of interference seems to be coming our way more and more, illustrating an interesting phenomenon. Before cable was so widespread it never occurred to a TV viewer to call the local TV station and complain about interference, and in turn, a TV station, when receiving such a call, certainly would not entertain any thought of trouble shooting the problem unless it was so widespread as to damage the station's ratings. With cable, however, there is a more personal relationship. This occurs firstly when ordering or enquiring about cable service and again when the installer comes, and perhaps a third time on a service call or at the "cable shop." The customer also receives a significant amount of direct mail from most systems plus possibly a program guide or "bulletin board."

In many cases when the interference is slight or intermittent the subscriber cannot identify it as TVI, and so he/she turns to the cable system for help. This attitude has carried over to non-subscribers as well and they too will often call on the system for help. Some of them do realize that the FCC is the true and final guardian of our airwaves and seek help from that quarter in the first instance. Yet, even these calls are being turned around and sent to cable systems in increasing numbers.

TVI calls have a tremendous potential for good or bad public relations and we cannot back away from this chore even if the preliminary information indicates an interference source other than the cable system. Once a TVI complaint or enquiry has been registered, the good name of the system is at stake and prompt action is required.

Taking action

At this point, many operators face a psychological problem. Often the complainant is irate and nobody wants to have a confrontation under these conditions. Frequently the result is procrastination and nothing gets done. But it must be dealt with since every TVI report is a case and the complainant is the key witness. This person was/is at the "scene of the crime" and yet we go to great lengths to avoid him. We would rather go out and clean up every tiny leak within five miles of his home than knock on his door for fear of what he will say to us. Rule #1: Get in touch with the complainant *personally* and *immediately*. Tomorrow is already a day too late. After all, the name of our business is *service* and we need to show that we care, and that we are doing something about the problem.

If the person is angry or hostile we know to give him a chance to tell everything that is on his mind (without interruption). Listen carefully and make notes. If not already apparent, ask the time of day and the duration in which the TVI occurs in order to detect a pattern that could be tied in with some other activity in the neighborhood (an example might be 6:30 in the evening when the microwave oven is in use). Finally, ask to see a demonstration or set up a further interview at a time when interference is likely to occur. Note on which channel(s) it comes up and whether it is coherent RF causing a static or moving beat of some kind or if it has the characteristics of electrical interference. When you have permission, it's a good idea to cycle the electrical devices in the home on and off while viewing the TVI. In a significant percentage of cases the interference is generated right in the house where the TVI is picked up. For example, many electronic bug killers give off signals around channel 8 at levels high enough to cause TVI to strong local TV stations.

Sometimes you may be sent in to solve a problem when the cause is already known. For instance you may know before you set out that the source is a transmission (such as CB) and has been identified by voice and content. If the transmissions completely wipe out one or more channels or worse yet, come through on the telephone because of rectification in the carbon granules of the microphone button in the handset, it is probable that the TVI is being caused by a relatively high-power transmission on the order of 100 to 1,000 watts. Higher power becomes really troublesome when there is a poor match between the transmitter and the antenna, especially when that antenna is being worked against ground. The RF seems to get on everything except the antenna.

A very useful and inexpensive item to have on hand in this and similar situations is a couple of toroidal cores or sleeves. The nice part about using these is that the serviceperson doesn't have to cut any wires or coax

Indians...what indians?

It wasn't too many years ago that you could listen on the ham bands and hear frequent statements such as, "Well I have to close down now, Tennessee Valley Indians you know!" or more positively, "Hey! I got rid of my Tennessee Valley Indians." The reference, of course, was to the first letter of each word, which spelled out TVI.

At that time the subject was so sensitive that hams didn't want to even mention the ugly words on the air. Since then the ham's problems have been greatly reduced due to the widespread use of single side-band transmission with final amplifiers that are quite linear and therefore do not so easily generate harmonics and spurs. This is in sharp contrast to the old popular Class C final amps that had to be driven to 2.5 times cut-off to be efficient, not to mention the Class B push-pull output stages that were meant to eliminate even harmonics but which could throw spurs all over the spectrum if you didn't "fine tune" the neutralization to perfection.

Other factors were the availability and use of more and better low-pass coax filters. One of these was designed and produced by the Radio Society of Ontario (Canada). It even had adjustable, custom notches. And naturally there was the ever growing expertise of the amateurs.

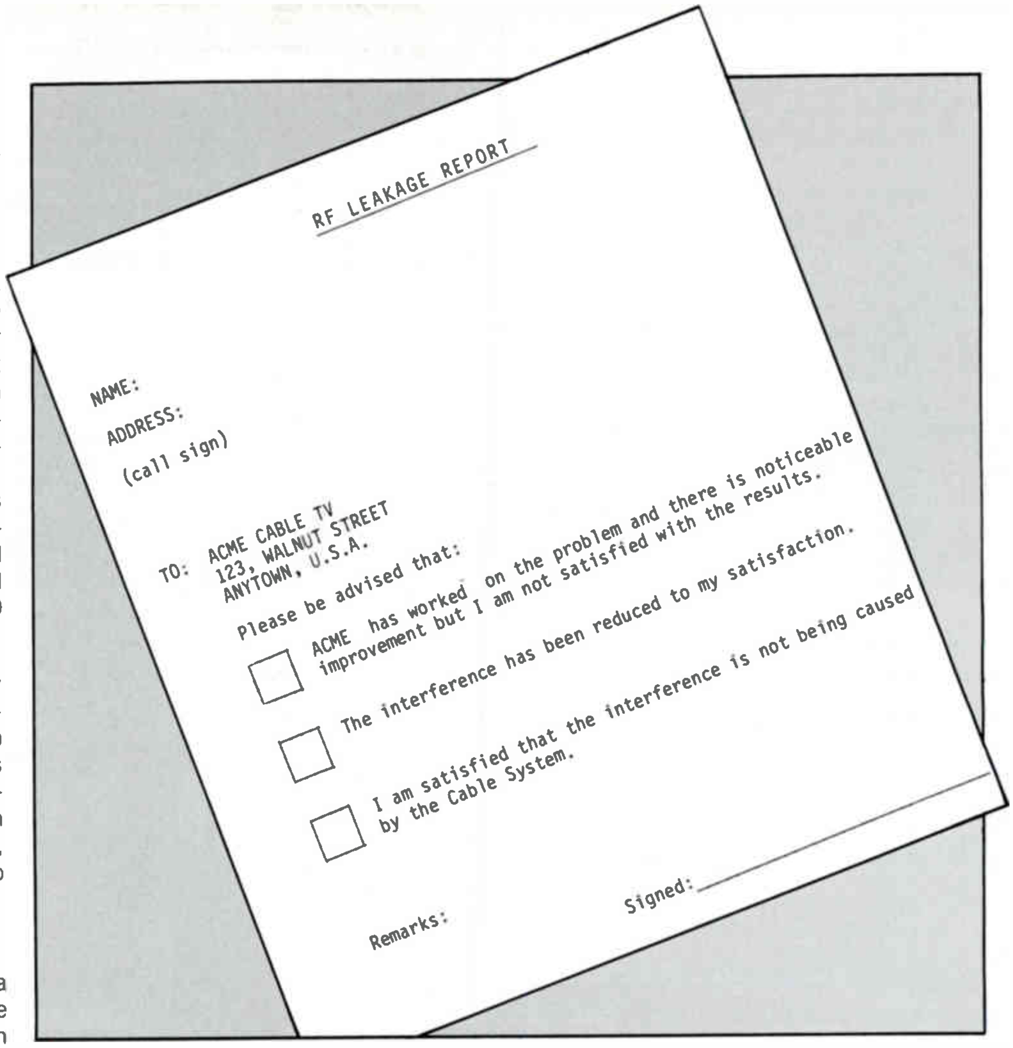
Nowadays, the ability to troubleshoot TVI quickly and effectively has become a frequent requirement for chief techs and service techs. Apart from resolving our own leakage problems, the FCC frequently appeals to the industry to solve non-cable related reception problems experienced by cable subscribers and non-subscribers alike. These TV reception problems stem from such diverse sources as oscillating antenna preamps, over-powered CB transmissions, bug killer lamps and other consumer devices that permanently or temporarily do not meet FCC Part 15.

Since chasing Tennessee Valley Indians can be very time consuming and counterproductive, it behooves us to arm ourselves with as many extra tools and ideas as possible.

and there are no matching, frequency response or loss problems, which facilitates a number of quick tests very easily. Just wind a few turns through the toroid, reconnect and any sheath or common mode RF is immediately attenuated sufficiently for a conclusive demonstration.

In some cases it is necessary to place only a ferrite sleeve over the suspect line or drop wire without even disconnecting it. If high-power operation is suspected from a CB station, it might be advantageous to get a field strength reading from a definite spot within a few hundred yards while the interference is in progress. After meeting with the complainant, arrange to meet with the CB operator. If he is legal (4 watts), he probably will be very cooperative and willing to do tests. A field strength reading taken at a previously tested site will reveal any marked difference (like 10 dB or more) in the radiated power.

When you have established that the TVI source is non-cable related and probably demonstrated the mechanism of its occurrence, the PR job is done and your system name has been cleared. If the complainant is satisfied ask him to sign a simple, non-intimidating form. It is valuable to have this on file, available for future contingencies. Also, when you get back to the office be certain to immediately document the proceedings .



RF LEAKAGE REPORT

NAME:

ADDRESS:

(call sign)

TO: ACME CABLE TV
123, WALNUT STREET
ANYTOWN, U.S.A.

Please be advised that:

☐ ACME has worked on the problem and there is noticeable improvement but I am not satisfied with the results.

☐ The interference has been reduced to my satisfaction.

☐ I am satisfied that the interference is not being caused by the Cable System.

Remarks:

Signed:

Troubleshooting ham RFI

A ham call is a five-star alarm. If you have a ham tech on your staff, let him be involved; he knows the lingo. Full and immediate attention is required from the tech manager and/or chief tech:

a) Meet with the ham the same day if possible and take a uniformed technician with you.

b) Keep an open mind and try to make a friend.

c) Eyeball his installations, especially his TVs, FMs, VCRs and any other electronic equipment whether or not it is connected to the cable system.

d) Terminate the drop at the tap and observe. Does it make a difference?

e) Cut the system completely about a half mile upstream to put out the whole subdivision for a few seconds and observe again. What happens?

f) You now should have a fair idea of the magnitude of the problem. If absolutely necessary have the E modulator briefly cut while still in the ham's house to make sure it is your cable system. Try to do this during non-peak hours. This guards against trying to correct your own system for leakage coming from a SMATV, adjacent cable system, oscillating TV receiver or TV antenna preamp. Now, you should *know* the magnitude of the problem. Do these procedures in the order given and do them immediately. We tend to damage our own cause by not acting promptly enough or at the other end, by avoiding the face-to-face meeting while plunging in and repairing 40 miles of plant when the problem was right in the ham's house.

There was once a case where an entire trailer park was rebuilt in a desperate attempt to solve a long outstanding complaint when the interference finally turned out to be a TV right in the ham's trailer. It was not connected to the cable. Cable systems are not the only radiators of unwanted RF! Computers, or anything with a microprocessor for that matter, tend to put out broadband RF and need to be checked out. Split ferrites that fit neatly over 25-conductor, flat ribbon cable are available and helpful.

g) Personally drive the ham's area for three blocks around with a leakage detector tuned to the channel E picture carrier and capable of detecting 2 or 3 μV/meter.

h) Get the *National Repeater* book from your local ham store or the American Radio Relay League, 125 Main St., Hartford, Conn. 06111.

i) If the problem is with a repeater with input or output on 145.250, consider offsetting to avoid conflict with the fixed-frequency repeater. Remember that this is a "band-aid" and not a long-term solution to leakage problems. Since channel E/18 is not an aeronautical frequency you are free to move it around. Should a severe leak develop, there is usually an opening within 10 to 15 kHz that will not interfere with the use of any repeater for about 90 miles around.

j) All of the above should be executed within four or five days of a ham call or letter. Are we too busy to do that? We won't be too busy to meet with the FCC when they knock on our door.

k) Get the release form signed at the moment the ham is satisfied. You cannot rely on a proper response through the mail.

To pursue the subject further

A useful publication that handles general RFI is *Radio Frequency Interference—How To Identify and Cure It* from the American Radio Relay League (ARRL). There also is *How To Identify and Resolve Radio-TV Interference Problems*. It has excellent TV screen pictures in color prepared by the staff of the field operations bureau of the FCC—1919 M St., N.W. Washington, D.C. 20554, file reference 1410-C.

A further valuable work that deals with all aspects of reception and RF propagation is *The Radio Amateurs Handbook*. It is presented in highly readable terms with a minimum of mathematics. It covers VHF, semiconductors, digital work and a host of other related material that the cable technician of today should have at his fingertips. It is one of the finest electronic learning and teaching tools available to cable personnel today. It can be obtained from the ARRL.

One place to get ferrites is from Amidon Associates, 12033 Otsego St., North Hollywood, Calif. 91607. For 50 to 300 MHz try the large toroidal core part #FT-240-43. It has an inside diameter of 1.4 inches making it simple to pass several turns of line cord, telephone cord or coax through it—plugs and all.

Good luck with them Indians!

