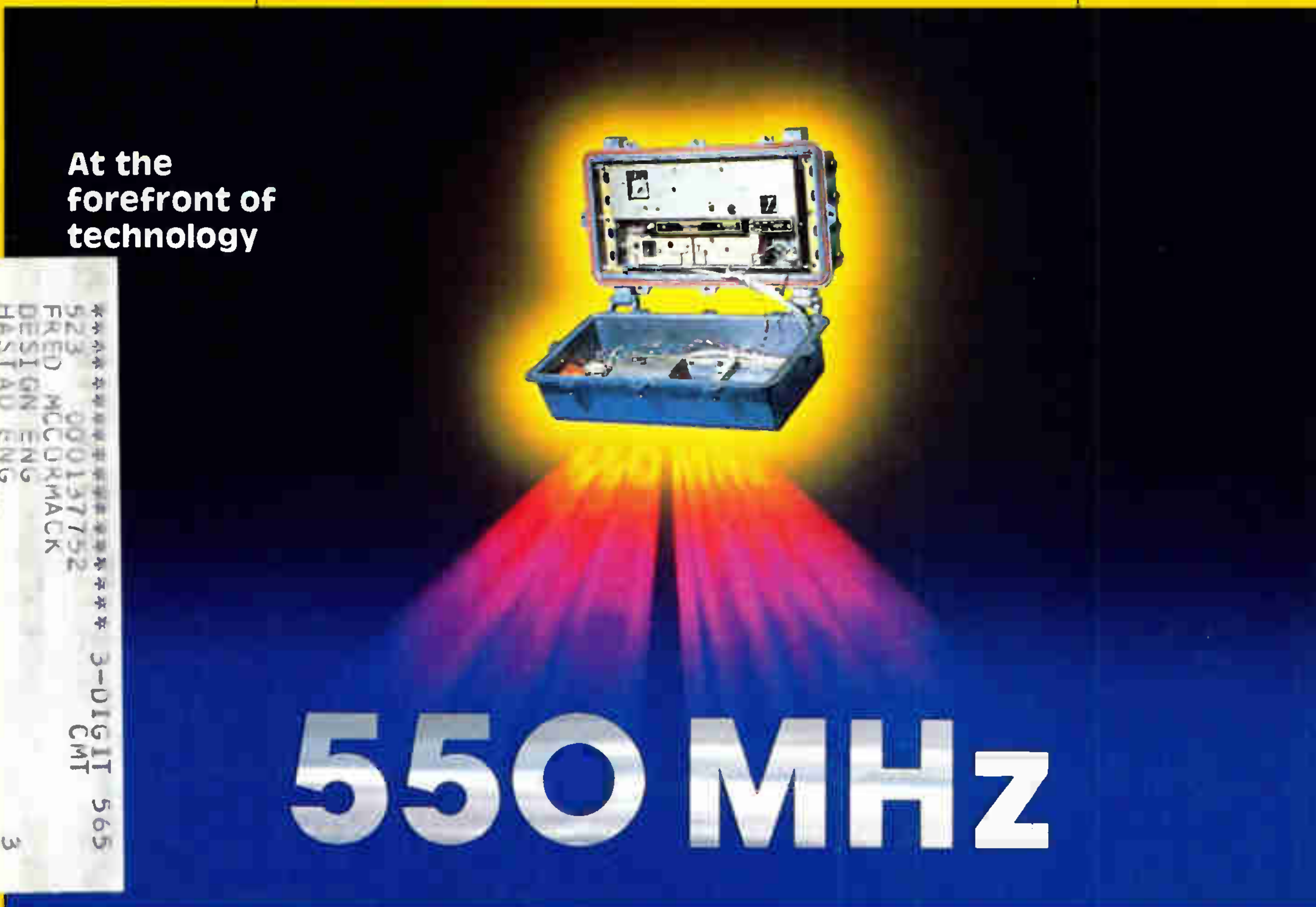
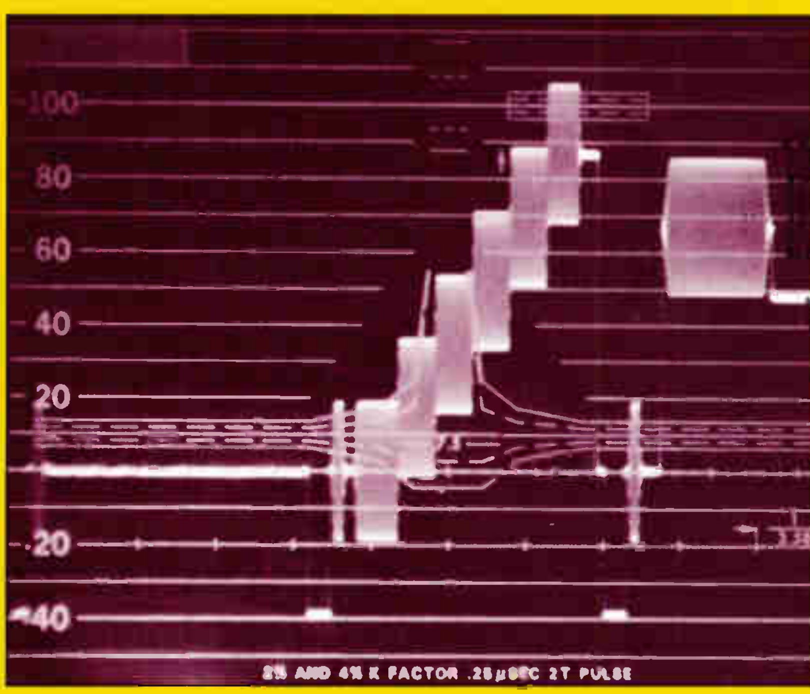
COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers





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February 1987

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Reader Service Number 2

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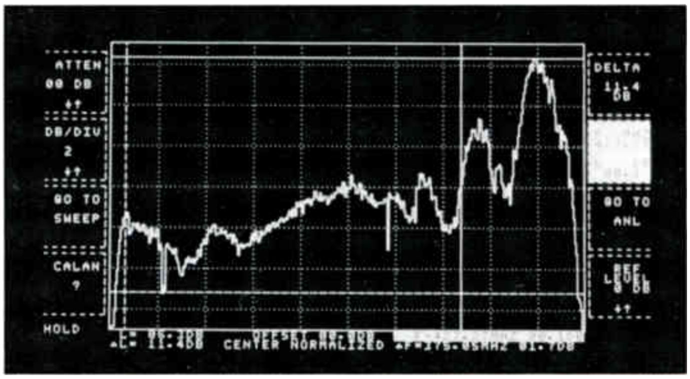
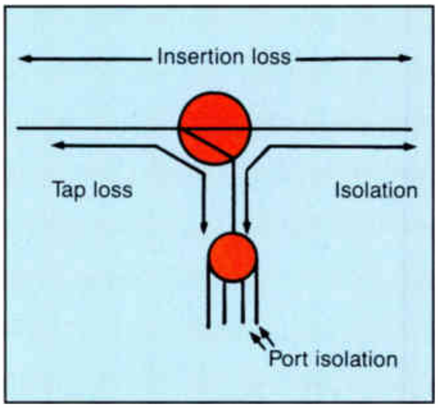
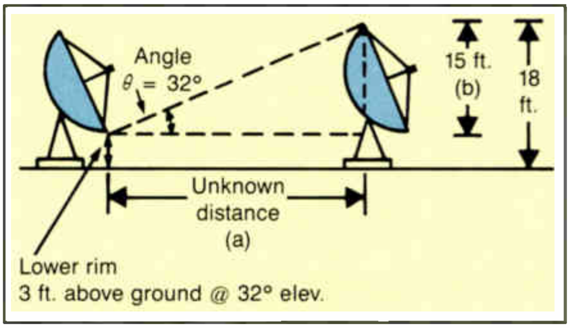






Features

 Communications Technology™ (ISSN 0884-2272) is published monthly by Communications Technology Publications Corp., 12200 E. Briarwood Ave., Suite 250, Englewood, Colo. 80112 — or — P.O. Box 3208, Englewood, Colo. 80155, (303) 792-0023. February 1987, Volume 3, Number 12. Office of publication is 12200 E. Briarwood Ave., Suite 250, Englewood, Colo. 80112. Change of address notices should be sent promptly; provide old (or copied) mailing label as well as new address, including ZIP code; allow 6 to 8 weeks for change. Second-class postage paid at Englewood and Denver, Colo. POSTMASTER: Please send address changes to Communications Technology, Box 3208, Englewood, Colo. 80155.

The self-limiting mentality

I've just returned from a very snowy engineering and technical management development seminar sponsored by the national SCTE and its Chattahoochee Chapter in Atlanta, Ga. This two-day seminar was by far one of the best educational and well-structured sessions I've ever had the pleasure to attend. Many kudos to Chattahoochee Chapter President Mike Aloisi, his staff, and Bill Riker, executive vice president of the SCTE, for a job well done.

This seminar, nationally promoted for the last few months, was billed as a way to expand one's knowledge to build management and supervisory skills necessary for effective performance. Registered attendance was a whopping 60 (actually, about 55 engineers and technicians showed up). The Atlanta area boasts hundreds of engineers and technicians. The fact that attendance was low may have been due to lack of interest by the engineers and technicians or, more probably, that their managers wouldn't allow them to attend the seminar. In either case, these excuses are appalling.

I'm mad as hell...

I'm sure most of us remember the movie *Network*. Peter Finch, unhappy with a particular situation, enticed his viewing audience who agreed with him to shout, "I'm mad as hell and I'm not going to take it anymore." Of course, I'm not suggesting that the engineers and technicians who want to attend these seminars, but aren't permitted to do so by their managers, be quite as tactless as Peter Finch was. But you get the general idea. I find it particularly difficult to believe that our engineers don't want to better themselves and are content to stay at the level they're at for the rest of their careers.

As far as I can tell, there are probably two major reasons that these seminars are not well attended. Are managers afraid their technical people will be stolen by another company? Or, more honestly, are managers afraid their people will end up knowing as much as they do and, hence, feel their jobs may be in jeopardy? This is what I call "the self limiting mentality."

What these paranoid managers don't realize is that if their people cannot grow and expand, it will be the managers—because they are so valuable in their particular niche—who never get promoted. These managers can't move ahead in the company since they have not passed on their expertise. They now find themselves in a self-made hole because they've made their jobs indispensable, and so others (perhaps not as qualified) get the promotions the managers would like to have.

The sessions

The first session, "The History of Technology," was presented by Professor Melvin Kransburg of Georgia Tech. The professor is quite a character. He explained that information by itself won't feed, clothe and shelter us. It is a means to help us but it's not an end in itself. The human element is very important despite high technology. "There is something in human contact," said Kransburg, "that makes that aspect very important."

Merrill Hanlon of Scripps Howard spoke on "Labor Relations." He detailed the basic skills managers need: communication, problem analysis/problem solving, delegating/assigning work, providing direction and decision making. Hanlon also provided some excellent advice: "It's good management to pay your people competitively and promote from within. Titles," he stressed, "are a damned poor substitute for money."

Dave Watkins of Telescripps gave a workshop on "Budgets." He provided insight on ways to budget for new construction and rebuilds.

A workshop on "Insurance and Loss Control" was given by Marty Mason and Kathy Dupree of Metrovision. This session provided insight into how to work with various claims and keep the money that wasn't budgeted.

The "Compliance" workshop was ably co-handled by Paul Mass, attorney for Long, Alderidge and Norman, and Cliff Paul, a consultant to RTK. Mass reviewed regulatory policies and Paul discussed the technical aspects of CLI and what the FCC will look for in a cable system.

On the second day, Chandler Brown of Broadwell Training Institute discussed "Assessing Your Management Skills." According to Chandler, "The work will expand to fit your time schedule." He also divulged an essential formula: P + I = C (participation plus involvement equals commitment).

Leona Tenebruso of Showtime/The Movie Channel presented a workshop on the art of "Negotiating." She emphasized, "Successful negotiating is a state of mind."

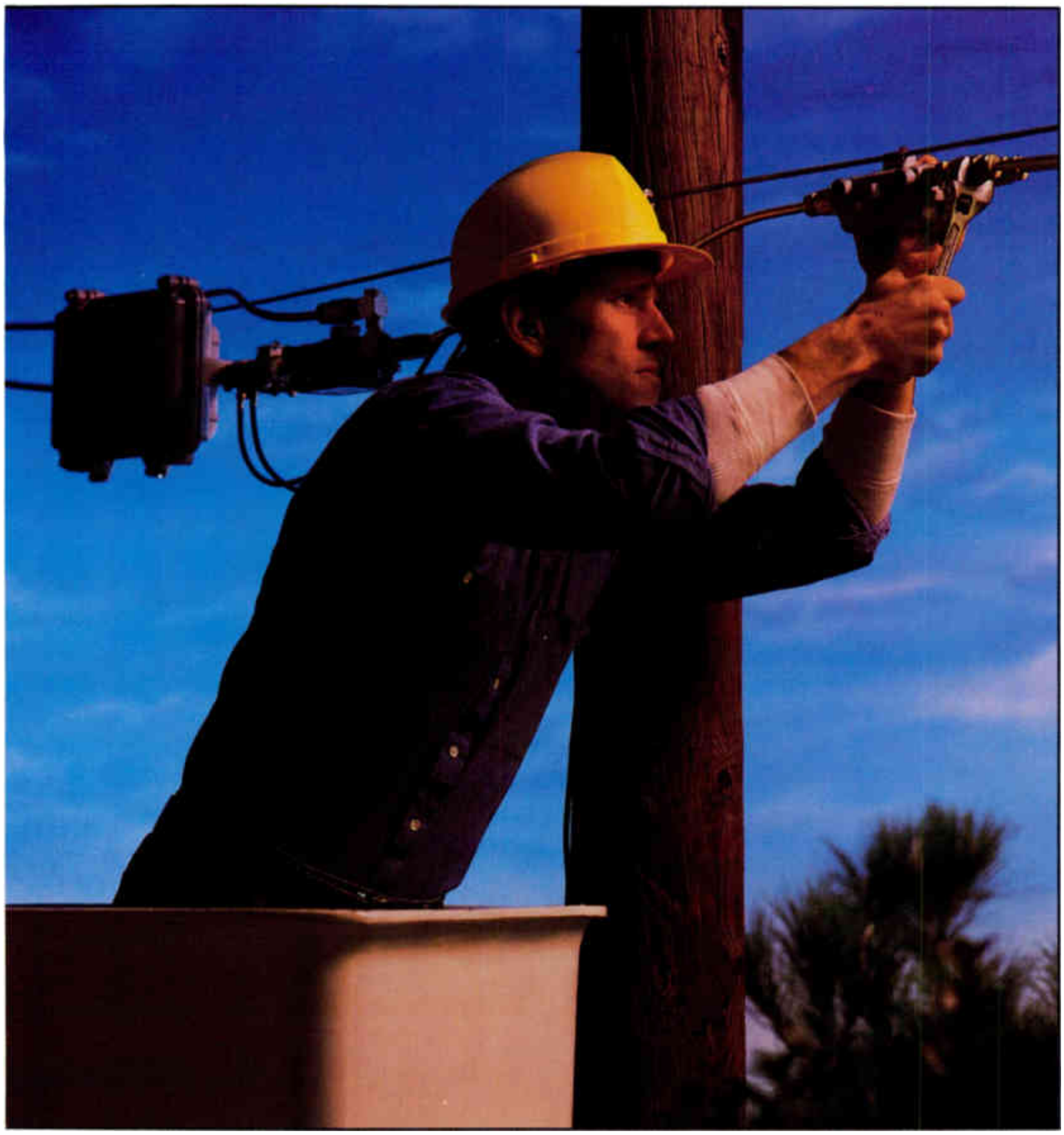
Rounding out the sessions was Bill Riker, who stood in for NCTA's Wendell Bailey. Riker described the BCT/E Certification Program and discussed in detail what the committee looks for in the Professionalism and Ethics exam.

Robert Luff of Jones Intercable and president of the SCTE was the guest speaker for the luncheon. He discussed various SCTE activities and stated, "Probably the most exciting news is that we cut the ribbon on the first national SCTE building that we own." Thanks are also in order for Prime Cable, which videotaped the sessions. Their representatives were presented with a plaque at the luncheon. On the evening of the first day, a cocktail party was given by the chapter. The afternoon of the second day was dedicated to taking the BCT/E examinations.

Some words of advice to engineers—get mad as hell and gently persuade your managers to allow you to attend these sessions. *You'll* not only benefit but your career will, your company will and the industry as well.

Toni I. Barnett

How to Avoid Splitting Headaches.



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Texas Show to host technical panels

SAN ANTONIO, Texas—At the Texas Show, Feb. 18-20, the Society of Cable Television Engineers will coordinate four technical panels, to be held Thursday, Feb. 19. The technical agenda for the show, which is sponsored by the Texas Cable Television Association (TCTA), is as follows:

Wednesday, Feb. 18
10 a.m.-2 p.m.—BCT/E Certification exams
2-7 p.m.—Exhibit hall open
4 p.m.—Annual membership meeting
7 p.m.—Texas-style barbecue, dance and entertainment courtesy of Home Box Office.

Thursday, Feb. 19
7:30-8:45 a.m.—Continental buffet
8:45-10:15 a.m.—Community Antenna Television Association (CATA) Open Forum, with Preston Padden, president of the Association of Independent Television Stations, and Steve Effros of CATA.
9 a.m.-Noon—Exhibit hall open
10:30-11:45 a.m.—SCTE technical panel: "Future TV sets," moderated by Bill Riker of the SCTE. What is expected in the next few years and how it will influence local cable operation.
Noon—Luncheon speaker: John Henry Faulk
1:45-3 p.m.—SCTE technical panels (concurrent): "Rebuild vs. retrofit," moderated by Tom Polis of Communications Construction Group Inc.; and "Addressability," moderated by Dan Pike of Prime Cable.
2-7 p.m.—Exhibits open
3:15-4:30 p.m.—"FCC update on technical issues," moderated by Cliff Paul, consultant. Discussion of matters before the FCC, their likely resolutions and consequences to the cable industry.
7 p.m.—Banquet and John Mankin Award presentation. Entertainment by The Four Tops, courtesy Showtime/The Movie Channel.

Friday, Feb. 20
9 a.m.-1 p.m.—Exhibits open

For information, contact Bill Arnold, TCTA executive secretary, (512) 474-2082.

TCI purchases stock for control of UACI

DENVER—Tele-Communications Inc. announced that a wholly owned subsidiary of TCI has completed the purchase of a controlling interest in United Artists Communications Inc. (UACI). TCI acquired about 55 percent of outstanding stock for approximately $150 million in cash and $268 million in convertible notes (about 15 million shares of TCI Class A common stock).

As a result of the agreement, UACI announced changes in its management and board of directors, including the resignations of its co-CEOs Marshall and Robert Naify. Stewart Blair, formerly senior vice president of TCI, was appointed as a director and president and CEO of UACI. Dr. John Malone, currently president of TCI, was elected a director and chairman of the board of UACI.

Product distributor faces piracy charges

SAN DIEGO—Cable Home Communication Corp., a subsidiary of General Instrument Corp., filed a civil suit in U.S. District Court in Phoenix, Ariz., Jan. 7 against two companies that have allegedly infringed upon copyrights held by its VideoCipher Division. The suit seeks to prevent the defendants from manufacturing and selling products that permit unauthorized reception of encrypted satellite signals, to recover profits from the business and to award monetary damages arising from the copyright violation.

According to J. Lawrence Dunham, executive vice president and general manager of the

VideoCipher Division, "This civil suit is the first action that has been filed aimed at stopping satellite TV pirates. This legal action is only one part of a concentrated effort to end piracy in satellite television."

Dunham also stated that the company will implement "multiple levels of security" within the VideoCipher II system to render pirate descramblers useless.

C-COR shareholders approve stock buy

STATE COLLEGE, Pa.—At a special meeting of C-COR shareholders, a proposal was approved to purchase nearly 1 million shares of the company's common stock at $7.50 per share. The stock had been owned by Pennsylvania State University, former C-COR Chairman James Palmer and relatives and friends of Palmer.

The closing of the stock purchase was held immediately after the meeting; the resignations of three directors and Palmer were accepted at that time. Also, the Palmer Group signed agreements that for three years thereafter it would not purchase C-COR stock, seek representation on the board of directors or seek to gain control of the company.

SCTE plans events for Cable-Tec Expo

EXTON, Pa.—The Society of Cable Television Engineers has several special events planned for the 1987 Annual Engineering Conference and Cable-Tec Expo, to be held April 2-5 at the Hyatt Hotel in Orlando, Fla. Scheduled to speak at the April 2 engineering conference is astronaut and shuttle Cmdr. Paul Weitz. He is expected to present slides of space missions and address the relationship between NASA and the cable TV industry.

On Friday, April 3, the Expo Evening will be hosted by Medieval Times, where attendees will be the audience for 11th century-style festivities, including a joust between medieval knights. For more details, see page 2 of this month's *Interval*.

A special "behind the scenes" technical tour of Walt Disney World will be held twice on April 5. This 3½-hour program, optional at extra charge, includes a film presentation and a field trip to the Magic Kingdom production center and Vista United Telecommunications.

For registration or more information on the expo, circle #1 on the reader service card or call (215) 363-6888.