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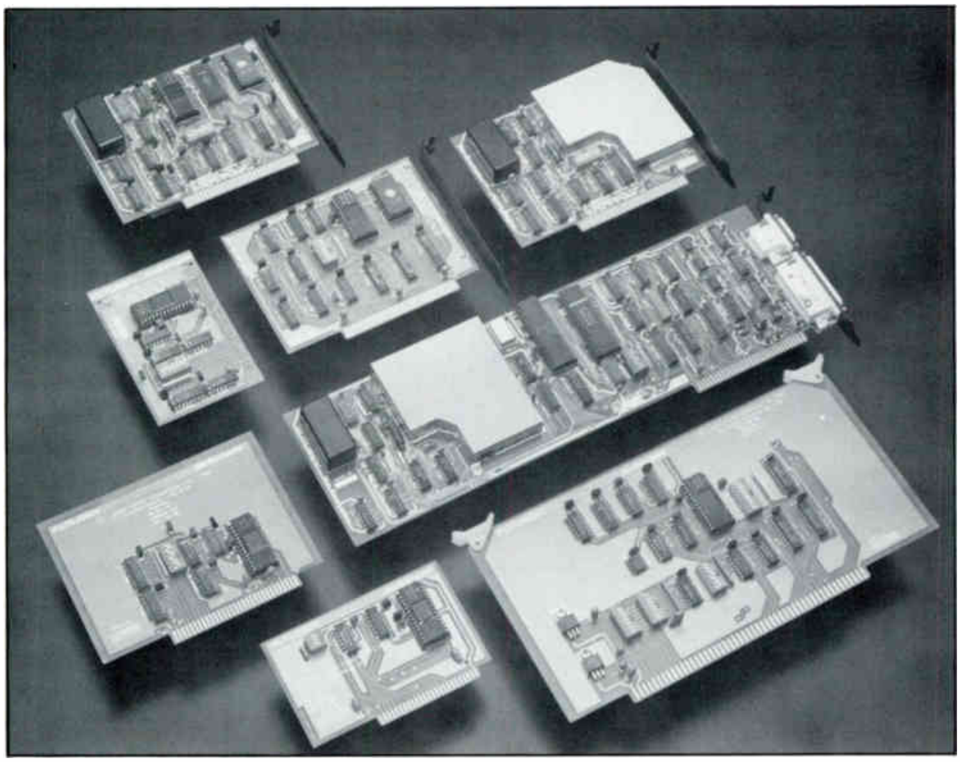


The Encryptor™ family of data encryption/decryption boards.

'Message security or secrecy is nothing new. . . an early use of encryption turns up during Caesar's reign in the Roman Empire'

Deciphering encryption

By Bill Hancock
Head of Technical Publications

And Ed Grundler
Manager of Engineering Services, Jones Futurex Inc

Jones Futurex Inc., founded in 1981, is primarily involved with security computing technology, data storage and data communications through its development of encryption products. The company was formed by Glenn Jones, founder and president of Jones International Ltd. He describes the parent firm's business as the "mind extension" business and feels that integrated electronic pipelines are the key to delivering as much of the recorded knowledge of man as possible. In order for a substantial and meaningful flow of information to occur, however, that information must be made secure.

The encryption methods that are used in product designs at Futurex are based on the Data Encryption Standard (DES), which is approved by the National Bureau of Standards. The DES is a mathematical algorithm that encrypts data by generating unintelligible random symbols replacing ordinary letters, numbers and the spaces between them that we all would otherwise recognize as "text." This encryption procedure, which is virtually impossible to decipher in real time, is used to store and transmit computerized information in ways that maintain the integrity and intent of the information. The encryption procedure also can be used to create message authentication codes (MASs), which are used to validate the authenticity of messages transmitted in plain text by the addition of singular, unique MACs developed for each message.

The proliferation of computer uses in business, education, research, travel and the home, makes protection an essential part of any data controlled or created by computer. Message security or secrecy is nothing new. We've been using message protection schemes for centuries; an early use of "encryption" turns up during Caesar's reign in the Roman Empire.

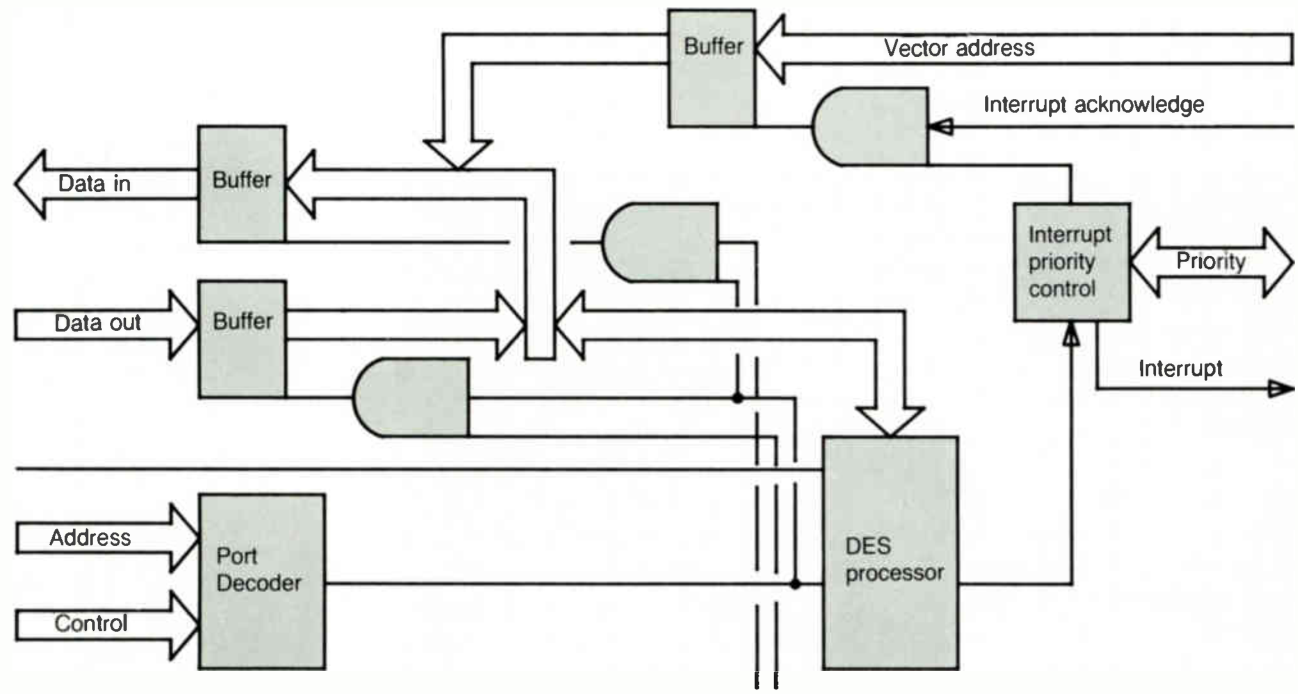
Caesar's scheme to protect his strategic battle plans from being read by the courier or the enemy, was to substitute a different alphabet sequence for the "regular" letters in the message that "made sense." This *substitution* system relies on corresponding alphabets—one normal, the other rearranged.

Today, substitution schemes, or cipher alphabets, are more often than not known as "Caesar alphabets" or "Caesar ciphers." 50 B.C. was not the earliest use of encryption—the concept probably coincided with the first alphabet—but it illustrates the original idea in use. The whole matter is simplified when one considers who actually uses enciphered messages and why:

> "Historically, four groups of people have used and contributed to the art of cryptography: the military, the diplomatic corps, diarists and lovers. Of these, the military has had the most important role and has shaped the nature of the field." (*Networks*)

Today, computerized strategic messages require similar schemes to protect sensitive business or financial information. Consequently, corporate managers held accountable to both superiors and shareholders find themselves responsible for protecting company assets from competitors. The entire financial industry is affected: home banking networks, ATMs, video transactions, POS credit purchases and, particularly, electronic

Figure 1: ENC 100 block diagram



funds transfers (EFTs)—which daily process transactions totalling billions of dollars.

Unauthorized personnel—including competitors, company insiders without proper access authority, or indiscriminate "hackers" with or without malicious intent—continually try to invade, and sometimes alter, corporate and government data bases. Computer crime appears more and more frequently in news reports; the majority of successful computer "attacks" aren't even detected according to a recent FBI computer crime report. Reasons include the lack of computer crime prevention procedures as well as up-to-date computer crime legislation.

Today, the security of information is a sizable business, and it is estimated that it will become a $500 million-plus industry by 1989.

To counter computer crime, Futurex has developed a unique combination of hardware and software products in a systems approach to solve a wide range of security issues. These computer security products are software-supported hardware devices that combine enhanced processing with software-driven applications options. The Encryptor™ products have as a basis a printed circuit board (to be inserted into a personal computer), which is supported by software that encrypts, decrypts and authenticates data created, stored in and communicated between computers. First developed as a device to secure data stored in personal computers, new models have been and are being developed to secure data communications between host and personal computers, as well as between personal computers.

The Encryptor products can be used in conjunction with a secure keyword system. These products comply with the DES. This encryption method is specified for use by many U.S. government agencies and contractors in situations where sensitive information makes data encryption necessary.

The Encryptor software/hardware design goes beyond encryption to generate MACs, which are produced by applying the DES algorithm to specified critical elements of a message, say, a source account number, dollar amount and destination account number. Rather than encrypt data, the process creates instead a unique message code that's a result of the "key" used and the data authenticated. The sender generates a MAC and appends it to the plaintext message. The receiver also generates a dependent MAC from the original and verifies the message. The MAC can be stored with the message for auditing purposes. (On Aug. 16, 1984, Secretary of Treasury Donald Regan directed that all federal government electronic funds transfers be properly authenticated by using MACs by June 1, 1988. Consequently, every terminal, personal computer and central [host] computer in the financial community that's used in federal government EFTs will need MAC capability by that date.)

A block diagram of the ENC-100 is shown in Figure 1. The block labeled DES processor contains the Western Digital WD2001 integrated circuit, the "hardware" by which the DES algorithm is applied to incoming plaintext.

The DES command allows options to be selected within either the encryption or decryption function. One can instruct the computer to keep the same encrypt or decrypt key active and in the DES processor, query the processor's status, or eliminate the specified unencrypted file after the encryption process has been completed.

A design goal specified from the very beginning restricts unauthorized access by allowing no "door" into or out of the processor's key storage facilities. Therefore, it is extremely important to remember the string used to invoke the DES command; the DES program makes no attempt to save the keyword, and the encrypted file can't be recovered without reference to this key. Further, the Encryptor immediately wipes the screen clear to prevent key theft. In fact, the ongoing design restricts every possible access to the keys, even by the designers, by means of user-generated and loaded key sequences.

Inside the DES

The most widely used cipher in the United States for the encryption of stored or transmitted computer data in the public sector is the Data Encryption Standard. It was developed at IBM (similar to a system developed earlier under the code name "Lucifer") and approved by the National Bureau of Standards in early 1977 (FIPS PUB 46, Jan. 15, 1977).

The DES *enciphers* a 64-bit message block under control of a 56-bit key to produce a 64-bit ciphertext. The enciphering operation consists of 16 iterations of the following two steps (see Figure 2):

1) Exchange the left half of the 64-bit message with the right half.
2) Replace the right half of the message with the bit-wise exclusive *OR* of the right half and a 32-bit word that is a complicated function *f* of the left half, the key and the iteration number. The function *f* involves, in

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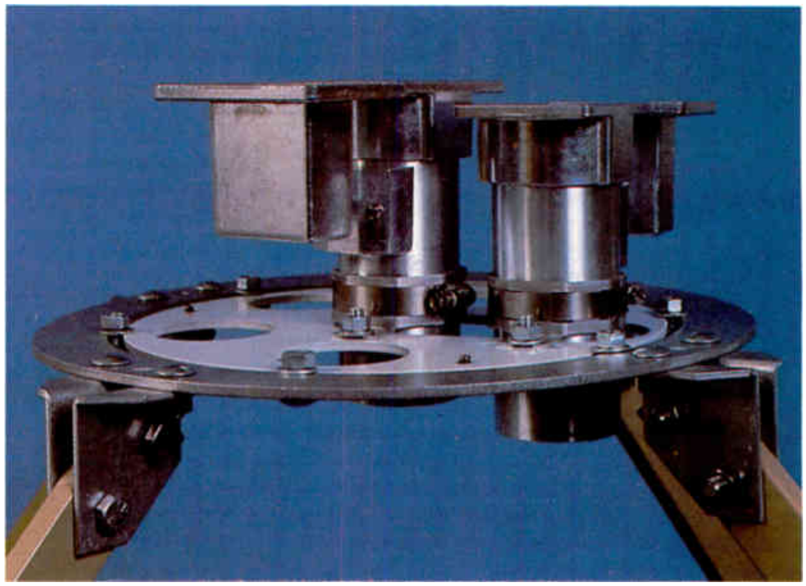

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(and many more)