- Broadband Networks Inc. of State College, Pa., announced the signing of a stock purchase agreement to provide $225,000 of equity capital. Funds for the transaction were provided by Zero Stage Capital of Pennsylvania and private investors. Broadband Networks plans to enter the local area network market with its series of split-band tap units.
- CableData has opened its eighth regional office. The new Chicago office will cover seven Midwestern states previously served by the company's office in Indianapolis. Once the transition is completed this month, the new office will serve approximately 120 cable systems and 2.3 million subscribers. Also, CableData recently signed agreements to provide billing and information services to Prime Cable's Las Vegas, Nev., system; all of Falcon Communications' Southern California systems; and Coaxial Communications' Columbus, Ohio, data center.
- ABC Cable Products has signed Capscan Cable Co. as sales agent for Models ABC-1010/J450 and ABC-1000/J400 wireless remote control units, which are compatible with Jerrold converter equipment. Capscan also will be a stocking distributor for Model ABC-1010/J450.
- Pioneer Communications of America has merged with the Laser Disc Industrial Division of Pioneer Electronics (USA) Inc. of Long Beach, Calif., effective Jan. 1. The merged company is targeted to become the business-to-business, industrial electronics arm of Pioneer Electronic Corp. in the United States, and will be headquartered in Upper Saddle River, N.J.
- Buckeye Cablevision Inc. has selected baseband addressable equipment from the TOCOM Division of General Instrument Corp. for its Toledo, Ohio, cable system. The value of the order is estimated at approximately $10 million. The Buckeye system passes nearly 170,000 homes and has three hub sites connected via fiber optics and microwave.
- Magnavox will supply approximately 100 miles of 550 MHz products for Colonial Cablevision's rebuild in Revere, Mass., including feedforward trunk amplifiers, power doubling bridgers and line extenders, and 8000 Series taps. The company will provide design service on the rebuild. Magnavox also announced the winners of its Tower of Taps contest at the 1986 Western Show: Milt Nolan of Pacific Bell, Joe Majczak of New Channels and Denise Serres of Rocky Mountain Communications. Each received a Magnavox compact disc player.
- Insight Communications Co. of New York will acquire all cable systems owned by Acton CATV Inc. that are located in Utah. The systems serve over 15,000 subscribers in suburban Salt Lake City, Brigham City, Orem, Delta, Vernal and Cedar City.
- Trilogy Communications Inc. announced a major capacity expansion. The purchase of additional manufacturing equipment was necessitated by an increase in demand for MC² coaxial cable produced by Trilogy. Completion of the expansion is expected by March 1.
- Scientific-Atlanta Inc. (S-A) recently received an order from Barden Cablevision for approximately $300,000 of headend products and electronics for its 550 MHz single-cable system in Detroit. Also, S-A signed an agreement with Pacific Bell to provide coaxial cable and headend and distribution products for its cable TV distribution services to a cable franchisee in Palo Alto, Calif. Finally, S-A received an order valued at over $325,000 from American Cablevision of Queens for headend and earth station products.

A tragedy in three acts: Murder in the boardroom

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

ACT I—55th floor penthouse on Park Avenue, heart of the Octopus Corp. Ltd., whose motto is "Growth first and foremost." The remnants of a Sybaritian feast are still visible as the board meeting commences.

CEO and Chairman of the Board Wilson Roosevelt Sherman—tall, lean, indisputably handsome and aristocratic—rises to the occasion: "Gentlemen, today marks another giant step for Octopus Corp. Ltd. The merger is final with Atlanta Radio and Phonograph Co. As is our usual practice, we have analyzed in detail all of the operating entities within Atlanta and are proceeding expeditiously to integrate them into Octopus where appropriate. However, some divisions are of questionable value and will be sold or dropped. The documents assembled on this table present all the pertinent facts for your scrutiny and we will vote on each as outlined in the schedule of events for this meeting.

"Due to some unforeseen adverse publicity in the press we have been unfairly condemned on our proposal to drop the Atlanta Electronics Laboratory in Atlanta, Ga. Therefore, we will advance this agenda item to the first slot. Bottom line: Elimination of the laboratory with its $10 million yearly budget and the sale of 10 acres of very very prime real estate will add $30 million to next year's profit—and at a 20 times price earnings market valuation—$600 million for the next acquisition! The meeting is now open for discussion on this item."

John Jay XIV—chief counsel, board member, portly, white haired and immaculate: "Octopus Corp. Ltd. has complete legal powers to cease the operation at Atlanta Labs and sell the property. Rest assured that you are not personally or morally threatened by lawsuits over this matter since you are fully covered by our D&O insurance."

Richard Learned—Ph.D. in astrology, president of Gotham Technical University, bearded and distinguished in his presidential robes (he does presume that look no matter what the occasion!): "Atlanta Laboratory has managed on occasion to approach the quality of university research and we will heave a sigh of regret at its demise, but if the board will fund an Atlanta Chair, we shall carry on its proud tradition in electronics."

F. Scott Marshall—chairman of Banks Unlimited: "The growth and excellent earnings of Octopus speak well of its management. I vote yea."

Retired Vice Adm. Horatio Jones—still retains a weather-beaten, rugged, seadog air: "I signed aboard as director of Octopus after a thorough look at its business practices and morality and I have never regretted my decision. We should stand behind our officers no matter what our critics may charge."

Ms. Laura Lee—vice president of Heavenly Cosmetics Corp. (yes, she is attractive): "There is not a single female professional on the staff of Atlanta Labs. Since they obviously have violated the principles of EEO, I am happy to see their demise."

Reverend Jack Jones: "My profession requires me to preside at the funerals of my flock and I suffer at the loss of a loved one along with the bereaved. Death, even of a corporation, is a matter of great sorrow and I must abstain in this matter."

Chairman Sherman: "Members of the board, I thank you for your vote confirming management's decision to close Atlanta Laboratories. We pass on to the next item."

ACT II—The next day at Octopus' public relations office.

Bruce Barton, front man for Octopus. Impeccable background, former White House aide, former congressman, lawyer, war veteran, etc.

Ben Cohen, scholar, copywriter, playwriter, occasional lecturer.

Barton: "Here we go again. Sherman is marching through Georgia and he wants us to paint him as a southern savior supporting the confederation."

Cohen: "What, another merger?"

Barton: "Yes, but worse than the 20 percent reduction in staff and orphaning several towns, is the closing of the Atlanta Laboratories."

Cohen: "I have never heard of Atlanta Labs."

Barton: "You're nothing but a damn intellectual. Atlanta gave us FM radio and most of the antennas used in broadcasting."

Cohen: "So what, if they didn't do it somebody else would. Besides I don't see their name on anything I buy."

Barton: "Well, somebody out there is bitching about the loss of American science and I want a good cover-up."

Cohen: "Yes, sir, right away, sir."

ACT III—Atlanta Laboratories conference room. A week later.

President David Brewster—casually dressed, not too old, clean shaven: "Gentlemen, you have seen it in the papers, but I now have the official last word, Atlanta is kaput! A relocation and counseling team is here from Octopus and you are invited to use their services as long as necessary. A psychologist is also on hand for family therapy. On top of all benefits, there will be an additional week per year severance pay. As we all know, Atlanta was the last U.S. R&D lab in consumer electronics. Octopus is funding a university chair in honor of Atlanta to be filled by one of their engineering professors and has asked for one volunteer among our ranks to act as his assistant to carry on the Atlanta tradition."

Engineer: "I ain't never yet seen anything useful coming out of a university."

Brewster: "True, all too true, but do we have a volunteer for the position? No? Perhaps some tech who wants a degree will come forward. Any questions? The funeral service is over."

Technical considerations for 550 MHz systems

This article, which originally was presented at the 1986 Atlantic Cable Show, discusses areas that should be considered prior to 550 MHz system construction and how they will impact the ongoing operations for the life of your cable system. The facts presented here are based on actual experience gained from the construction and operation of a 550 MHz system in one of the four areas serving the city of Philadelphia. Construction began in late April '86 and 50 miles had been activated for sales at the time of this writing. The entire projected 656 miles will utilize feedforward trunking coupled with quadrapower bridging and line extenders. The decision to utilize this technology vs. conventional and power doubling was based on our desire to obtain cost-effective maximum system reach while maintaining an acceptable level of distortion products.

'A signal with a minimum 45 dB C/N should be delivered to the (urban) subscriber to compete with... off-air broadcasts'

By John Donahue
Atlantic Regional Engineer, Comcast Cable

As with most technologies, feedforward and quadrapower techniques carry unique concerns with their obvious advantages. Consider the following example: An efficient design of a 450 MHz system utilizing conventional technology might yield the following averages of 0.7 trunk amps per mile, 2.8 line extenders per mile and 0.2 power supplies per mile. Philadelphia is averaging 0.4 trunks per mile, 3.8 line extenders per mile and 0.57 power suppliers per mile.

The startling difference between these two approaches is the 185 percent increase in required power supplies. True, the increased requirement is due in part to the higher number of actives required to accommodate this very dense area of Philadelphia, but the simple fact remains that the latest in amplifier technology requires more power to operate than conventional. You will be confronted with power consumption increasing from a typical 30 watts for a fully loaded conventional 450 MHz mainstation to 60 watts for a comparably loaded 550 MHz feedforward mainstation. (It's interesting to note that even a power doubling mainstation will increase consumption to 44 watts.) Additionally, you will encounter an increase in line extender power consumption from a typical 25 watts to 40 watts.

At a time when we as operators are focusing heavily on the bottom line, this situation has to be of major concern. If you consider an average electrical rate of 10 cents per kilowatt hour, the annual operating expense would be $788 per pole-mounted power supply that exhibited 80 percent efficiency. If you projected this annual expense over 650 miles of conventional plant, the total cost would be $103,000. Projecting the same costs over 650 miles utilizing feedforward and quadrapower technology, the total would be $292,000.

There is no easy solution to this situation. One consideration is to use highly efficient power supplies. A 90 percent efficient power supply will reduce the total power bill by 11 percent in the preceding example. A possible hope for the future would be power supplies offering higher output voltage and increased current handling capabilities with passives that could withstand the higher current flow. This should reduce the amount of required power supplies.

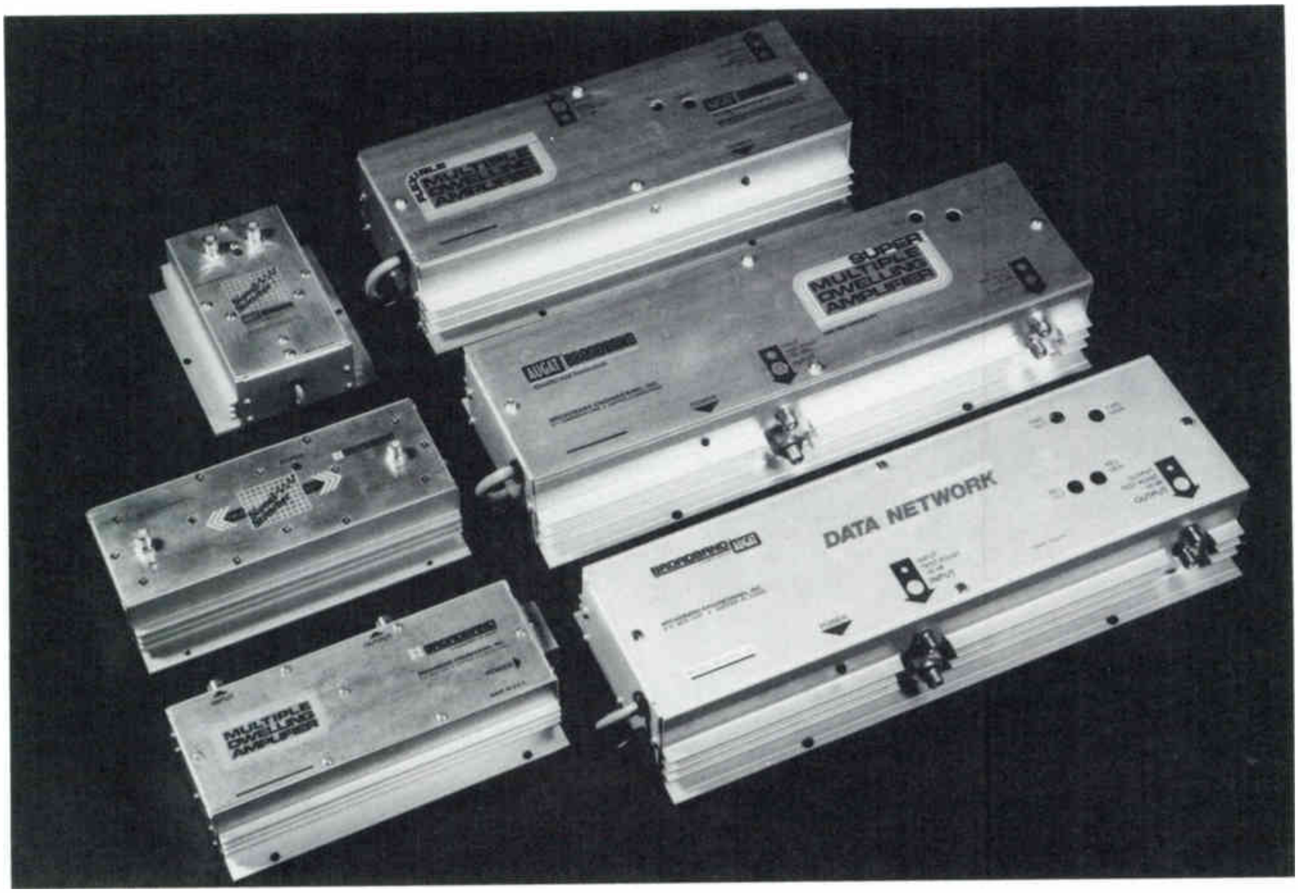
Ingressing signals

Another consideration that should be examined is the ever-present effect of ingressing signals and their impact to the victim channel. You not only have to consider the VHF and two-way radios that we have become accustomed to below 450 MHz, but you must consider a crowded land mobile allocation between 450 and 470 MHz and UHF television channels 14-26. If you use HRC channelizing in the headend to obtain a subjective improvement in composite triple beat and composite second order, ingressing signals may be even more of a concern.

For example, if your system were located in an area where a local TV broadcast of Channel 3 exists, using standard channeling, you probably would phase lock your Channel 3 modulator to the off-the-air signal. In this configuration the subscriber could withstand a carrier-to-interference (C/I) ratio of 35 dB before the situation is noticeable and a service call is generated.

If you use HRC channelizing, the carrier is 60 MHz for Channel 3. The local broadcast channel still is transmitting a carrier at 61.25 MHz, which potentially can give you an in-band interfering carrier at 1.25 MHz. Referencing to the "W curve," which details the perceptible picture-to-interference ratios with respect to frequency, we find the C/I ratio at 1.25 MHz to be 51 dB for acceptable reception. Even using cable, connectors and hardware that exhibit a high degree of shielding, you still may not achieve the desired C/I ratio in areas of high ambient signal levels, such as most urban areas.

This situation only will get worse as the system ages and drops age, which will result in increased service activity and, as we all know, this translates



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to higher operating expense. Increasing the output at the headend of the victim channel will assist in increasing the C/I ratio but is not recommended due to increased distortion products. Possible alternatives are not to use the victim channel (which usually is not an option) or to program it with a service with a projected low viewership. (If you opt to do this with a local off-air station, be prepared to explain to the broadcaster why all the money it spent on creating a channel identity is not applicable to your system. A better alternative here is to utilize converters with mapping capabilities so that you can transport the signal on an unimpaired channel and have it appear at the normal broadcast channel assignment when tuned.)

Compensating for attenuation

In order to maintain the highest amount of control to compensate for cable attenuation change due to temperature variations, the high pilot should be tuned to the highest frequency practical. To this end, amplifier manufacturers have selected 498 MHz for HRC systems and 499.25 for non-HRC systems. One important aspect of the automatic gain control (AGC) function is the filter that allows only the pilot carrier to be detected. As might be expected, it is difficult to design a filtering network at higher frequencies that exhibits adequate skirt selectivity and drift characteristics. Once in operation, it is good practice to periodically verify the proper alignment of the AGC function.

This verification can be accomplished easily through two simple tests that can become a part of routine or preventive maintenance. The first test verifies the proper reaction of the AGC circuitry. Simply place a power blocking terminator across the input center conductor to the station while monitoring the output. If the AGC responded properly, the output level should return to the normal operating levels if adequate reserve gain is available. The other simple test is to have someone decrease the output level of the two adjacent channels to the pilot while the output of a station is being monitored. If the output changes, there is an indication that either the skirt sensitivity has worsened or that the filter has drifted. AGC functions for these simple tests are not unique to 550 MHz operation but there should be a higher level of concern for its continued proper operation due to the higher frequency of the pilot.

Ongoing maintenance

Once the system is constructed and activated, the first and most obvious concern is providing the required tools for ongoing maintenance. At the top of the list of required tools is test equipment. Installation-grade field strength meters that are 450 MHz capable and possess a UHF tuning option are adequate for installation and service personnel (although you cannot tune to channels between 450-470 MHz). For line and maintenance personnel, it is recommended that a meter with a higher degree of accuracy be purchased. As in all applications, the key to the ongoing successful operation of the instrument is the routine maintenance coupled with frequent calibration to a known signal source.

Aside from the mere availability of equipment, another major concern deals with the high level simultaneous sweep system. If you will recall, to obtain an accurate sweep trace on a system with 35 or fewer channels, you typically would insert the sweep signal at +15 dB with reference to the absolute level of the video carriers. Operating at this level produced noticeable interference to the subscriber but generally was considered not objectionable. When systems expanded to 60 channels, the ratio grew to 20 dB with respect to the video carriers to provide an adequate sweep trace. At this level, the interference was perceived as more objectionable but tolerable by the subscribers. However, due to the increased complaints, the widespread use of remotely controllable sweep transmitters was employed so that the signal is on only a minimum amount of time.

With the advent of a 550 MHz system containing 80 channels, the ratio has further increased to 25 dB with reference to the video carrier level. The resulting interference is very objectionable to subscribers and has resulted in numerous complaints. The situation is aggravated further if you have scrambled channels that contain addressing tag information in the vertical interval. If the sweep signal goes through on top of the information, the decoder can stop descrambling. Although this is a momentary loss, it certainly is more annoying than flashes.

In Philadelphia, the situation has gotten so bad that the use of the sweep is limited to only early morning hours until a solution can be found. The solution, we hope, appears to be a product now under development that is a microprocessor-controlled, mid-level sweep system that essentially notches the signal at every video carrier frequency.

Another "tool" necessary for the ongoing maintenance of the system is developing new troubleshooting techniques and training the technical staff to use them. These techniques are necessary to verify the proper working order of the parallel gain blocks associated with this technology.

Consider feedforward technology. If one of the parallel gain blocks fails, theory says that the output level should stay the same. The damaging effect is the amplifier no longer will operate with the decreased contribution of distortion products. Because the contribution of a single amplifier is relatively small, a technician probably would overlook it. In reality, if one gain block fails, the output levels probably will change slightly; but will your technician detect the cause?

Some technicians troubleshoot this situation by measuring the current draw of the feedforward module. This is often a difficult test that could cause service interruptions as you place the ammeter in series with the hybrid under test. Even if the current draw is correct, a broken path or another component could cause a failure. The most conclusive test appears to be monitoring the output while you interrupt power to the individual hybrid. If the module is functioning properly, you will not lose signal when one of the two hybrids is deactivated. Most manufacturers provide convenient jumpers to facilitate this test.

The use of quadrapower and power doubling techniques should be treated a bit differently. The most conclusive test is to ensure that the module has the properly rated gain. This can be done simply by measuring the input signal, the output signal and applying any internal insertion loss such as pads, equalizers, diplex filters.

The key to maintaining a system utilizing this technology is the quality of training that our field staff receives. The concepts behind this technology are complex and should be understood thoroughly by the people who ultimately will maintain the equipment. To accept and understand these concepts a technician should have a good grip on the basics of cable theory. As well, an amplifier's mechanical aspects and their effect on the proper functions of the station should be covered. Minor problems can have devastating effects on the operation of a 550 MHz system.

Improving picture quality

We must be more concerned with the quality of reception that we deliver to all subscribers, especially in urban areas. It is not unusual for urban subscribers to be accustomed to off-the-air reception that is received with such high absolute level that it can produce pictures exhibiting a 52 dB carrier-to-noise (C/N) ratio or better. When even an untrained eye compares that quality of reception to the 42-43 dB C/N picture that cable generally produces, our pictures are perceived as inferior and complaints increase regardless of the benefits of increased viewing selection.

It is generally accepted that a signal with a minimum of 45 dB C/N should be delivered to the subscriber to compete with the quality of reception from off-air broadcasts. It is true that, comparatively speaking, there still will be a noticeable difference even at this level but generally it is not objectionable to the average subscriber.

One of the leading contributors to the noise in a signal especially in low trunk cascades is the absolute input level into the converter. For example, the resulting C/N ratio after a 20-amp trunk cascade with a bridger and line extender is 45.9 dB. If you allow the input to the converter to go as low as 0 dBmV, the C/N ratio of the converter typically would be 46 dB. Applying the power addition combining deration rule, the resultant C/N ratio would be 42.9 dB. It is felt that this quality of signal would compare unfavorably with the quality of off-air broadcast signals. In the same example, if the input into the converter was increased 4 dB to yield a 50 dB C/N, the resultant figure delivered to the subscriber would be 44.5 dB, which is felt to be much more acceptable.