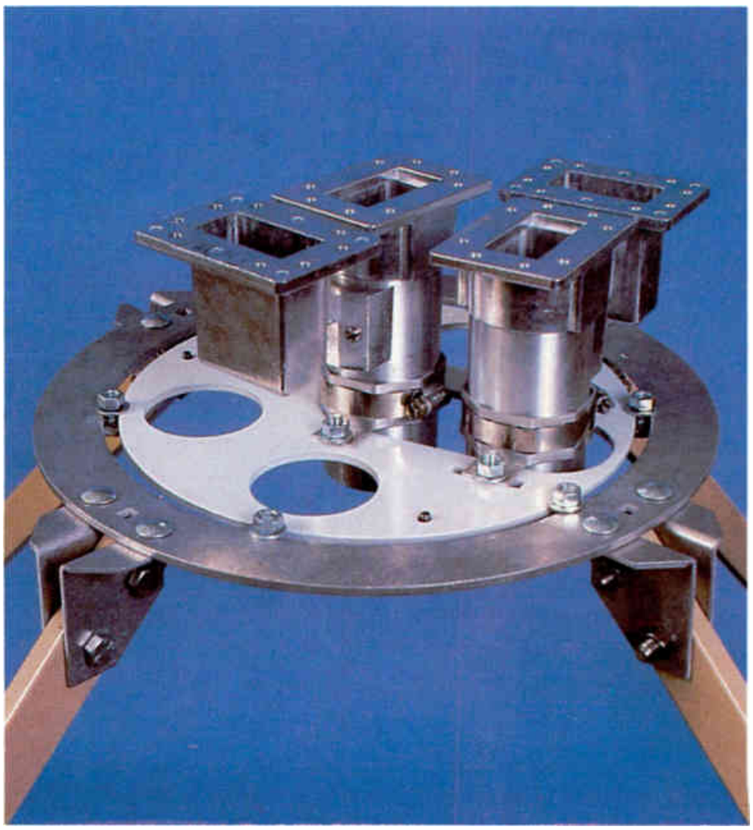

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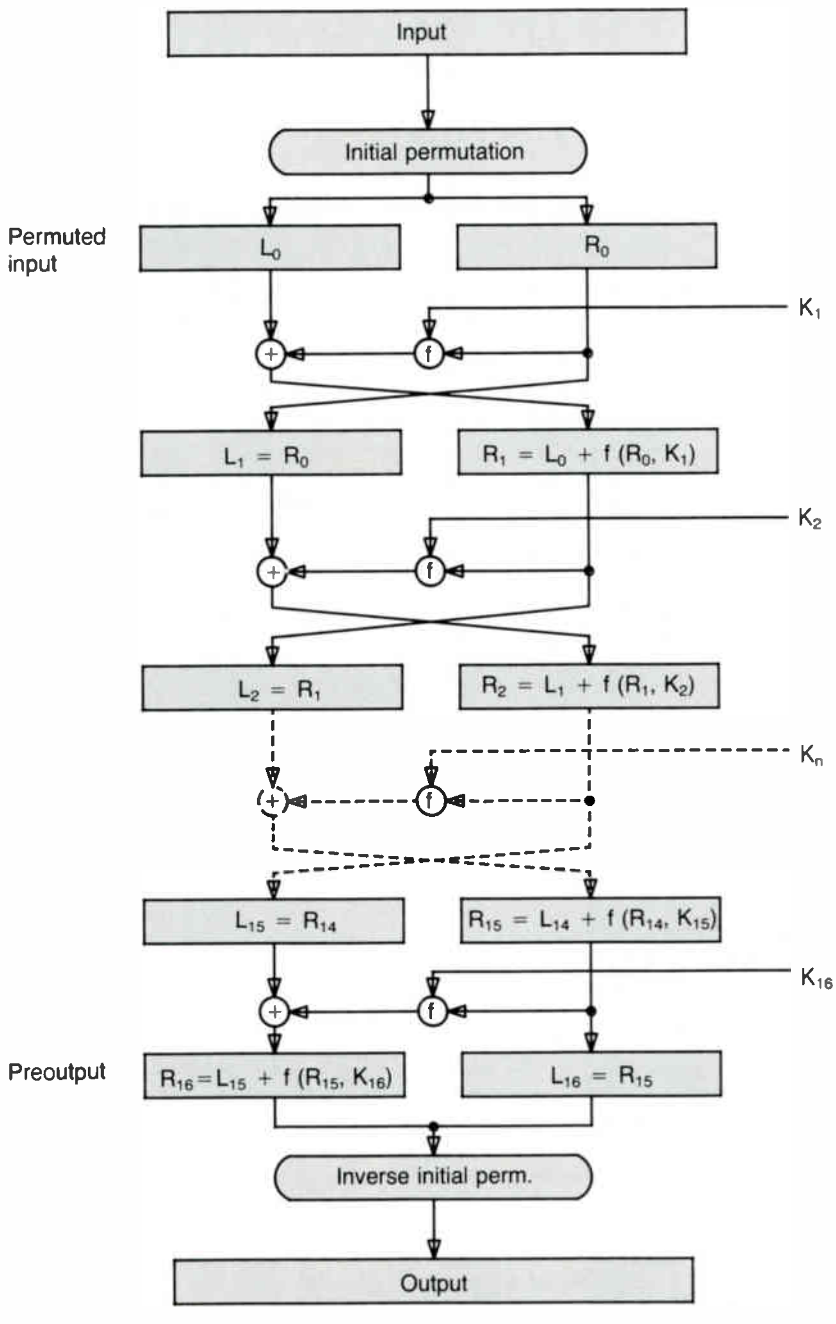
Figure 2: Simplified Data Encryption Standard



part, a number of substitutions of short sub-blocks using specially constructed substitution tables, S-boxes, and permutations of the individual bit positions. The basic DES function has been implemented by a large number of manufacturers on special-purpose large scale integrated (LSI) chips, which can encipher at megabit per second rates.

Why is the hardware-implemented DES so popular? Its speed. Encryption or decryption takes about 100 milliseconds to implement on an 8-bit microprocessor, and this time can be reduced to about 5 microseconds on a custom-built LSI device.

In a 1980 NBS publication, *DES Modes of Operation*, several methods for incorporating the DES algorithm into a cryptographic system are explained in detail. These methods, external to the DES algorithm, have come to be called the "modes of operation." They include the Electronic Codebook (ECB) mode, the Cipher Block Chaining (CBC) mode, the Cipher Feedback (CFB) mode and the Output Feedback (OFB) mode.

The Electronic Codebook is a direct application of the DES algorithm to encrypt and decrypt data. Cipher Block Chaining is an enhanced mode of ECB that chains together blocks of cipher text. Cipher Feedback uses previously generated ciphertext as input to the DES to generate pseudo-random output that are combined with the plaintext to produce ciphertext, thereby chaining together the resulting ciphertext. Output Feedback is identical to CFB except that the previous output of the DES is used as input in OFB, while the previous ciphertext is used as input in CFB.

The CFB and CBC modes are intended for encryption of narrative text and automatic data processing data, for transmission over communications channels. The OFB mode is intended for applications where error extension due to encryption/decryption cannot be tolerated. The ECB mode is approved for the encryption and decryption of data encrypting keys and initializing vectors, for transmission over telecommunication systems.

A message authentication code involves using CBC to compute and append a MAC to a message. The same computation is performed at the reception end. The results are compared. If they are the same, the message "authenticates." If not, the transmission link is ended.

Encryption research at Futurex

January 1981—Jones Futura Foundation was formed to conduct research into secure video systems. It is the R&D "sister" of Futurex, which was incorporated in November 1981 for the purpose of manufacturing and marketing products generated by Jones Futura. Since 1981, Futura has focused on research and prototype generation in the areas of communications, telecommunications and computer security technology.

Futurex Security Systems, a division of Jones Futurex, is the marketing and manufacturing subsidiary of parent Jones International Ltd., a 22-year-old diversified holding company based in Denver, with interests in cable television systems and telecommunications services.

Late 1981—Engineering delved into the mysteries of how to protect the data in transit from headend to subscriber, and started to look at encryption algorithms. We "discovered" the DES during this period and started to learn what it was all about.

Jan. 1, 1982—Ed Grundler, group leader and design engineer for the R&D effort in secure video systems, was challenged by the development possibilities that might arise from an encryption board for the S-100 based computer—at least it would protect our proprietary research files on disk. Under Grundler's guidance, the engineering group created the first Encryptor printed circuit board: the Encryptor 100.

The ENC 100 was made available to the public in the second quarter of 1982 with a software program for the OASIS operating system. Some time later, a second software program was developed for the CP/M-80 as an option for the ENC 100 board.

The next development was the Encryptor 101, which can be populated with up to eight encryption devices to encrypt several data streams, under different keys, simultaneously. Originally, it was intended for a secure cable system headend computer, which explains its multiple DES chips. Now, it has uses in a wide range of customer applications, in addition to maintaining controlled accesses between the headend and legitimate subscribers.

Apple time and more

Next, the ENC 200 was marketed. This Encryptor was designed for the computer we all thought was to sweep through the business users' marketplace and eventually wind up in every office in most of the civilized world: the Apple. The ENC 200 runs under Apple DOS (3.0 at this point in its development).

The introduction of the IBM PC pointed the Jones Futurex research and development team from Apple to IBM. In 1982/83 the Encryptor 300 hardware was developed. The accompanying software for the ENC 300 included two file encryptors: one to run under MS-DOS, the other to run under CP/M-86. The first ENC 300s were command-driven, but because users perceived menus as the "in thing," a menu-driven version was developed.

Also during this time the Encryptor 301 was developed in answer to a perceived need to *not* take a slot in the PC. The plug-in to the board is a task requiring some dexterity by an installer, a soldering iron and pin strips with which to create an internal slot for the IBM PC's severely limited add-on ports.

More protection needed

A Fortune 500 manufacturer needed a systemwide board that would provide not only encryption but, at the same time, store keys on the board. By early 1983 the ENC 302 board was developed. The research software group developed "minimal" software—consisting of a series of subroutines—that "exercise" the board; the customer wrote most of his own programs on this base.

The Encryptor 302 design keeps a keyspace of 32x8 bytes (256 bytes of key word-addressable space) in an EPROM on-board. There are inherent security risks for a system in which key loading occurs at each log-on access. Keeping the keys "fixed" on the board frees the system's users from the tasks of loading keys, remembering key sequences, and by extension, losing the keys. Most importantly, the on-board keyspace shifts "key-keeping" responsibility from many users to one person: the security system manager. The manager's job is to maintain the system's integrity and help guarantee that there are no individuals with written keyphrases stashed in a desk drawer or file cabinet. Moreover, these keys, used in conjunction with software, offer a number of logical and physical security options—the ability to combine heirarchical or multi-layered security, user authentication modes and PC identification, as well.

An operating arm of the nation's central banking system needed more than what was offered by the ENC 302 with its on-board fixed key storage. So, in early 1983, two new boards—ENC 303 and ENC-304—were developed.

The 303, an IBM PC fixed key/variable key Encryptor, combines the 302's fixed key function with a doubled keyspace in ROM/RAM for variable key storage that can be accessed, loaded and changed by the secure communications processor. A battery-powered key destruction event is triggered if the ENC 303 is removed from the PC bus. The physical security protects the owner's encrypted data from being accessed by someone who removes the board from its PC slot.

The 304, also an IBM PC fixed key/variable key Encryptor design, encases the key storage chips and two RAM chips in a 16 gauge sheet steel "can" that is sealed with an epoxy potting material. The two RAMs are complementary in that one is always battery powered, while the other is battery powered while the board is installed in the PC. (The reasons for this arrangement are proprietary.) The metal/epoxy barrier prevents an intruder from probing the chip pins to find key code characteristics. At its birth, the base software for the ENC 304 consisted of an assembly language driver that could be linked to a compiled BASIC program. (The driver, in conjunction with the board, handles the cryptography.)

The major difference between the two is a metal can that surrounds the encryptor and key storage areas on the 304. This can satisfies two conditions detailed in FED-STD-1027. The first is a physical security design that impedes or restricts physical access to the board's encryption and key storage areas. The second is an EMI/EMC block that contains any internally generated electromagnetic interference radiation, while also protecting the sensitive areas of the board from external radiation. The ENC 303 was not designed to have the epoxy-filled physically secure surrounding. Since then, the ENC 304 has been changed often as a response to customer's requests, but the ENC 303 hasn't.

Glossary of terms

Electronic codebook cryptography: A method of using the data encryption algorithm (DEA) to encipher and decipher data where the data are broken into blocks of eight octets (bytes). Each block of octets is treated as a separate entity. The drawback, and the source of the name electronic codebook, is that a catalog or codebook can be generated for each key. The reason for this is that the same block of octets always enciphers to the same output block with a given key no matter where it occurs in the text. Note that making this codebook is not easy and that it requires large amounts of storage.

(Block) cipher feedback cryptography: A method of using the DEA to encipher and decipher data where the data is broken into blocks of n bits. Each block contains the same number of bits. The number of bits can be anywhere from one to 64. The choice of the number of bits is determined during design to be optimum for the situation. Normal choices are: one, eight (byte-wide), and 64. In cipher feedback, the DEA device is used as a cipher stream generator. The initial input to the algorithm is a 64-bit random number called an initialization vector (IV). The most significant n bits of the output are exclusived ORed (XORed) with the data to be encrypted. The result of the XOR is the ciphertext, which is then routed to its destination. The output ciphertext also is fed back to the IV, hence the name "cipher feedback." During the feedback phase, the IV is shifted left n bits. The left-most n bits are lost, while the n cipher bits are added to the IV from the right. The reason for using cipher feedback is that the output of each encipherment depends, not only on the current plaintext, but also, on all previous plaintext. There is limited error propagation which is a desirable feature in most cryptographic systems. The cryptography itself is self-synchronizing.

Cipher block chain cryptography: A method of using the DEA similar to 64-bit cipher feedback. The data is blocked in groups of eight octets. The first block is XORed with an IV and the result is processed through the algorithm. The output of the algorithm is the resulting ciphertext. The ciphertext also is used as the IV for the next block. This results in error propagation. Cipher block chaining is self-synchronizing also.

Output feedback cryptography: A method of using the DEA that is identical with cipher feedback mode, with the exception that the feedback is taken prior to the XOR of the n bits with the data. Output feedback has no error propagation capabilities. The usual place to use this method is in a noisy environment where the transmission medium generates an unacceptable number of errors. Output feedback is not self-synchronizing.

MAC generation: A method of using the DEA to generate a signature for a block of data that cannot be duplicated without the knowledge of the encryption key. Cipher block chaining with a null IV is the cryptographic mode. The ciphertext is discarded with the exception of the first 32 bits of the final output block. These bits are appended to the message as a signature that can be duplicated on the receiving end if the recipient has the proper key. Changing any bit in the message will cause the generated MAC to change in an apparently random manner.

Late in 1983, we began concentrating on additional aspects of the standards available to the public generated by national, federal and international organizations. This was done because of the types of custom applications we were being asked to look into, mostly by various financial institutions.

In December 1983, a worldwide independent financial institution's request for a "custom" device resulted in a new board: the Encryptor 305. This is a product that combines the ability to operate in IBM's world, with encryption: 3270 emulation, with DES required by the wholesale banking community. Here, the IBM requirement meant protocol conversion, or system emulation; the security standards moved our design solution into the realm of the next-to-impossible.

In addition to the 304's functions, the ENC 305 adds two RS-232C communications ports to its options. The two ports serve different environments. One provides an IBM PC compatible asynchronous communications adaptor. This asynchronous port is fully programmable and will support only asynchronous communications. The second port is routed from a Z80 SCC controller in support of synchronous protocols, including IBM's bisynchronous and synchronous data link control (SDLC). Software support is required to drive one or the other, however. The second port can be configured to asynchronous, an optional use design.