In 550 MHz systems, obtaining these input levels is more of a concern simply due to the higher attentuation of drop cable and the higher insertion loss of passives at these frequencies. Design guidelines typically call for a minimum level at the design frequency and a maximum reverse slope between the lowest channel carried and the design frequency as measured at the output port of any tap installed in the system. A typical design guideline might call for a minimum of 13 dBmV with a maximum of −3 dB slope.

In a 450 MHz system, the average drop of 150 feet using 59/U cable would deliver 4.3 dB at 450 MHz and 13.3 dB at 50 MHz to the converter input. The same design guideline in a 550 MHz system would deliver 3.5 dB at 550 MHz and 13.3 dB at 50 MHz to the set using 59/U cable. Referring to the preceding C/N example, this is approaching the limit of unacceptable picture quality in an urban market even before any passives to accommodate additional outlets, FM and VCR connections are made.

If you use 6/U drop cable with the same design guidelines, the 4.9 dBmV at 550 MHz and 13.8 dBmV would be delivered to the set. Again, referring to the C/N example, this level should provide acceptable picture quality. The other option is to raise the design guidelines as they pertain to the minimum level required at the tap. However, this can be a very expensive option. Obviously these examples have assumed worst-case situations but the determination of minimum tap levels and the selection of the type of drop cable should be major concerns of 550 MHz systems in an urban market.

There are many more details that you will consider as you progress through construction and operation of a 550 MHz system—all the way from determining the required square footage to house all the headend electronics and associated cooling system to determining the amount of time an installer will spend with a subscriber explaining 80 channels. The obvious is that 550 MHz systems will cost more to build, operate and maintain. However, they do offer an expanded highway in which to deliver our product, opening the door for not only additional entertainment services but also positioning us to accommodate the future.

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Reader Service Number 15.

Expanded bandwidth frequency response testing

By A. William LeDoux
Marketing Manager, CaLan Inc

There have always been two forces at work in a CATV plant: engineering and marketing. While for the most part, they have managed to survive together, frequently, it has not been without some chaos.

Unfortunately, it seems that the engineering side of CATV has spent a lifetime trying to catch up with the ever-increasing demands of the marketing side. Marketing finds a new service to sell and engineering has to find a way to put it on an already overloaded system. The end result has been the demand for higher and higher bandwidth, with more and more channel capacity.

Now, this is not all bad. New services mean more revenue and more revenue offers the potential of continuous improvement in the overall service. But this never-ending cycle does bring with it some unique problems.

Take system sweep testing, for example. Back in the 1960s, we all ran 12-channel plants, using the standard broadcast channel frequencies, and converters were never even mentioned. A 12-channel plant is something that we only now are appreciating. The standard channel assignments eliminated the possibility of intermodulation, and level testing was simply a matter of tuning across these 12 channels. System sweep was a "novel" idea, reserved for those ambitious and experimental engineers who really enjoyed staying up until 3 a.m.

Figure 1

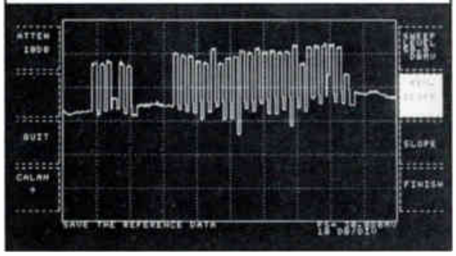
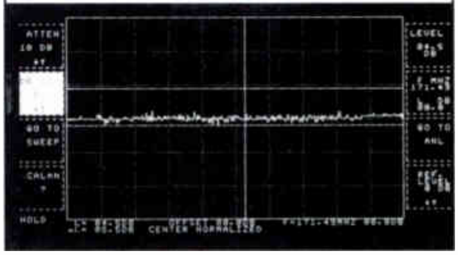


Figure 2



Enter pay cable

Now we had "mid-band" channels. Adding these channels showed us all the things we really did not want to see. We discovered that the center of our band was not quite as pretty as the low- and high-band. It typically was either the Rocky Mountains or Death Valley. System sweep became a necessity.

As more and more systems began sweeping, the benefits of this type of testing became readily apparent. The band edges showed the reasons for that high channel's continuous noise. The mid-band signature, with its 20 MHz wide "hump" of noise explained the random background noise that seemed to always be there throughout the band.

In addition to identifying problems more readily, system sweeping offered the ease of alignment never before available. When changing out a pad or an equalizer in a station, the results were obvious across the band immediately. A module changeout now could be accomplished, and set rapidly and precisely, reducing downtime. New plant and extensions could be turned on and proofed reliably. The truly strong advocates of system sweep testing also verified that, compared to setup with a meter, the same crew could

cover nearly five times as many stations using an amplitude-calibrated sweep.

But, 'all good things must...'

Now we had expanded through the high-band, up beyond 220, past 270 to 300 MHz. A 36-channel plant became something entirely different to attempt to sweep: the "high-level" approach (running 20 dB above the carriers) became very difficult to trigger; the "low-level" system (running 30 dB below the carriers) now became excessively noisy, as the additional carriers were added. And, to make matters worse, the early morning hours were no longer "dead-air" time, so even off-hours sweeping was not possible.

In the late 1970s, an advanced solution appeared, which allowed a "modified high-level" (only 10 dB above the carriers) approach to the problem, by increasing the sweep speed and averaging out the effects of the carriers on the system. Using an automatic pilot, the new system allowed for much easier setup and use, and added digital storage capability to sweep testing.

Upward and onward

The modified high-level did add some interference on the system, approximately one-third of a horizontal line. This was not a significant amount of interference, until it went past a new addressable baseband converter. The new converters couldn't handle the additional energy. It

Figure 3

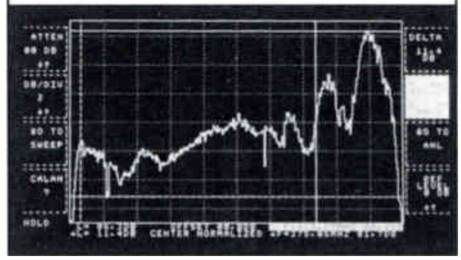
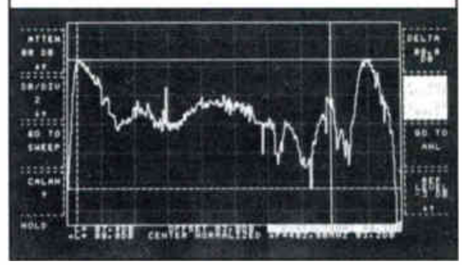


Figure 4



caused not only major interference, but even occasional de-authorizing of the paid-for premium signal. VCRs, now in abundance, also were not capable of ignoring this higher level signal interrupting every five seconds. To compound the problems, subscribers had by this time become very sophisticated and now expected interference-free video.

Now add even more channel loading. The more carriers, the more energy across the band. The more energy, the higher you have to run a sweep to get away from it. The modified high-level (running at 10 dB above the video) now becomes a very fast high-level (now requiring 20 dB above the carriers) sweep. Well, back to the low-level? Unfortunately, the low-level detects every carrier, as it runs below the carrier level. This results in what appears to be a modified spectrum analyzer display, with a very muddy trace down on the bottom of the display, and losing 3 to 4 MHz of trace every time it detects a carrier, as the carrier "rides" on the trace.

Why not just use an analyzer and view the carrier peaks as the system response? Possible, but limited by resolution and, of course, the carriers on the system. Remember, one of the key benefits of the sweep in the first place was looking not *in*-band, but rather just *out*-of-band. To use an analyzer for this purpose, you have to add carriers everyplace you would like to view the system response. Anybody want to add more carriers to their system?

A "smart" sweep, one that knows where the carriers are and avoids them, appears to solve the current problems. Using a microprocessor to control the system, this smart sweep could turn on momentarily at specified frequencies, be detected and then turn off. Carriers on the system could be "guarded," protecting them from interference. What about the areas being guarded? Are we back to losing a portion of the sweep around each carrier? Not necessarily.

If the receiver is a very fast, controllable analyzer, the carrier level can be read and then

stored as a reference at the headend, or first amplifier. This reference, including the "signature," could be stored and then downstream measurements could be compared to this. The carriers now become a part of the sweep trace, filling in the missing points.

As the sweep does not actually "hit" the video, the sweep level may be run just below carrier level, allowing resolution within .25 dB as the cascade is swept. In theory, the sweep-to-noise ratio should be only slightly worse than the system carrier-to-noise ratio, allowing this type of resolution to the extremes of the system.

Figure 1 shows this system in operation. The display shows the various "guard bands" set up on the system. Notice that some of the guard bands run above the sweep (the video carriers), and some run below (the aural carriers), showing the areas within the band now protected from the sweep signal. This trace, with its characteristic signature, drop cable, splitters, flatness of both the transmitter and receiver, and other variations,

Figure 5

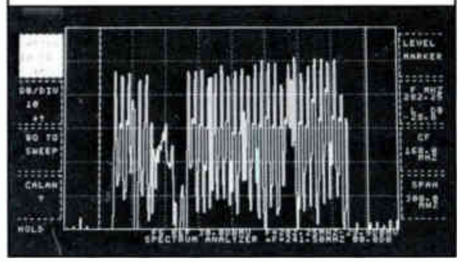
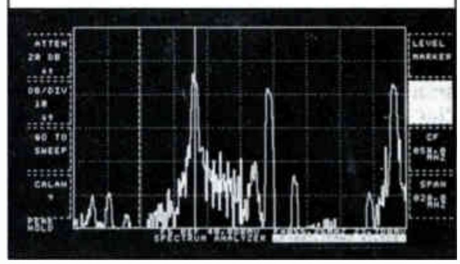


Figure 6



is now used as the reference for the system.

Figure 2 shows this trace, now "normalized," in that the reference data has been stored and the receiver is now comparing the input to this reference. As the input is exactly the same as the reference, the starting point is a straight line trace. Hard to beat ±0.0 dB as a reference!

Figure 3 shows the sweep now 32 amps into the cascade, with 60-channel loading, taken at the bridger output. The band being swept covers 35-565 MHz. Notice the tilt now introduced (because of the bridger) and the amplitude changes across the band. This is 2 dB/division, so the changes are enhanced, showing both amplifier signature problems and alignment difficulties. But it is being displayed, and can be adjusted to correct the problem.

Figure 4 is now two line extenders into the distribution, beyond the bridger shown in the previous figure. Notice the return to a "flat" vs. "tilt" output for the distribution portion of the system and the common high-band "humps" in the response. We also now have an increase in the low-band "hump," which could be seen at the bridger output, but did not show as dramatically. Again, the problems can be isolated, identified and corrected.

As the receiver is also a field analyzer, Figure 5 shows an analyzer display of a smaller system. Figure 6 shows an expanded view of a channel, reading a carrier-to-noise measurement. Just because we're sweeping doesn't mean that we can ignore the other parameters.