Current design work

The Jones Futura Foundation research and development team has completed design of the ENC 306, which in effect, combines the ENC 304 with emulation of IBM's SDLC. The design effort is being done for another branch of the nation's central banking system. The company's long-term goal is to maximize the use of the boards in all of this system's branches.

Work also is underway on a flexible design for a systems approach, including the final testing on a prototype Encryptor board to make the Zentec 8001 a secure terminal. In addition, the company has the option of completing development of its Secure Communications Processor or integrating its security devices into non-secure communications processors of others currently in the marketplace. In the long run, a unique product will be created, combining encryption with the critical task of controlling which terminals have access to central processing units and communications networks. Software under development now includes a series of terminal emulators to run in a secure mode; current emulators are available for the IBM 3101, the Zentec and the Data Point 8220.

Overall, the research and development in the data protection market can be summarized by John Akers' comment at the National Computer Conference last July:

> "Then there's privacy. As an industry, we have done a notable job of exploring and explaining privacy in the computer age. We have studied and publicized the rights of the individual and helped put in place principles and policies to safeguard those rights. But more needs to be done."

The ever increasing creation and speed of information, coupled with its transmission and processing, has resulted in the business world's increasing dependence on computers. The future needs of data security will be demanding, satisfying those needs will be essential.

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12) Kahn, D., *The Codebreakers*, New York: MacMillan, 1967.

MAC parsing and editing: Message authentication requires that both the sending and receiving end use exactly the same message. At first glance, this would seem automatic. Using computers, however, causes this to not be true as often as desired. Some computers use ASCII to represent their characters, while others use EBCDIC. These code sets use different bit patterns to represent each character, therefore, "identical" messages are coded differently and will generate different MACs. Also, some characters are illegal on some systems, and not on others. MAC parsing and editing is used to put the message in identical formats with a standard character set that is independent of the machine being used. This ensures that the calculated MAC will be identical on both ends.

Key storage: Since the secrecy of the system is the secrecy of the keys used for encryption or authentication, secure key storage is essential. If keys are encrypted, they may be stored anywhere with impunity. Keys that exist in plaintext must be handled with care. Futurex products provide a physically secure memory for these keys. The memory is protected by shielding and potting to impede probing attempts. The data paths from the secure memory are blocked from the system to prevent their being read from software.

Session establishment: Session key facilities allow random session keys to be distributed to requesting terminals on the network, each of which is verified by the controller. If verification is positive, encrypted sessions are established.

Transaction monitoring: This function allows an audit trail all accesses and attempts at access to be recorded on a system disk or output printer.

Terminal ID and terminal key processing: Allows terminal ID and terminal keys to be established and exchanged in a secure manner. This prevents an intruder from using the data in an active attack on the system by encrypting and authenticating each message.

User authentication code: This gives us a way to send user authentication data (e.g., pass phrases, etc.) to the device on the other end of the line without actually sending the data. A signature based on the data is generated using a key that is shared, the signature is exchanged, and then compared. The signature is different each time because a variable is included in the UAC each time.

Encryption and decryption: Encryption refers to the process of changing plaintext into ciphertext; decryption refers to the reverse of that process in which cipher is changed into plaintext. To encipher data, an application program must use the DES and a data-encrypting key. An application program that deciphers the data also must use the DES and the same data-encrypting key.

Terminal ID and terminal key processing: Allows terminal ID and terminal keys to be established and exchanged in a secure manner. These procedures prevent an intruder from using the data in an active attack on the system by encrypting and authenticating each message, thereby providing session-specific verification of sender and receiver.

Session establishment: The session is a temporary logical connection between terminal devices for an exchange of messages in accordance with ground rules that have been agreed upon for that exchange. Establishment of a session requires a clear set of message interchanges between the sender and intended receiver.

Technical impressions

Although many exhibitors reported they experienced a good flow of traffic and some did substantial business, this year's Western Show lacked the flair of recent years and precious little new was introduced or even discussed. Is this merely indicative of an industry that has been burned by too many unfulfilled promises and "blue sky" disappointments? Or are we witnessing the maturing of what was once an inflated and overly hyped-up industry that now knows its true path to long-term growth? In any case, the Western Show mainly presented new elements of the old thing that up to now cable does best: deliver entertainment, electronically, to the home.

With addressability and pay-per-view offering the most efficient and economical means of the delivery of entertainment to the home, several new addressable systems and converters were shown for the first time in Anahiem.

Scientific-Atlanta introduced the Series 8500 System Manager IV, a linked addressable management system designed for cable systems with 20,000 subscribers or more. The computer system provides integrated headend/set-top converter control software that can perform link control, set-top management, pay-per-view management, headend management and report/test functions. The system can be integrated with host billing computers or as a stand-alone control system. The system's hardware includes the Hewlett-Packard 1000 A600 microcomputer with Winchester disk drive, interface and 200 CPS dot-matrix printer.

S-A also introduced a new addressable set-top terminal with a built-in non-volatile memory that has eliminated the need for a PROM with all authorizations and frequency allocations downloaded from the headend. The remote diagnostic capabilties of Model 8550 indicate presence or absence of the data carrier, deactivation of the unit, tampering with the descrambler, phase lock loop or non-volatile memory and other status information.

Panasonic was showing a new series of RF converters designated TZ-PC100 and TZ-PC110. The units have conversion capacity of 402 MHz and 58 channels. The two model types are identical except that the TZ-PC110 offers handheld remote control. Both units offer a power indicator, up/down push button channel selection and power on/off button.

Texscan showed its new TRACS features that included: the Dual Subscriber Module, the Basic Service Module and the Set Top II. A subscriber module that contained two independently controlled tuners was shown as a working prototype; production units will be available in the spring of 1985. The service module can handle eight, basic-only subscribers. Each of the eight outputs can be switched on or off addressably, and a built-in low-pass filter limits output bandwidth to 54-216 MHz. This module is designed to accommodate the subscriber, who takes only basic service, with minimum equipment investment. Texscan's second generation set-top controller was shown in full key pad version, and a more limited version. Both versions feature infrared remote that can be disabled addressably.

Pico Products announced a new series of low profile (1¾-inch) rack mount modulators, and a security rack configuration of the OTAS off-premises addressable system. The M45 modulators feature frequency agility with plug-in filters and crystals. They are available in all channels from 2-W. OTAS security racks are designed for multiple dwelling applications; they come preassembled with up to 40 subscriber modules. Each module (one required per subscriber) has an addressable switch for basic service and seven active traps.

Out of the joint efforts of Westinghouse and Sanyo has come a set-top stereo module. Labeled the SM 2001, the unit can operate with most any converter, and it provides subscribers with stereo sound without the need for a stereo television set. Features of the unit include automatic video and audio tracking, remote volume control, FM stereo radio transmitted from the headend over the cable, TV sound from converter output channels 2, 3 or 4, and foreign language or second audio programming (SAP) capability. A special feature offered that the companies call "channel mapping," consists of a non-volatile memory with a cross-reference matrix. It relates the TV channel number entered by the user and displayed on the converter to the corresponding FM channel frequency actually on the cable, offering cable operators greater flexibility in allocating TV and FM channels.

General Instruments Jerrold division now offers two solutions for implementing impulse-pay-per-view (IPPV). At the show, the company demonstrated Starvue™, its current IPPV product for two-way addressable systems, and they introduced their new Starfone™ for one-way cable systems. Starphone is being targeted to smaller addressable systems interested in IPPV's revenue potential, according to the company. These systems were at a disadvantage compared to two-way cable systems. The add-on IPPV unit is scheduled for availability in the second quarter of 1985.

Wegener Communications of Atlanta introduced the Series 1791 TV broadcast standard stereo modulator. It accepts the stereo audio output from a Wegener Series 1600 demodulator or from a local audio source and provides both a baseband audio output and a modulated 4.5 MHz or 41.25 MHz RF output. An optional plug-in module is available to add the SAP channel.

The Discovery Music Network, a new competitor for Warner Amex's MTV, will be transmitting its audio using an innovation new to the cable industry but widely discussed within the general audio industry known as holophonics. Invented by Argentine audiologist Hugo Zuccarelli, the experience is of a three-dimensional location of sound surrounding the listener. The network claims the effects of holophonic sound can be obtained with conventional monophonic television speakers but is best experienced with headphones. Holophonics encodes spacial information in the recording process, which is then decoded in the human ear. The device can be applied to any electronic media and Zuccarelli Communications is considering applications in the airline headset field and for automobile sound systems.

So, some of the innovations at the show proved interesting despite there not being *major* breakthroughs. And, some of the companies in our maturing industry did well in terms of sales. They demonstrated, explained and introduced products clearly, taking advantage of the opportunities that only big shows provide.

Most of the following products also were present at the Western Show; some were not, some you might have missed.

Power supply

Anixter Communications has added the Alpha APP60-14 power supply to its Alpha product line.

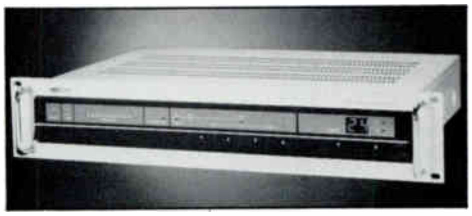
The Alpha APP60-14 power supply is a non-standby aerial mount power supply complete with a heavy duty secondary lightning arrestor. The unit also is available in a pedestal mount version.

In addition, being a distributor of Raychem's products, Anixter demonstrated the Raychem thermoshield cable repair system at the Western Show. This product allows cable operators to repair outer conductor cracks in any type of cable without having to shut down service. Once installed, the thermoshield restores outer conductor integrity by providing high RF shielding, a waterproof seal, mechanical strength and a low electrical resistance.

Finally, BiltRite Metal Products Inc. has named Anixter Communications a distributor of the new L Bracket system for the CATV industry. The L Bracket system, developed by Illinois Bell for CATV and telephone aerial construction makeready, consists of several brackets designed to provide the proper clearance for cable TV plant installation without having to move telephone plant on the pole. Illinois Bell has filed a patent application relating to the system.

The L Bracket system will be stocked throughout Anixter's nationwide network of online computer linked distribution centers.

For further information, contact Anixter Communications, 4711 Golf Rd., One Concourse Plaza, Skokie, Ill. 60076, (312) 677-2600 or (800) 323-0436.



Satellite receiver

M/A-COM Cable Home Group has announced the introduction of its CSR-T1001 commercial satellite receiver. Designed for SMATV and cable TV systems, the CSR-T1001 offers two independently tunable audio demodulators (5-8.5 MHz). Horizontal and vertical polarized IF inputs are automatically selected by means of an internal A/B switch according to the receiving channel. The receiver is LNB compatible and serves as a power source for the LNB. The unit offers voltage synthesized 24-channel selectable tuning. Each channel can be individually tuned and set for any received signal within a 500 MHz band. Providing for more flexibility, the unit makes provisions for tunable channel assignments for non-standard satellite configuration and future 12 GHz applications. It is designed to process frequency modulated signals and provides an unclamped baseband video (video plus all subcarriers present on downlink signal) and a filtered video output. Two-channel audio output provides stereo capability.

The CSR-T1001 has been designed with a microprocessor memory retention capability. The receiver also has been designed to interface with M/A-COM's VideoCipher™ descrambling system.

For more details, contact M/A-COM Cable Home Group, P.O. Box 1729, Hickory, N.C. 28603, (704) 324-2200 or (800) 438-3331.

Billing system

First Data Resources announced the availability of the Micro Delivery Option (MDO), a microcomputer-based billing service for cable systems with under 20,000 subscribers. The Micro Delivery Option offers the cable system operator on-line access to subscriber records for both current and historical information. Consolidated financial information also is available to MDO users.

For more information, contact First Data Resources Inc., Cable Division, 7301 Pacific St., Omaha, Neb. 68114-5497, (800) 228-9079 or (402) 399-7000.

Set-top terminal, management system

Scientific-Atlanta Inc. introduced the Series 8500 System Manager IV. The new system includes easy-to-use hardware and performance software designed to allow operators of larger cable systems to take advantage of the benefits of interfacing with computerized billing services. The system's software uses pre-formatted CRT display screens for efficient keyboard entries. The System Manager IV's disk capacity is determined by the cable operator's data base requirements; the 16.5 megabyte disk handles 50,000 set-top terminals, the 28.5 megabyte disk handles 110,000, and the 64 megabytes version handles 300,000.

In addition, S-A introduced the Model 8550 addressable set-top terminal. The terminal and its related control equipment offer user-friendly software, large capacity for premium programming and pay-per-view events, remote diagnostic capabilities, subscriber conveniences, business management interface and extensive security features. Dynamic switched sync suppression enhances the security, with additional features including a refresh timer signal, default frequencies, a legal terminal test and remote enable/disable of remote control units from the headend.

For more details, contact Scientific-Atlanta Inc., 1 Technology Pkwy., Box 105600, Atlanta, Ga. 30348, (404) 441-4000.

Alert system

Cadco's EmergAlert voice override system allows all television programming to be interrupted with a voice message from a local telephone. The unit serves as a safety feature, useful in apartments, hotels and similar complexes. It works with most heterodyne modulators and processors having composite IF loops; 12 coaxial switches supplied for a 12-channel system (expandable to 24 channels); and includes automatic program restoration, speech processing and automatic level control.

One or more carbon microphone telephones may be connected to the EmergAlert control unit located at the headend. When the telephone handset is lifted, a DC current draw is detected at the control unit, activating the EmergAlert. A voice message of up to two minutes may be spoken, then the system automatically resets itself, restoring normal television programming.

For complete details, contact Cadco, 2706 National Circle, Garland, Texas 75041, (214) 271-3651.

Software packages

Magnicom Systems has developed two software packages to enhance its MARC/10 information management system. The pay-per-view package enables cable operators to implement and track delivery of pay-per-view events. A subscriber wishing to order a program places a call to a customer service rep at the cable company. The CSR enters the necessary information into the MARC/10 computer terminal while the subscriber is on the phone. The computer then stores the request and processes it automatically at the time of the event.