Still a valuable tool

In spite of expanded bandwidth, VCRs, sensitive addressable converters and increased subscriber awareness, the system sweep remains a valuable tool, and especially effective when used in an amplitude-calibrated mode. New discoveries in microprocessor technology, combined with surface-mount RF design, can solve some of the difficulties encountered when applying system sweep in the modern CATV plant maintenance. ■

Ready or not, it's time

Test instrumentation in CATV has taken us from a Jerrold 704B and a TV set for alignment, all the way through microprocessors. But it always seems that we have been fighting a "catch-up" game; we always have needed the test equipment long before it showed up.

Over the past three years, we have been building systems with 450 MHz and greater bandwidth, yet we have not had sweep equipment that was capable of true frequency response testing above 440 MHz. I know the specifications say 450 on some equipment, but ask anyone who has tried to sweep all the way to 450. Besides, with a 450 MHz system, any logical system engineer will want to sweep a minimum of 50-470 MHz.

Cable systems not using the newer expanded bandwidths are plagued as well with limitations on when and how the system can be swept, as a result of the new addressable converters and VCRs, both of which cannot tolerate the interference caused by a sweep. Systems are returning to the 2 a.m. sweeping that we quit doing 10 years ago.

Even with meters it seems that it has been only the last year or so that some have appeared with the capability to cover more than 450 MHz, without using the UHF range and living with a frequency "hole."

It seems that with the capabilities of microprocessors and newer technologies available, the CATV industry is about due for a new breed of test equipment, designed for both the system operator (lighter, easier to use, expanded bandwidth) and the subscribers (non-interfering and non-damaging to addressable converters). I think we're all ready.

THE LITTLE FARMER & THE GIANTS

A MODERN CABLE FABLE

Once upon a time, in a not-so-far-off land, the grain the people used to make their daily bread was grown by four huge giants-and one small independent farmer. For years, all five grain producers co-existed peacefully, in an atmosphere of healthy competition.

But then one day, the four giants entered into a battle for control of the grain market. When the battle ended and the dust cleared, only two giants were left. And, of course, the little independent farmer.

Then a strange thing happened. Overnight, the competitive situation changed. And the people began to worry. "Now that there are only two giants," one person said, "what's to stop them from charging higher prices for their grain?" "If they do, we won't be able to make as much bread as before," cried another.

But the little farmer overheard the people talking. And he cleared his throat and took a step forward. "My friends," he said, "you're forgetting about me." "You," snorted a man at the front of the crowd, "what can you

do against such giants?" "I can do just what I've always done," the farmer replied, "supply the finest grain and the best service in the land-at a very competitive price. As long as I'm around the giants can't take complete control of the grain industry–if you'll all think of me and include me in your business."

There was a general chorus of "that's right," "we didn't think about the little farmer." And so, after the farmer pledged to maintain his independence and to remain in the land for many years to come, the people went back to baking their bread, greatly relieved. And they all lived happily, and competitively, ever after.

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The moral of this tale is that variety & competition in almost every industry are good for the consumer. Like the farmer, we at Capscan, the only full service, independent coaxial cable company remaining in the U.S.–promise to maintain our autonomy. And to continue providing the best quality products and service in the business. We invite you to call us for a competitive bid on your next project.

Reader Service Number 21.

The FCC and signal leakage

By Dennis P. Carlton
Engineer in Charge, Field Operations Bureau
Federal Communications Commission

Six or seven years ago, somewhere in northern Missouri, I was in the rear of an FCC monitoring truck at three in the morning completing one of a series of measurements in a 24-hour level test on the local cable system. I particularly remember the occasion because the temperature was well below freezing and I couldn't keep the gasoline-powered heater that was supposed to keep me warm running for more than two minutes at a time. With numb fingers in single-digit temperatures, I was torn between trying to get the heater to stay running, or to simply make the level measurements as quickly as possible and move on.

I opted to play with the heater, since I knew I had two more locations at which to make measurements; plus, I had to come back and do all the points over again at 6 a.m. I can't deny that at that moment I doubted the need to continue on with a 24-hour level test. Particularly when I figured that just two parties—the cable company and myself—would care much about the results anyway. The few lone souls who were watching at that hour could care less what the actual video signal level was, much less how it compared to the level 10 hours earlier. For that matter, I wasn't sure the cable company was *that* concerned either.

Until just a couple of years ago it was commonplace for FCC engineers to make such elaborate sets of technical measurements on cable systems. In fact, we had specialists who focused on checking for compliance with FM, television and CATV regulations. These three services were lumped together because of the greater amount and sophistication of equipment needed to conduct the various tests. In the case of cable systems, the measurements made really were complete proofs of performance, encompassing all of the technical quality parameters contained in Section 76.605 of the FCC rules and regulations, including 24-hour level tests, signal-to-noise ratios, aural-to-visual ratios, frequency response and several others. The tests sometimes took two or three days to complete. The ordeal was probably a harrowing experience for most system engineers and technicians.

In any case, after the tests were completed, and if significant problems were identified, a discrepancy notice was issued to the system operator requiring a written reply explaining the cause of violations and a statement that the problems would, or had been, corrected. Although the time spent checking system technical parameters seemed ominous, it was unusual for anything much else to happen as long as identified discrepancies were corrected within a reasonable period of time.

An end to mandates?

It's fairly safe to assume that such extensive measurements won't be made on cable systems by FCC engineers in the future, because there are no longer any remaining signal quality mandates. The old requirements are now standards, and unless compelled to do so by the cable franchising entity, compliance with them no longer is required. Before you sigh with relief, though, remember that now, filtering to the top of the priority list of things for FCC inspectors to look at when visiting cable systems is, of course, signal leakage. And, because signal leakage is a problem that can cause harmful interference to other radio services, failing to keep it in check may be cause for some penalty beyond a simple discrepancy notice.

If you eliminate must-carry, there are really no major technical issues right now other than signal leakage. However, of all the issues in must-carry, of particular concern to many technical staffs is the potential impact of the A/B switch mandates on system leakage levels.

You can pick a side as far as projected magnitude and incidence of leakage sources are concerned. Some parties feel that the switches will be major sources of leakage. Others are worried only about signal degradation. In the matter of leakage, certainly a subscriber can contribute to the problem when installing an A/B switch, and in doing so mistakenly connecting the cable outlet to the "arm" of the switch so that it may be directed to the television antenna. But this is also true of the unknowing customer who decides to

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Reader Service Number 45.

"cable" a home with 300 ohm twin-lead. The best stance in my opinion is to de-emphasize cause and fault altogether, and just figure that all sources of leakage must be located and eliminated, A/B switch involved or not.

At the system level signal leakage is still *the* big deal today. And the closer we come to approaching full CLI implementation in 1990, the more important it will become. The commission's field staffs will focus on leakage measurements when making system inspections, and when subscribers complain about their local systems, attention will be directed to complaints where signal leakage is the likely cause.

So what really has changed in the past year from a technical enforcement and regulatory standpoint? Well, as was already mentioned, all the technical parameters set forth in Section 76.605 of the rules now are suggested standards and not mandated. That is, except for signal leakage. Although not yet finalized, terminal equipment technical standards also have pending proposed modifications to make regulations governing incidental radiation of terminal devices the same regardless of whether they were owned by the cable company or the subscriber. There are some differing opinions in the industry on this matter regarding the maximum level of radiation that should be allowed. And finally, the new leakage requirements—including notification, routine monitoring and frequency offset mandates when operating on frequencies in the aviation bands—now should be well implemented, since they have been in place for over a year.

Since many of you will be visited in the coming months by FCC field staff, you ought to be aware of the types of information that you will be asked to supply. If it's not apparent to you already, they primarily will be looking for and measuring signal leakage, and compliance with other terms of the new leakage rules. So, if logs are required they will be inspected. If aeronautical frequency bands are being used, checks will be made for proper frequency offset or other authorization. In general, system inspections by FCC field officers are primarily technical inspections designed to take a snapshot look at your overall technical operation.

A quick review of rule changes to Part 76 effected by the commission in Docket 21006, as well as other general regulations relating to signal leakage, follows. It hits the highlights, but not in detail. Thus, if you are the one responsible for regulation compliance, you should have a copy of the regulations themselves. Don't rely on this summary to be complete.

All cable systems must comply with the general radiation restrictions contained in Section 76.609 of the rules. For example, leaks on frequencies between 54 MHz and 216 MHz are limited to 20μV/m when measured from a distance of three meters for all systems.

Different regulations apply, though, as far as compliance with the CLI, leakage monitoring and logging results are concerned, based upon the size of the system and the frequency bands used. There are three main categories:

1) If your system serves less than 1,000 subscribers and uses only frequency spectrum allocated to off-air broadcasting, you only need comply with radiation restrictions. You don't have to make any tests, keep any logs or even routinely check for leaks.

2) If you serve 1,000 or more subscribers, or use frequency spectrum other than that authorized to off-air broadcasting, then you must (in addition to complying with the radiation restrictions) conduct signal leakage measurements each calendar year, as specified, and maintain the resulting test data on file at your local business office for five years.

3) If you use frequencies in the aeronautical communications or navigational bands, then in addition to the requirements listed in Item 2, you must comply with all of the new regulations regarding notification, CLI, periodic monitoring, etc., adopted in Docket 21006.

Docket 21006 regulations

The primary goal of Docket 21006 was to effectively protect aeronautical navigation and communications radio services from potentially hazardous leakage interference, and still not unduly hamper development of cable technologies that needed to use frequencies in the aviation bands. For those systems that were then using or desiring to use frequencies in the aeronautical bands above a specified level, regulations were adopted that:

- Established uniform frequency offset requirements for operation near aeronautical channel center frequencies in bands 108 to 137 MHz and 225 to 400 MHz (Section 76.612).
- Established the cable leakage index to become effective July 1, 1990 (Section 76.611).

- Established requirements for regular leakage monitoring and logging, to be performed every three months (Section 76.614).
- Changed the signal threshold power level triggering aeronautical restrictions and notification requirements to 10^{-4} watts *average* power (Section 76.612).
- Established prior notification requirements for systems intending to use signals in aeronautical bands above the threshold level, and established annual notification requirements (Section 76.615).
- Set forth grandfathering provisions for those systems properly using aeronautical frequencies prior to Nov. 30, 1984 (Section 76.619).

If these general categories bring questions to mind, you should review the rules and dockets themselves. However, a few areas warrant additional brief comments.

The notification requirements outline several specific items that must be submitted prior to using frequencies in the aeronautical bands. When notifying, it is not sufficient to simply state that you intend on using a particular frequency. Make sure you review the requirements before submitting your notification of operation in the aeronautical bands.

Grandfathering rights were extended to systems on a specific frequency basis—not a systemwide basis. This means specific frequencies already authorized on Nov. 30, 1984, would be grandfathered, but any new frequencies added must be on proper offsets. Even though a system existed prior to the grandfathering date, no new frequencies could be added and used under the old guidelines. These circumstances in some cases cause hybrid systems to exist where some frequencies being used are grandfathered, and new ones having been added after the new regulations went into effect are on proper offsets.

One final area is monitoring the system for signal leakage in the aeronautical bands. There are different requirements, depending on your system's status. For a purely grandfathered system with no new offset frequencies in use, monitoring requirements specify that the system operator conduct regular monitoring covering all portions of the system at least once each calendar year with equipment capable of detecting a leak of a field strength of 20 μV/m or greater at a distance of three meters. There also must be a log showing the date and location of each leakage source identified, the date on which the leak was eliminated, and the probable cause.

For systems operating under the new regulations (including hybrid systems), the monitoring requirements are similar in content, but they must substantially cover the plant every three months. In order to comply with the monitoring requirements it would be sufficient for cable personnel to make spot checks throughout the entire system while performing service calls or installations in discharge of their normal duties.

No specific monitoring effort encompassing the entire system at one time is required. Maintenance should be ongoing, however, and not just a one-shot affair once a quarter or once a year. You should be looking to repair leakage sources as they occur. As far as required logs are concerned, if when inspected they don't contain any entries, you had better have a real tight system. Otherwise, I think it's reasonable to assume that maintenance and monitoring are not being sufficiently performed.

The quick and easy key

So, after all this, what's the quick and easy key to trouble-free success? That's not hard at all: Make your customers happy and don't let signal leakage cause interference to non-subscribers or other radio spectrum users. And remember, if you need assistance in sorting out regulations, or otherwise need help in resolving an interference problem, don't forget to call upon the nearest FCC field office. They are there to do more than just check licensees and permittees for compliance with regulations. They also are there to help solve interference problems and answer questions regarding the rules and regulations. If you have a problem or question, call the local FCC field office.

Finally, don't count on the "L" in CLI to stand for "lucky"—plan ahead. July 1, 1990, is just around the corner.

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

Broadband LAN performance testing

This is the fourth installment in a six-part series.

By Steve Windle
Applications Engineer, Wavetek Indiana Inc.

Before a broadband LAN is built, it's a good idea to test the components that make up the system to ensure they are within the manufacturer specifications. This can save some time by weeding out problems before they become a part of the system. Some of the tests can be performed on components after they are installed, but for the most part tests are easier to perform on the bench.

Return loss is a relative measurement that compares the level of RF applied to a device with the level of RF reflected from the device. The reflection occurs when the impedance of the device under test and the impedance of the signal generation equipment and/or the transmission device connecting the two are unmatched. This mismatch causes a proportion of the RF applied to the device to be reflected because it is not absorbed or dissipated by the device. Poor return loss reduces desired transmission energy and will cause standing waves that may be observed while sweeping. By performing a return loss test, one can determine if the match is good (compared to the manufacturer's specification) and find damaged goods. A structural return loss test on cable reels can identify periodic damage (for example, a ding in the cable at regular, periodic length intervals), sometimes caused by mishandling or a manufacturing problem.

Two forms of return loss testing usually are performed by the system technician. One, port match, is associated with components in the system, such as directional couplers, splitters and line amplifiers. The other, structural return loss, is a phenomenon of the transmission cable and should be tested with a slightly different technique.

The test equipment generally used to measure return loss consists of a sweep generator, return loss bridge, detector and display device. A fixed bridge (fixed impedance) is typically used to measure port match and a variable impedance/capacitance bridge is used to perform structural return loss tests on coaxial cable.

To test for port match, connect a sweep generator's RF output to the input port of a 75 ohm RF bridge. The RF bridge will permit the measurement of the energy reflected from the device under test. Connect the output port of the bridge to a detector or the RF input of the sweeper if so equipped (Figure 1). Set the sweep to cover the desired operating bandwidth and adjust the output level to 10 dB below maximum. (Line amplifiers should be tested at lower levels. Refer to the specific manufacturer's instruction manual for proper level adjustments.)

Next, connect a precision mismatch to the bridge test port. This component has a calibrated return loss and should be used as a CRT calibration line. For line components, a 20 dB mismatch should be used. Connect and record the reflection curve (Figure 2) with a grease pencil or with the storage capacity of the equipment. Then, connect the device under test to the bridge and increase the output level until the highest point of the test curve crosses the reference curve (Figure 3). Subtract the amount of level increased from the reference line value. The resultant is the return loss value of the device under test.

The use of a comparator with the sweep generator simplifies the measurement considerably. An RF comparator is a test instrument that toggles the sweep between the test device and a set of precision attenuators, giving the operator a "real time" reference. This eliminates the need to trace the reference on the display scope with a grease pencil. The measurement is obtained by noting the amount of attenuation required to align the reference trace with the test trace. Before the test is done, the reference should be aligned to the test response with nothing connected to the bridge's test port (100 percent reflected signal). This compensates for the insertion loss of the bridge, so you won't have to subtract it from your total. Refer to the operating manual for hookup and operation instructions.

When structural return loss of cable is measured, the resistance and capacitance controls on the variable bridge are adjusted to flatten the return loss reponse. This adjustment for best-case response is necessary because cable impedance is very rarely exactly 75 ohms, and capacitance varies depending on the type of cable.

The structural return loss response is typically very spiky. The measurement is made on the highest spike, since the highest spike will indicate the worst-case return loss. To avoid a detection error called "scan loss," the technician may want to narrow the sweep bandwidth around that spike and slow the sweep rate. When a comparator is used, the reference attenuators are stepped up until the reference trace just crosses over the spike. Then the amount of attenuation added, after the original reference was set up, is equal to the return loss.

Tap isolation

Broadband multitap ports are designed to pass RF energy back and forth from the input

Figure 2: Reference curve

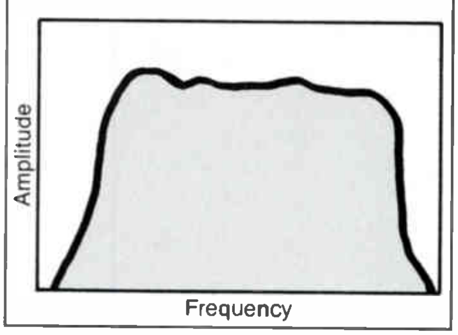


Figure 3: Test curve (with reference)

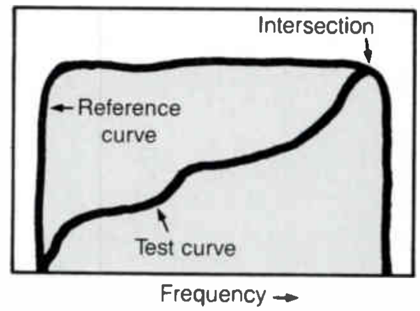


Figure 1: Return loss test setup

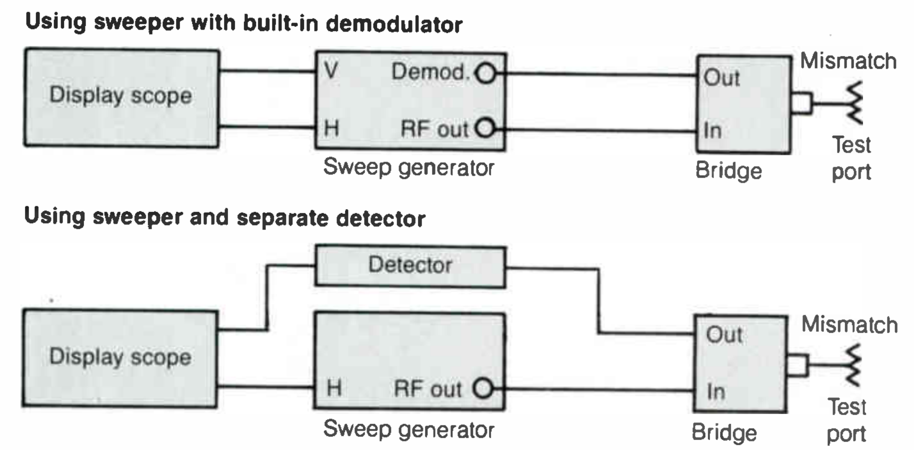
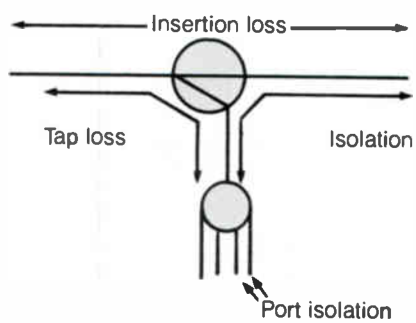


Figure 4: Multiport tap



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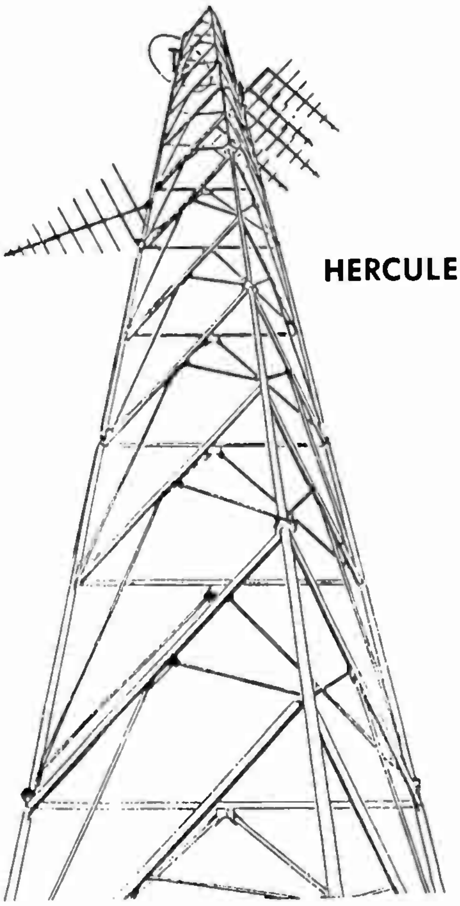

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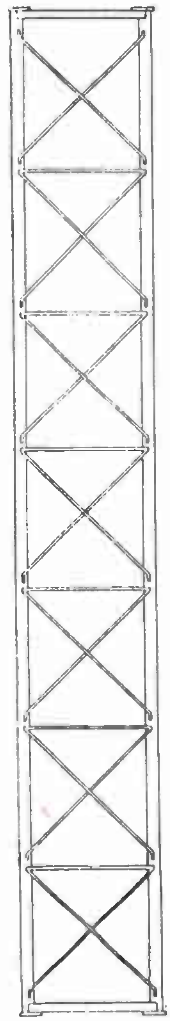

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connection while attenuating the signal from the output port or other ports. This "isolation" of the port connection secures the terminal device from interference due to reflections or spurious products from a second port operation (Figure 4).