With the Report-Writer software package, cable operators can retrieve and organize any of the data available within MARC/10 into a report format of their own design.

For complete details, contact Magnicom Systems, 1177 High Ridge Rd., Stamford, Conn. 06905, (203) 968-0088.

Stereo adapters

General Instrument's Jerrold and TOCOM Divisions introduced MTS stereo compatible products designed to bring stereo TV sound, equal to or better than FM stereo, into the homes of cable television subscribers.

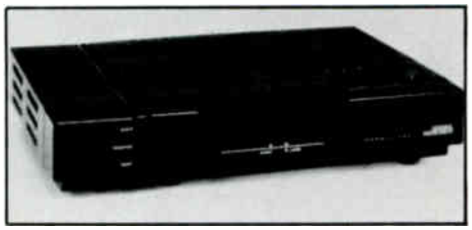
The MTS stereo adapter is an add-on unit designed for compatibility with existing Jerrold RF descrambling converters and plain converters, as well as the plain converters of most other manufacturers. The TOCOM MTS stereo decoder is designed to work with the Model 5503 baseband converter.

Both GI stereo systems (including modified modulator and add-on units) will allow the transmission and reception of multichannel sound on CATV systems employing the BTSC system recently endorsed by the FCC. The stereo add-on unit allows for the reception and demodulation of BTSC encoded stereo sound and the second audio program (SAP) on both scrambled and clear channels. Baseband audio outputs hook up to either stereo compatible TV's or home audio systems. A hand-held remote control unit is featured with the MTS stereo adapter unit.

The TOCOM 5503 provides baseband video and composite audio via a built-in access plug. The optional MTS decoder, attached to this access plug, processes composite audio signals and provides left and right outputs to stereo receivers and speakers. The decoder is controlled by a standard 5503 IR remote control unit.

Shipments of both stereo adapter units and the newly configured handhelds are expected to begin in the third quarter of 1985.

For more information, contact General Instrument Corp., 2200 Byberry Rd., Hatboro, Pa. 19040, (215) 674-4800.



IPPV system, addressable set-tops

At the Western Show, the Jerrold Division of General Instrument introduced Starfone™ for implementing impulse-pay-per-view (IPPV) in today's one-way cable systems.

The Starfone IPPV system is a cost-effective way for a cable system to expand from one-way to two-way addressability, according to the firm. It employs the cable system for downstream communications to the subscriber's home and a telephone return path for upstream communications. It is compatible with all one-way Jerrold addressable systems using Jerrold Starcom® 450 converters.

Equipment required to put the Starfone IPPV system into operation includes a front-end signal processor, data modems and telephone lines. The processor and modems are contained in one rack-mounted piece, which is modularly upgradeable and expandable.

The subscriber portion of the Starfone system is configured as a sidecar add-on unit, compatible with Jerrold addressable converters. It hooks up to standard telephone equipment using a plug-in extension line. The Starfone system is field upgradeable.

A store and forward feature in the subscriber equipment provides local transaction storage for instant authorization of purchased IPPV events. A consumer-selected code prevents unauthorized or unintentional purchases.

Jerrold's present IPPV product offering, Starvue, operates in two-way cable systems. It provides similar capabilities for secure subscriber authorization of pay-per-view events, and also features instant program authorization. Starvue is a flexible, field-upgradeable product compatible with Starcom 450 addressable converters.

Both Starfone and Starvue provide opinion polling and limited shop-at-home capabilities, and have the capacity to store up to 15 transactions. Starvue is already installed and operating successfully in the Boston Cablevision system.

The Jerrold Division of General Instrument also premiered a new series of RF addressable converters at the Western Cable Show. Starcom VI has capabilities such as downloadability, built-in diagnostics, a consumer-controlled approach to parental control, optional customer channel assignment mapping and two-way upgradeability for impulse-pay-per-view. The new RF addressable converter also features infrared enable/disable remote control capability, enhanced signal security, non-volatile memory and full compatibility with existing Jerrold addressable systems.

Starcom VI is scheduled to be available in mid-1985. Its downloadability eliminates the need for PROM-burning and allows all terminal parameters, features and service authorizations to be transmitted from the addressable computer controller. Benefits include centralized control over system functions, signal security and reduction of an operator's inventory requirements.

Subscriber features on the Starcom VI include favorite channel recall, last channel recall and channel-by-channel parental control. Extensive diagnostics include built-in capability for easy on-site checking of the converter using a series of diagnostic codes displayed on the front of the Starcom VI.

The unit is compatible with all Jerrold addressable computer controllers, while additional features are supported by the AH-4 addressable controller.

For more information, contact Marketing Communications Department, Jerrold Division, 2200 Byberry Rd., Hatboro, Pa. 19040, (215) 674-4800.

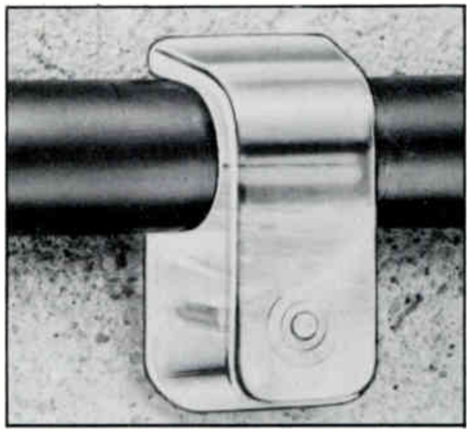
Stereo module

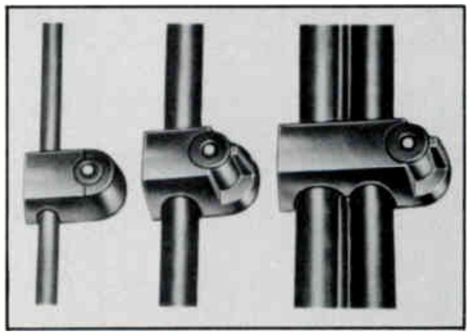
Westinghouse and Sanyo introduce the SM 2001. This stereo module can be integrated into almost any type of converter, however it is most flexible with the Jerrold Starcom 400/450 addressable converter, because it can be controlled by the Jerrold remote controls.

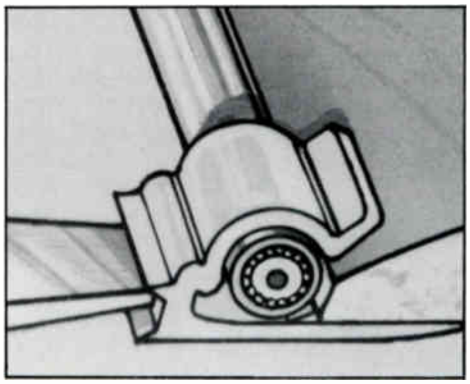
The channel mapping feature of the SM 2001 affords the cable operator greater flexibility in allocating TV and FM channels. Front panel indicators on the unit include "TV" (red), indicating the stereo module has been tuned to a TV channel between 2 and 69; "AUX" (orange), indicating the auxiliary or second audio channel is available and the subscriber can then press the AUX key; "FM" (green), indicating the SM 2001 has been tuned to a FM radio channel; and "STEREO" (yellow) indicating the presence of the stereo pilot in either the TV or FM radio modes.

Other functional features of the unit include outputs providing separate right and left audio from the CATV/FM channel for connection to a conventional stereo or amplifier and speaker system or to amplified speakers, channel 2/3/4 inputs from the converter and set by the cable operator, last channel memory, and FM/TV automatic audio level by means of an automatic gain switch.

For more details, contact Joe Baker, Westinghouse Building, 11 Stanwix St., Pittsburgh, Pa. 15222, (412) 642-3494.







Cable installation clips

ITW Linx™ introduced three clips for attaching cable to a variety of materials. The ½-inch Tapin® clip and the Onetap™ clip both will attach coax to concrete, mortar seams, brick and hardwood without pre-spotting or drilling holes, according to the firm. These two clips enable the user to route cable during installation. Both are available in long pins for brick or stucco. The Onetap comes in three sizes.

The company's dual Snapin™ clip fastens dual coax to baseboards, door jams and window frames. It fits RG-59 or RG-6 dual cables and may be pushed into baseboard by inserting a blade screwdriver into its slotted top.

For further information, contact ITW Linx Installer Products, 195 Algonquin Rd., Des Plaines, Ill. 60016, (312) 296-5469.

Build planning service

Communication Systems Design & Planning Inc. announced "Fast Trac," its latest service. Fast Trac provides communication system executives with facts and figures needed to finance communication system construction programs and to prepare operating budgets.

The client supplies sample maps of the area to be built and upon receipt of the maps, CSDP develops a computer-aided system design program for the model, designs the model, assembles a bill of materials and returns the package (including design software) back to the client.

With this service, many different system parameters can be explored and the most cost effective approach to a new or rebuild system isolated, according to the firm.

For further information, contact Communication Systems Design & Planning Inc., 200 Park Ave., Suite 100, Falls Church, Va. 22046, (703) 237-1313.

Stereo modulator

Wegener's Series 1791 TV broadcast stereo modulator provides the cable operator with a means to generate U.S. broadcast stereo signals for integration into the cable network. The system accepts the stereo audio ouput from a Wegener Series 1600 demodulator or from a local audio source. It installs in the Wegener Model 1601 four-channel mainframe.

Other features include: dbx® noise reduction system; simultaneous TV stereo and FM band stereo simulcast capability; interfaces available for baseband audio, baseband video or IF; and crystal-controlled FM stereo modulator.

For further information, contact Wegener Communications, 150 Technology Park/Atlanta, Norcross, Ga. 30092, (404) 448-7288.

Converter security seal

Telecrafter Products Corp. has introduced the Converter Warden Security Seal. Since tampered and defeated converters amount to 30 percent of all theft of service, the Converter Warden is the positive approach to a leading theft problem, according to the firm. The self destructive seal cannot be removed intact. Attempted seal removal results in seal separation and area reading "VOID VOID," plus particles visible to black light, a positive detection of tampering.

The seals are available in sizes 1 x 1¼ inches for covering screw holes, 1 x 5 inches for sealing top to base and 2 x 5 inches for informational needs.

For complete information, contact Telecrafter Products Corp., P.O. Box 30635, Billings, Mont. 59107, (800) 548-7243 or (406) 245-8200.

Computer system

Data Communications Corp. displayed its new business computer system, for cable operators, at the Western Show. Called BIAS PC Cable, the system fits into the family of BIAS products for the electronic media industry.

The stand-alone IBM PC-XT based system serves sales, traffic, and accounting departments. The basic BIAS PC Cable software includes a sales management system, traffic, billing, and accounts receivable. Designed for a non-computer staff, it is self loading and programs are called up by means of selecting from a menu screen.

The system may be expanded to four workstations with the IBM PC-XT.

For more details, contact Data Communications Corp., 3000 Directors Row, Memphis, Tenn. 38131, (901) 345-3544.

600 MHz system

Complementing its series of 600 MHz taps and subpassives (see *CT*, July and August 1984), Magnavox CATV Systems has designed a new line of amplifiers that operate at 550-600 MHz. Production models are expected to be available April 1985.

The new line of actives, which will include trunk, bridger and line extender amps, incorporate conventional and Power Doubling™ technologies in various configurations to achieve the extended bandwidths.

For more information, contact Magnavox CATV Systems, 100 Fairgrounds Dr., Manlius, N.Y. 13104, (800) 448-5171 or (315) 682-9105.

DTMF modem

Cetec Vega's new I-733 DTMF/RS-232-C modem converts received DTMF messages to ASCII, and converts ASCII messages from a computer's RS-232-C serial port to DTMF. Incoming and outgoing messages are buffered to allow high-speed block data transfer.

The I-733 is adaptable to a variety of applications, including: computer-aided dispatch systems; integrated dispatch and status monitoring systems; message logging to printer, disk, or remote display; remote data entry; and computer-supervised status monitoring and control systems. Demonstration software for using the I-733 with an IBM PC or an Apple IIe is included.

Also available is the I-732 PC-board version in the widely used 4½ x 6½-inch card format with 22-pin edge contacts.

For additional information, contact Cetec Vega, 9900 Baldwin Pl., El Monte, Calif. 92667, (213) 442-0782.

Audio-video modulators

Pico Satellite introduced two modulators series designed for multiple dwelling, private cable systems. The PCM audio-video modulators are crystal controlled for adjacent channel operation and are available in a 35 dBmV output (PCM-35), and a 55 dBmV output series (PCM-55). Both are available on any single VHF (2-13) or mid-band (A-I) channel. Each has separate modulation and level controls for audio and video. Power supplies for each are fused and regulated.

For additional information, contact Pico Satellite Inc., 415 Gator Dr., Lantana, Fla. 33439, (800) 321-6351.

Satellite antennas/demodulator

Microdyne Corp.'s single channel per carrier (SCPC) demodulator offers radio broadcasters access to nearly all SCPC channels available via satellite.

The PCDR (5), which demodulates and processes the 70 MHz IF signal put out by a companion downconverter, can supply reception of state and national networks and special event channels.

The SCPC demodulator's flexibility is provided by the front panel five-section pushbutton switch assembly, which allows the user to select wideband or narrowband, choose de-emphasis from 0 to 75μ seconds in 25μ second increments, and set expander ratios for 2:1 or 3:1.

In addition, Microdyne Corp.'s single channel per carrier (SCPC) demodulator offers radio broadcasters access to nearly all SCPC channels available via satellite.

Microdyne introduced its 1.2- and 1.8-meter antennas for C-band or Ku-band. The 1.2- and 1.8-meter antennas have Ku-band transmit gains of 42 and 46 dB respectively, and receive gains of 41.5 and 45.2 dB. For C-band, the 1.2 and 1.8 meter antennas have transmit gains of 35.2 and 38.5 dB respectively, and receive gains of 31.5 and 35 dB.

These single-piece antennas, providing transmission and reception of SCPC broadcasts, low density data and teleconferencing, are molded from the same material as Microdyne's 5- and 7-meter antennas. Their small size makes them extremely rigid; they can be assembled on site in one man-hour.

For more information, contact Microdyne Corp., P.O. Box 7213, Ocala, Fla. 32676, (904) 687-4633.

F connectors and FM tap-offs: Making the right choice to do the job

The "Tech Tips" column is intended to bring to the forefront many basic technical procedures, concepts and product descriptions of commonly used devices in our industry. Though sometimes basic in nature, it is intended for these explanations to broaden the readers knowledge and further promote their using the right product for the right application. Any comments, additions or technical tips that you might like to share with your fellow engineers/technicians should be sent to "Tech Tips Editor," care of this magazine.

The ½-inch attached ring F connector

The improper selection, use or crimping of the most basic connector can lead to cracking, corrosion, shorting, radiation, excess attenuation and mismatching. The following steps will eliminate many such problems:

1) Know cable types—Many cable systems use a variety of RG-59 and RG-6 cable at the same time. Having the ability to visually know if a cable is an RG-59, RG-6, tri- or quad-shield type will help to avoid using the wrong connector.
2) Choice of proper connector—Many manufacturers make a full range of inside diameter (ID) sizes to fit each cable type. If you select a connector with too small of an ID, it will be hard to push on. If the ID is too large, it is possible that ring cracking and/or a weak bond to cable will occur upon crimping.

   Typical IDs are: RG-59 (.290-inch), RG-59 quad (.312-inch), RG-6 (.324-inch) and RG-6 quad-shield (.342- or .357-inch).

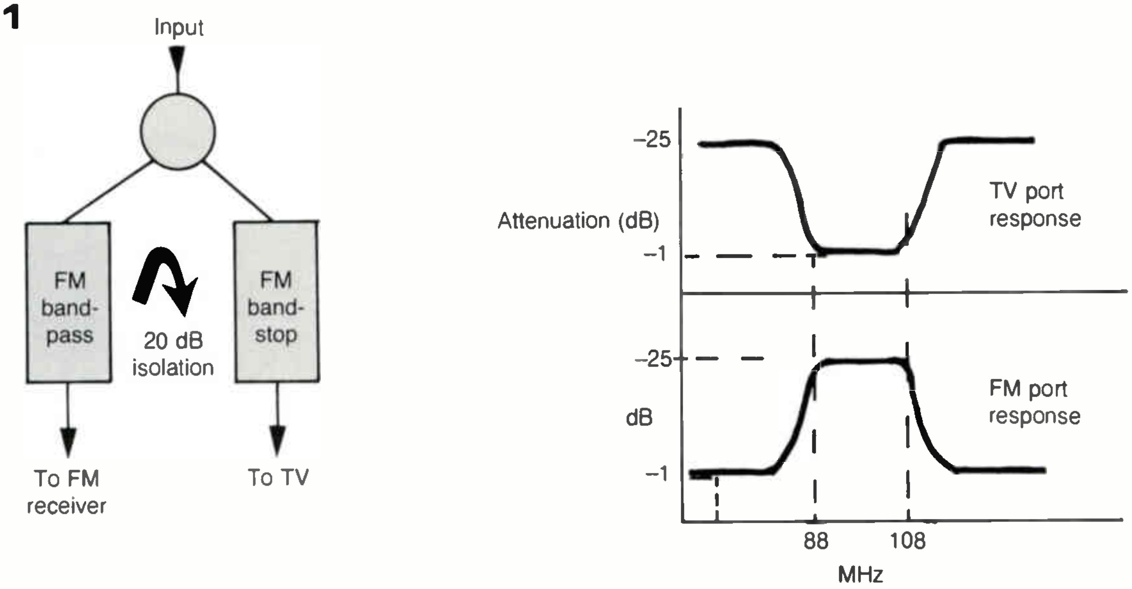
   Note: The outside diameters (OD) of most ½-inch attached ring connectors are the same in order to standardize crimp tool use (.357 ID connector only requires a larger jawed tool).
3) Outdoor use—If you intend to use the connector in a corrosive environment, select one that has a high quality tin electroplate or cadmium chromate finish. Ask your supplier if the connectors have been independently tested in a standard salt spray test. This test is one of the few ways, though subjective in nature, that comparisons can be made in a repeatable test. It consists of placing the connectors in a controlled temperature enclosure and mistifying them with a 5 percent salt water solution for a period of 5-10 days. Even though the results are subjective to the observer, in that how much a plating has corroded or pitted can be debated, it is still a repeatable method of comparing a variety of manufacturer's connectors. The number of days in this salt spray environment does not have an exact correlation to years in the outdoors. It is important, however, to know these tests are available, and that you should ask if they have been performed (by an independent lab) on the connectors you are purchasing.

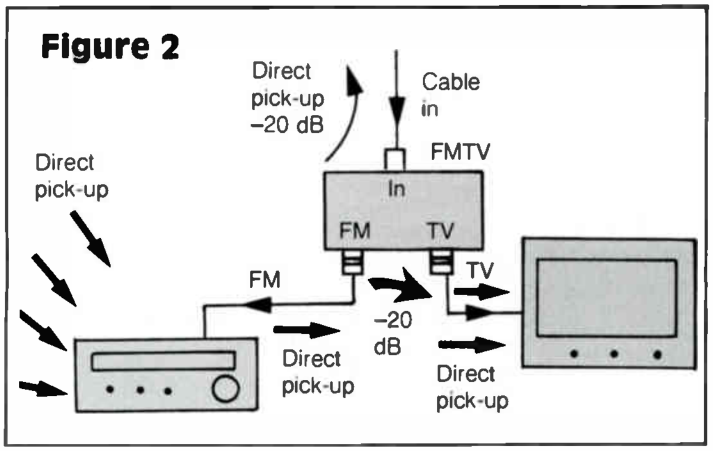
Once you have the right connectors for your cable, be sure to have the proper crimp tool and use the correct jaw size for the crimp. Most ½-inch attached ring connectors (except .357 ID) have a .375-inch OD. This requires a hex tool with a flat-to-flat distance of a .324-inch. If a larger one is used, such as the one for an RG-6 quad (a .357 connector), requiring a .370 dimension, a poor crimp results. A smaller one will possibly pinch the edge of your connector ring causing cracking. It is very important to use the right hex crimp tool and jaw section in that most tools have two hex sizes per jaw.

Cable stripping and preparation

Once the connector and tool for your cable is selected, it is important to know the proper installation and stripping technique. Many cable engineers have preferences such as whether to fold the braiding back

Figure 1





or cut it off. All will agree that cutting through the foil bonded to the foam, leaving the center conductor too short, not scraping residue off center conductor or leaving strands touching the center conductor from sloppy installation is not desirable. Leave the bonded foil attached to the foam dielectric. Do not cut through it while stripping your cable. The contact between the bonded foil and the connector shank is important to maintain RF shielding and ground continuity. Many engineers like to fold back other shields rather than cutting them as an extra precaution to the bonding foil being accidently cut.

Even though many of the newer cables do not leave a bonding residue on the center conductor, there are still some that do. An installer should check to make sure the center conductor is clean after stripping off the foam. If not, it can cause signal attenuation and service calls even though all was okay at the time of installation. Remember most drop cables use only copper clad steel for the center conductor. The copper should not be scraped off in the interest of cleaning the conductor.

The stripping lengths set by each system engineer should be adhered to. These dimensions should be determined noting typical depths of F-61 receptacles for the center conductor and inside lengths of the F connector.

When crimping, the tool should be squeezed all the way to the close or "break-over" position. Many installers sometimes crimp until the tool feels tight. To get the full strength between the connector ring and cable the crimp must be consistent.

As a final step, the F connector should be wrench or security tool tightened to a minimum of 45 degrees beyond hand tight. All quality F connectors are made from brass, which has some give, so you will not damage your connector. This extra tightening will maintain the bond and avoid troublesome ground discontinuities that can occur when cable movement loosens a connector and allows oxidation between male threads and female connector. This also is important to cut through anodizing on diecast taps, splitters and grounding blocks.

Choosing an FMTV tap-off

The choice and application of the FMTV tap-off or splitter has been widely misunderstood causing system problems such as snowy pictures, non-addressing addressable set-top converters and poorly received FM stereo. The key factor in making things work is choosing the right design for the application.

The FMTV splitter or tap originally was intended to allow the FM signal on a cable to be directed toward the FM receiver tap and all other TV signals (except FM) to the TV set or converter. This was accomplished with an FM bandpass filter (usually two-stage) to one port and a band-stop filter (two-stage) to the TV port. Both ports rejected the other's signal by about 25 dB (Figure 1).

There were two reasons to use a complex two-stage filter rather than a simple two-way splitter. The first was to reduce the signal loss to the TV set. Many existing systems did not plan for FM stereo applications

Figure 3

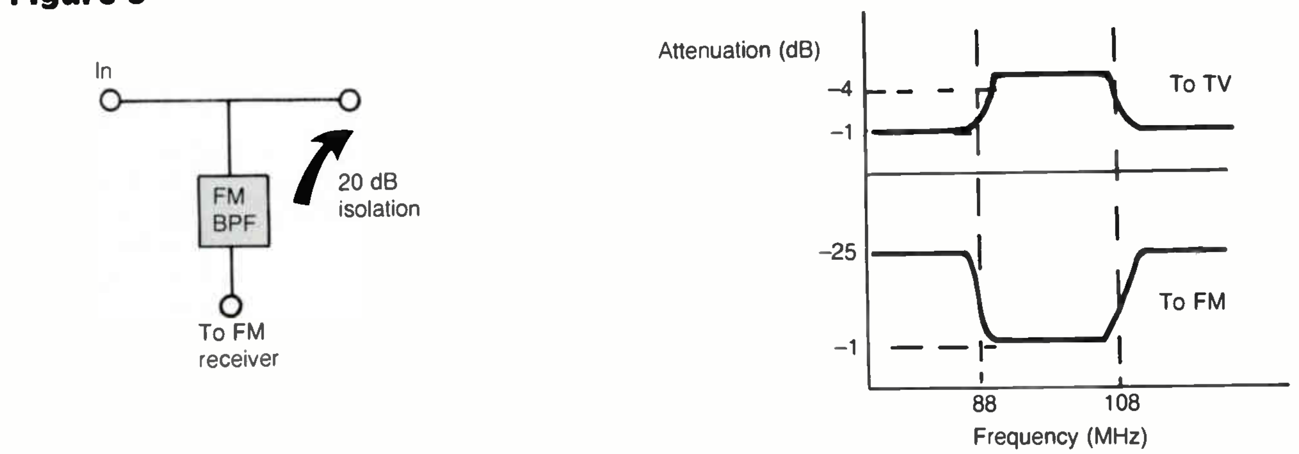
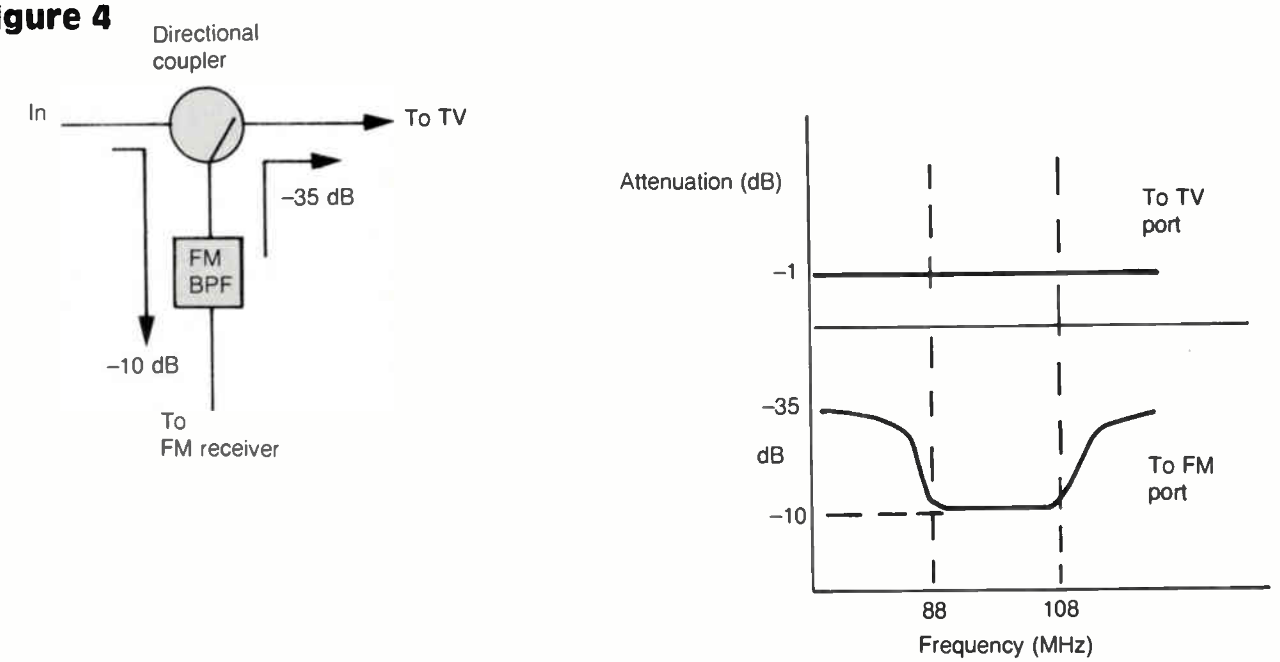


Figure 4



requiring an additional 3.5 dB signal. The solution was to use a frequency splitting scheme resulting in only about .5 to 1 dB signal loss to the TV set.

The second reason to use frequency splitting techniques rather than a splitter was to prevent the direct pick-up of local off-air signals from entering the system through the FM receiver and mixing with the cable signal causing ghosting or interference. The splitter only reduced this signal 3.5 dB to the cable line and 30 dB to the other port, which was not sufficient to prevent problems.

From Figure 2 we can see the attenuation of direct pick-up and the low through-loss of the FMTV device. This type of FMTV tap-off/splitter was suitable and manufactured by many companies. The problem was that addressable systems also required the FM band to pass to the TV port, in that their addressable data was in the FM band. This produced another type consisting of a through-line and one FM bandpass filter to the FM port (Figure 3). This second type of FMTV tap is usable with addressable converters though not usually marked as such.

Another problem evolved creating a third type of FMTV splitter. Type 2 FMTV splitter still had between 3-6 dB signal loss in the FM band to the TV port. This was found not acceptable for some critical set-top addressable converters. In addition, strong direct signal pick-up areas were still having problems with only 20 dB isolation between ports of TV signals. These problems created the directional coupler TV tap-offs (Figure 4).

This device consists of an 8 dB directional coupler with a FM bandpass filter to the tap. It provides a flat 1 dB loss to the set-top converter and 10 dB loss to the FM tap. This is not usually a problem where the FM is normally transmitted at –15 dB below TV picture signals. The combined signal level to the FM stereo is about –25 dB, which is okay for a reasonable quality FM stereo. It also provides about 35 dB isolation for directly picked-up signals in the FM receiver.

A fourth type of FMTV, though expensive, is available with an amplifier to provide unity gain to all ports. This requires AC power at each tap and is not very practical.

From the preceding discussion, it should be apparent that the correct choice of FMTV tap-off, is critical for both direct pick-up isolation and operation of an addressable converter. You should determine your requirements and select the best model for your application. Also, be aware that proper RF shielding of the tap through a secure positive cover seal should be treated as a prime selection factor.

Michael Holland
Vice President
Macom Industries/OEM Enterprises

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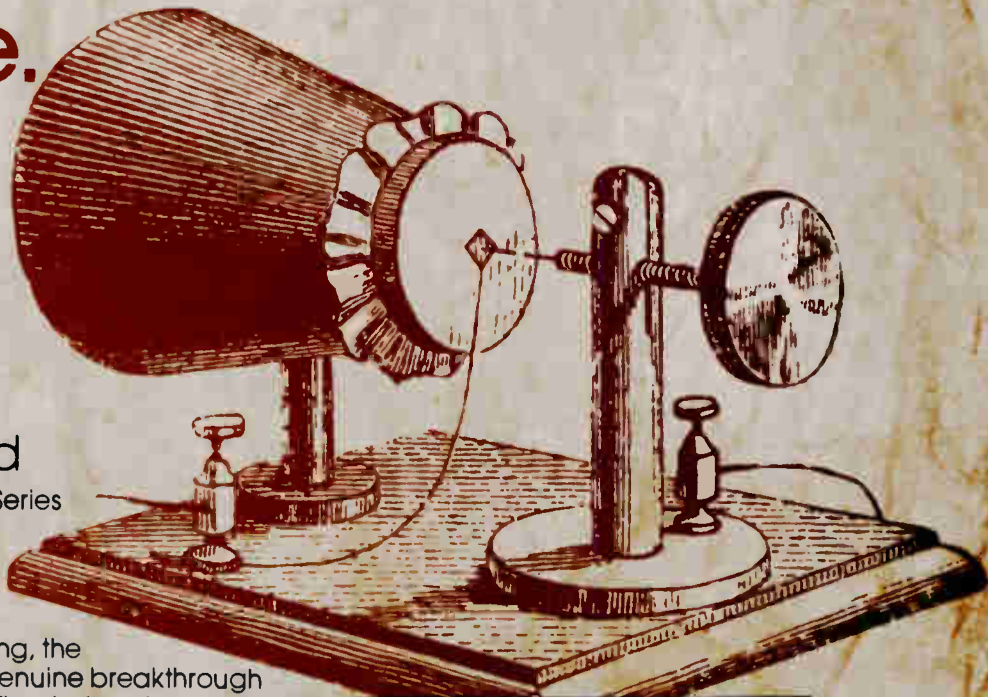

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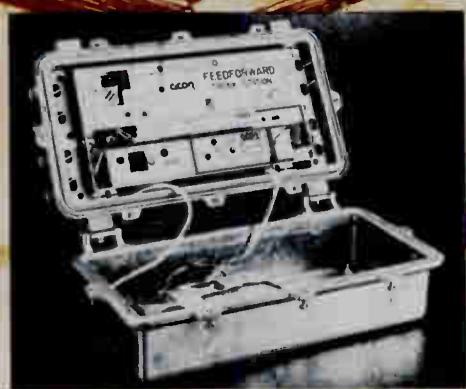

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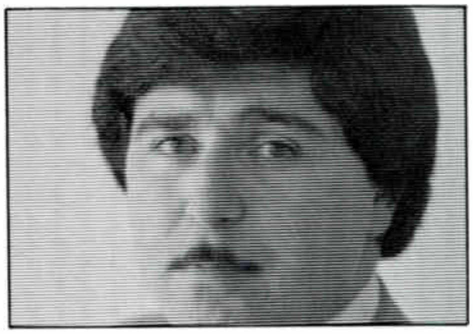

By Anthony J. DeNigris
President, Nationwide CATV Services Inc

It's no secret that the cost of building cable plant can be very expensive. During the period of massive growth in the industry, it was not feasible for most system operators to set up in-house construction departments that could keep pace with the ever-present quotas and deadlines. Now that new growth has slowed and the pressures have eased (?), it would seem a more practical time to replace outside contractors with an in-house staff. In analyzing any situation where it may seem foolish to continue paying a contractor for work that could be easily done in-house, factors other than monetary also must be considered.

The issue of quality

Industry growth has promulgated the emergence of hundreds of contracting companies, all eager to get "a slice of the pie." In earlier days, work could be easily found. All too frequently, a contractor would merely appear at a construction site and be hired on the spot. When the emphasis seemed to be strictly on production numbers, quality of workmanship often suffered. Over the years, many system operators have had to live with the effects of poor construction practices, and this has left a bad taste in their mouths and has resulted in prejudicial feelings against contractors.

Regarding the subject of quality, it would seem that in-house crews (usually paid by the hour) could spend as much time as necessary to ensure that everything is "just right." There would be no reason for such crews to seek shortcuts or take "the easy way out." Of course, someone would have to be in charge of the project, making sure the crews are doing everything they are supposed to do and in the proper manner. Could there be any problems with such a set-up? Yes.

First, responsibility for construction that takes place in-house usually cannot be undertaken by system personnel who are occupied with routine, unrelated duties. Therefore, the need to hire someone experienced in plant construction and project management becomes necessary. Second, since in-house crews are being compensated on an hourly basis, there is little or no incentive to achieve high levels of production. Therefore, the emphasis can be placed on quality of workmanship since time doesn't seem to be a factor. The danger in these situations is that the crews will be too comfortable, "taking it easy" rather than "giving it hell." Third, it is difficult to find competent personnel. It would seem that there is a whole wealth of "experienced" linemen just floating around. However, what is too often the case, is that the truly knowledgeable ones are still working in positions of responsibility for the contractors who have made it worth their while to stay with them. This means that the knowledge needed to deal with a great many situations that may be encountered in the field may be unavailable, and this will invariably result in lost time in production as well as a probable reduction in quality.

Looking at the aspect of quality on contractor performed work: Contractors usually provide a site supervisor, and possibly additional supervisory personnel, to work hand-in-hand with a project manager. Right off the bat, this provides that extra degree of supervision. And, when all are functioning as a unit, it greatly increases the opportunity for monitoring the activities of the crews in the field. With this degree of supervision present, it makes no difference whether crews are paid hourly or on an incentive basis because the level of workmanship (quality and quantity) under the proper supervision that reputable contractors provide, will tend to exceed that of in-house crews.

Cost effectiveness

It would not be unreasonable to think that since a contractor is in business to make a profit, the profit earned by a contractor could just as easily represent a savings to the company if work were to be done in-house. Very often, this type of thinking leads to a situation in which the budget skyrockets. Why? There are several factors to consider.

Initial expenditures can be very high. The acquisition costs of vehicles, equipment (such as cable trailers, lashers, ladders, rollers, etc.) and tools will take several years to amortize. In the case of underground construction, where trenchers, plows, compressors, boring equipment, sod cutters and tamping machines may be needed, costs will be even higher. Also to be considered are the costs of maintenance, insurance and gasoline. You might think that having all this equipment may be unnecessary. However, there will be applications for all of it, and unless you are as well equipped as the contractor you are replacing, the job will not get done as quickly or as well.

As previously mentioned, there are also immediate payroll considerations for crews, foremen and a supervisor. This encompasses not only salary, but also federal and state unemployment insurance, social security, workman's compensation and usually, medical insurance. Do not forget any additional costs in the future, such as vacation pay, increased rates for liability insurance based upon an expanded payroll, and unemployment benefits to be paid in the event of a layoff. Since we are at a time when the pressures for completion of active plant may not be as great, the possibility of layoffs is very real when work slows down or comes to a halt for any of several reasons. Unless the people on the crews are trained to perform work in other areas, both they and the equipment will sit idle. And, unless the crews are highly motivated, they will not perform at the same level of efficiency as crews working for a contractor on an incentive basis. Thus the in-house crew results in higher labor costs overall.

Past the breakeven point

At some time in the future you may become aware of the fact that in-house crews are costing more than you were paying the contractor previously. In addition to the reasons already given, let's look at some possible explanations for why "it was enough money for the contractor, but not enough for us."

A contracting company runs a specialized operation. As experts at the trade, contractors have amassed an immense amount of knowledge and experience in dealing with all types of situations (the unusual and bizarre as well as the ordinary), and that background gets them through situations that constantly seem to impede the efforts of in-house staff. When this happens, the costs can be measured not only in time, but also in money. It takes a long time to build solid, dependable, experienced and trustworthy crews. This fact should not be overlooked when considering whether or not to do work on an in-house basis. The contractor's operation is mobile and his personnel are geared to travel. A busy contractor is able to minimize the effects of shifts in production schedules. He has the ability to shift crews and vehicles in order to keep them busy, and where they are most needed. Sporadic shifts in production schedules are very costly to in-house operations. When people, trucks and equipment sit idle, this does nothing but waste money.

This article is meant to emphasize the fact that there is a valid place for contractors in the industry. System personnel tend to regard contractors as a necessary evil, but that type of thinking usually stems from a lack of control in past situations. A reputable contractor places his reputation and his resources on the line every time a project is undertaken. His stake can be just as great as yours (relatively speaking), and his background and experience, coupled with the wide range of services that he can provide is a valuable asset to the astute system operator who understands and appreciates the nature of the relationship.

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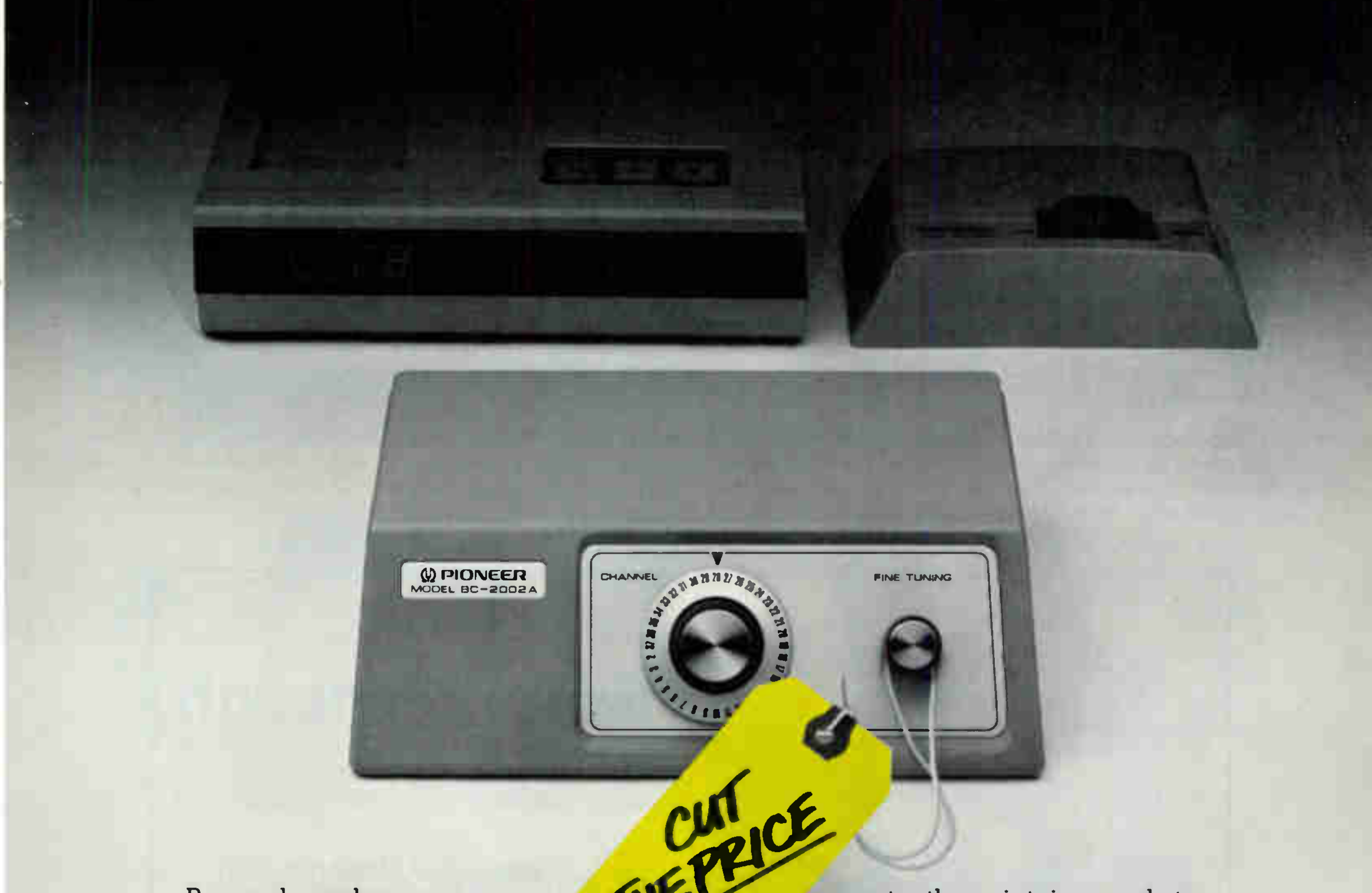

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CALENDAR

January

Jan. 9: SCTE North Jersey Meeting Group, Holiday Inn, Wayne, N.J. Contact Don Daniels, (201) 997-6600.

Jan. 15-17: Security Equipment Industry Association and **National Burglar & Fire Alarm Association** international security conference and exposition, Sheraton Twin Towers, Orlando, Fla. Contact (312) 299-9311.

Jan. 16: SCTE Rocky Mountain Meeting Group hands-on workshop on test equipment, ATC Training Center, Denver. Contact Bruce Catter, (303) 740-9700.

Jan. 21: SCTE Golden Gate Chapter meeting on "Multi-Channel Television Sound," Concord Sheraton, Concord, Calif. Contact Dave Large, (408) 998-7333.

Jan. 22-23: Society of Cable Television Engineers technical seminar on "Multichannel Television Sound," Concord, Calif. Contact Pete Petrovich, (415) 828-8510; or Dave Large, (408) 998-7333.

Jan. 22-24: C-COR Electronics technical seminar, Los Angeles. Contact Deb Cree, (814) 238-2461 or (800) 233-2267.

Jan. 23: SCTE Florida gathering to form a local chapter, North Holiday Inn, Fort Lauderdale, Fla. Contact Cliff Paul, (305) 878-2176.

Jan. 30-Feb. 1: Texas Cable TV Association annual convention, the Texas Show, San Antonio Convention Center. Contact Bill Arnold, (512) 474-2082.

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.

Feb. 5-6: Arizona Cable Television Association annual convention, Hilton Hotel, Phoenix. Contact ACTA, (602) 257-9338.

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.

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 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.

Planning ahead

Jan. 30-Feb. 1: Texas Cable TV Association annual convention, the Texas Show, San Antonio Convention Center.

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, 'CABLE-XPO,' 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.

AD INDEX

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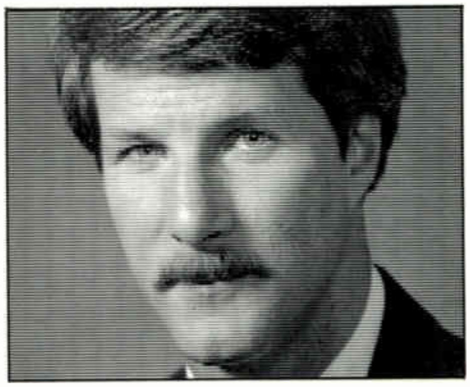
A New Year's resolution—establishing goals



By Bob Luff
Vice President Engineering United Artists Cablesystems Corp

Why do so many of us from installer to vice president of engineering, morning after morning go to work and accelerate to cruising speed at our job without a clear idea of where we really want to go?

If you do not establish a set of goals for where you want to be at the end of the day, week, month, quarter, and the year, how do you measure your progress? How do you expect others to be able to follow or assist you? How do you know your destination is even worth your team's cumulative effort?

Why is goal setting so important? Because it works. It has always been one of the most basic and effective techniques to achieve a desired objective. The odds for successful obtainment of your objectives are increasingly improved with the employment of goal setting techniques. Likewise, the benefits of effective goal setting and its related activities go far beyond the achievement of the desired objective.

Why establish goals

The secondary benefits of goal setting include improved overall effectiveness, improved quality of work, improved deadlines, improved job satisfaction, and willingness to accept new challenges. Most of these secondary benefits are realized from three simple, but important human nature effects that result from having specific goals.

First is that work effectiveness increases because everyone responds better to direct objectives than the vague and invisible *do your best* type default guidelines. This principle can be illustrated by an example. Stand in a room and walk to the opposite wall. Now, turn out a light and do it again. When you cannot see the goal, the steps are shorter, slower, and usually stop well short of the mark. We cannot repeat even such a simple task as effectively *in the dark*. Accordingly, work effectiveness will be significantly increased if clear goals are always in place.

Second, specific goals produce clear expectations of what is required as well as the exact reward upon attainment. Of course, this unleashes the benefits of an incentive program. Assuming that the subject objective is desirable, the lure of attainment may be incentive enough. However, related incentives (praise or bonuses) all are working to the benefit of timely completion of a goal.

The third reason goal setting can be used to improve work effectiveness is based on an interesting relationship involving the difficulty of the goal and the resulting human performance. A hard goal leads to greater performance than a moderate goal because people work harder knowing that their challenge is difficult but realistic.

How to set goals

Effective goal setting for typical interrelated and complex real life objectives is not self-evident. The four key components to every professional goal are:

1) Specify the general objective
2) Specify how performance will be measured
3) Specify target performance
4) Specify the time frame

A goal must designate what you want to accomplish. Is it to clean-up the warehouse, make an inventory of warehouse items? Or both? Misunderstandings are the main reasons for work ineffectiveness.

Specify how the goal achievement will be measured. In a construction related goal, will the goal achievement be measured in time, dollars spent, workmanship, or some combination of all three. It is easy to see how different the outcome might be from what was expected if there is confusion on an overlooked element.

Specify the target to be reached. A target of ten percent increase in sales means ten percent from the present level, or ten percent over last year's? If the target is not clear, how can it be assured that the goal will be obtained.

Lastly, a written goal must contain the time span involved. Easily attainable goals are too often wastefully stretched over a whole quarter. Or worse, a difficult goal may be unrealistically set for completion before the budget year when its funding is withdrawn.

Successful goal attainment

Here is a written goal with its four components identified for clarity. The FCC has visited your system and found excessive signal leakage. The system was quickly brought into compliance. Now you are in charge of monitoring overall leakage performance to ensure that your system does not get over its head in leakage again. You see this as a task demanding your best performance. An effectively written goal would be:

(1) To monitor the system's signal leakage performance to ensure conformance with the FCC rules (2) by adopting the Commission's CLI calculation method of overall signal leakage accountability and (3) ensuring that the system personnel lower and maintain overall performance to a CLI = 64 or less (4) within three months.

A big problem with goal attainment is that life does not allow you to concentrate on one goal at a time. In fact, there will usually be too many goals to realistically complete. The professional goal seeker however, makes a list of all goals, then establishes priorities. A priority list ensures effort is not wasted. Likewise it allows sharing of the situation with others. Also, determine the coordination required with other people or projects that can influence the rate of completion. Another helpful consideration is developing a commitment from others to the successful completion of your goals. Ensure that your priorities are in phase with those of your work group.

A strong reliable feedback path to guage progress is essential for effective goal attainment. Without feedback you are likely to wastefully under or over shoot progress requirements. There are two basic types of feedback: cueing and summary. Both are valuable, but depending on the task, one may be more suitable. A cable installer would benefit more from cueing feedback from his pre-assigned work orders or dispatcher to determine if he was ahead or behind his expected daily schedule.

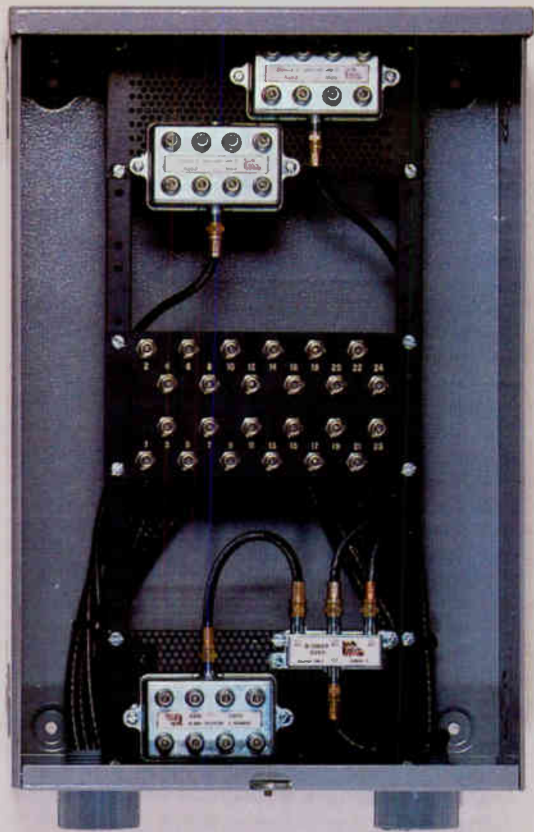
Action plan

An action plan is the last ingredient to put the goal setting techique into motion. Action plans afford an opportunity to run through the steps to catch flaws before resources have been committed; and they serve as sound basis for time and cost estimates; they quantify the people, equipment, facilities, and their coordination in achieving the goal; they allow for the feedback paths to be devised and they present an opportunity to explore delegation authority.

Goal setting—the best means to achieve increased performance and major objective attainment. By understanding why goal setting works, how to set goals, and employing additional goal attainment techniques, you will be able to create your 1985 Go*al Action Plan* in an hour or two. Remember, those that get things done get ahead.

Happy New Year, and I hope you achieve all your goals in 1985.

Messed Up. Dressed Up.



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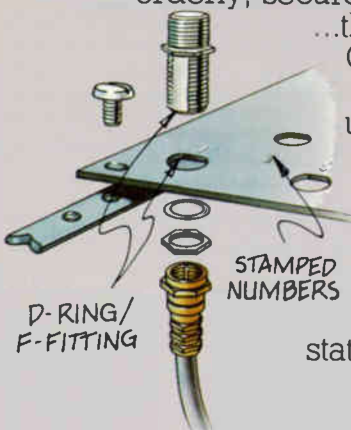

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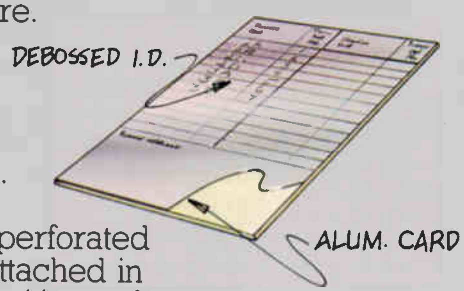

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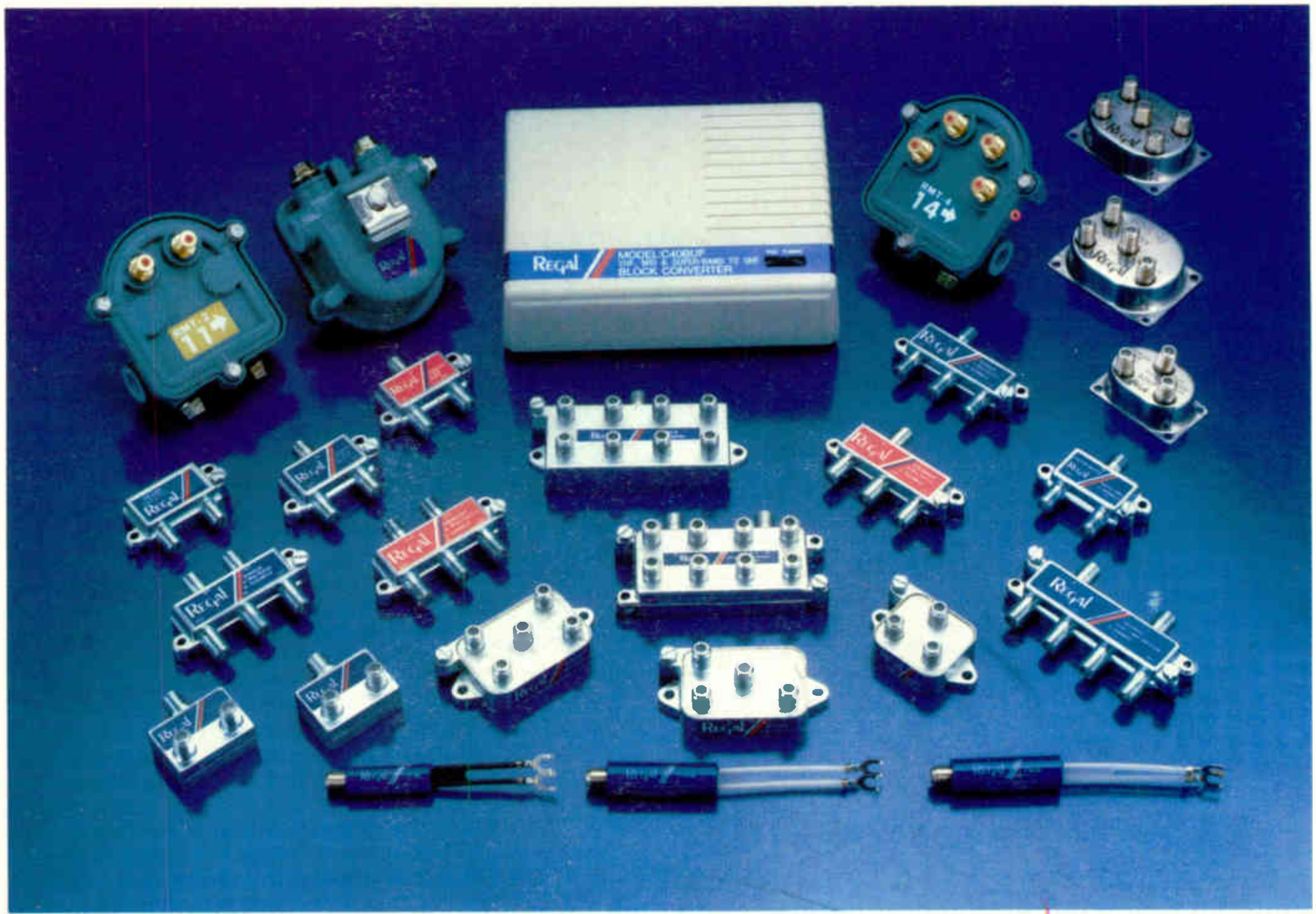

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