Since isolation is typically frequency-dependent, it is best to sweep the device with a sweep generator or a sweep recovery system. The instruments used to align and balance the system can be used efficiently to perform tap isolation tests.

To test isolation between ports, connect the sweep generator to one of the terminal ports and connect the RF input of the sweeper (or external RF detector) to the other port. Terminate all unused ports (including the RF input and output, see Figure 5). Set the test level of the sweeper to 50 dBmV or greater. Adjust the input attenuation until the isolation curve clearly deflects the CRT and is free of noise. The isolation is normally very good at low frequencies but becomes worse at high frequencies. The response usually has a fairly irregular pattern (Figure 6).

Record the highest level of received energy and subtract this level from the output level of the generator. The ratio, in dB, between the sweep input level and the worst-case receiver level is the tap isolation figure. If the measurement is performed on the bench, the line isolation, tap loss and insertion loss also should be checked (Figure 7). The technique for these tests is identical to the port test defined earlier. A sweep comparator simplifies these measurements by providing a display of a sweep generator output reference, along with the isolation response. When using this method, the amount of attenuation added to the comparator to bring the reference trace in line with the isolation response curve is equal to the tap isolation or loss.

Bench testing the components that go together to make up the network helps to ensure that they will work correctly after installation. Good test equipment makes these "weeding" tests easy to perform.

Figure 5: Isolation test

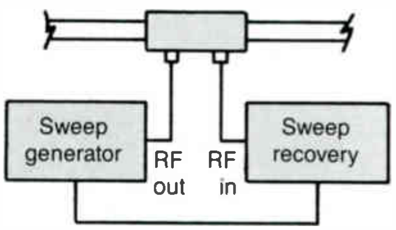


Figure 6: Test results

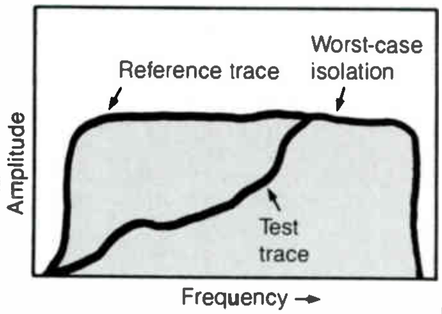
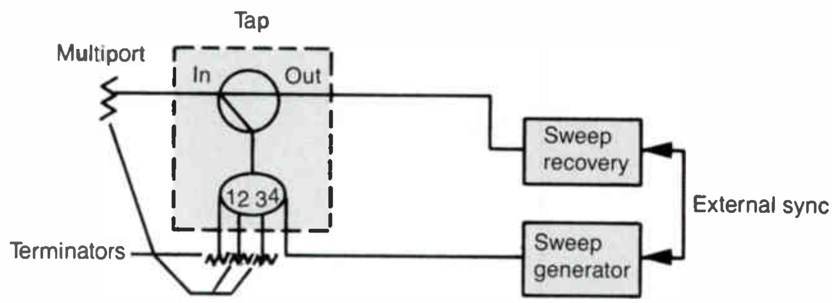
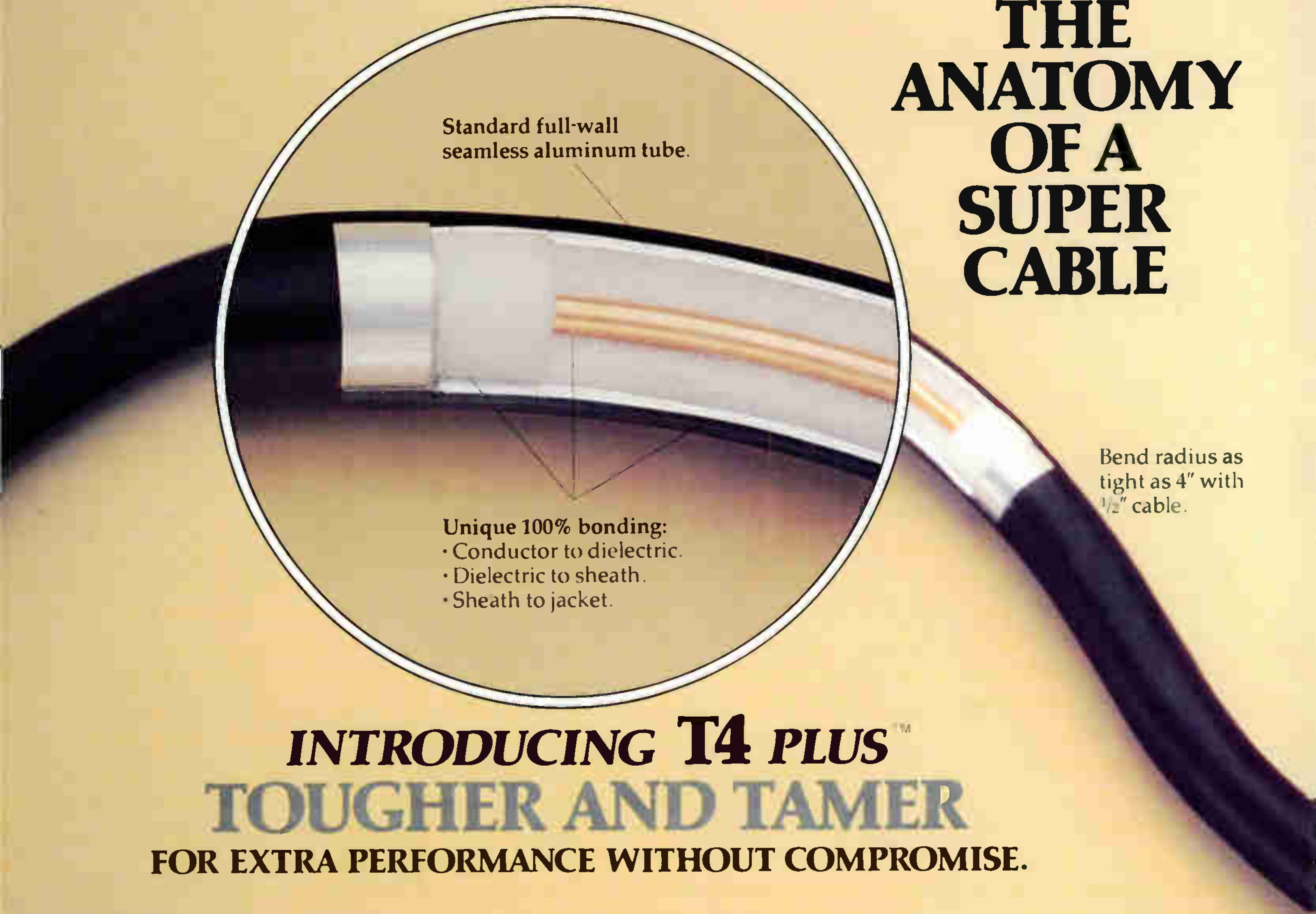


Figure 7: Line isolation test setup



THE ANATOMY OF A SUPER CABLE



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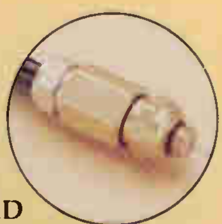

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Do engineers make good managers?

By Chris Papas
The MITRE Corp.

'Any engineer can be a manager just by being in the right place at the right time'

Not every engineer has the ability to be a manager nor does every engineer want to be a manager, but some have gone into management careers and been very successful. Whether or not an engineer will make a good manager is highly dependent on the personality of the engineer, the environment of the managerial job and the management training the engineer has received.

Since engineering schools rarely teach the basic interpersonal and managerial skills needed to do the job, these must be learned either through some type of formal training or be self-taught. There are a few of the "born leaders" who naturally fit in management positions; however, there are engineers who need some assistance in adapting to the role of a manager. A manager must have the ability and the flexibility to operate in the job environment and deal with people on different levels in different situations.

Unfortunately, there are some engineers who have been moved up to management positions for reasons not related to their management ability. Often, the promotion is a reward for doing a good job on a project. However, success in engineering work is not necessarily transferable to a managerial environment. They just may not be management material.

Better selection of technical personnel for management positions will help avoid the predicament of having the wrong person for the right job. When having to choose between several engineers for a management position, it is usually best to choose the most versatile rather than the best engineer, since the former will be more adaptable to the new job. Companies have found that by moving up technical personnel who do not have management ability into management positions, they pay a double penalty: They end up with management problems and they have drained their pool of technical talent.

Engineering training

The training an engineer receives in school is opposite to the skills needed to be successful as a manager. Engineers are trained to be experts in a specific area, to work with objects and to look for a single right answer to each problem encountered. On the other hand, managers are expected to have a broad understanding of the many functions in an organization, to work mainly with people and to weigh different possible alternatives in solving a problem.

Several common criticisms of engineers who have become managers are: They continue to "engineer" solutions to problems rather than manage the problems, they continue to try and solve problems themselves instead of delegating to their employees, and they have trouble relating to the people aspects of the job. Some engineers find it difficult to understand that there may not be a single "right" solution to a problem; the solution may in fact be a judgment call based on little or no facts.

One personnel specialist suggested that engineers need to be completely retrained to succeed as managers. Although that is overstating the case a bit, engineers do need to recognize the limitation of their training and that working with people is an inexact science.

There are other career paths that an engineer can take besides going into management, including: research, development, applications, sales, teaching, university research and independent consulting. In fact, there may be more alternate careers for an engineer than any other field. Although these alternatives are available to engineers, the greatest monetary and prestige rewards in companies heavily favor the management career at this time. Those who want to get ahead must go up the ladder.

The MITRE Corp. takes a different approach to the problem of engineers and managers. It offers a dual career path approach for engineers. Engineers with management potential and desire can move up the management ladder to corporate-level positions. Engineers who want to stay in technical positions can move up a separate technical ladder to corporate-level positions. This approach is not necessarily new, since other companies have such dual career paths, but the MITRE approach is well-defined in company policies. Some of the other companies have the higher level technical positions, but there is not any clearly defined way of working toward those positions.

Management training

In many companies, the management training is minimal at best and many new supervisors have had to "sink or swim" in the new job. Some new managers learn very well and develop a knack for dealing with employees, but a few do not and create huge personnel problems. Management training for new managers is needed to assist them in dealing with the problems that will come up. Topics such as leadership training, motivational training and conflict resolution techniques will greatly improve managers' confidence and ability to understand their employees and do their job. The end result will be increased productivity.

Sometimes, engineers attempting to obtain management training meet with some resistance from the company's management. Often, this type of management feels that, since the engineer "made it" without such training, it really isn't needed. These managers usually need some convincing that management training will increase the productivity of the company's employees.

Most companies realize the value of management training for their employees and spend a lot of effort obtaining it. There are quite a few courses, seminars and training programs available that can help engineers making the transition into a management position. Each company should decide which type of training is best for its employees.

The biggest problem with management training is the time and money expended by both the company and the engineers. Companies that wish to improve their managers' abilities must pay for the training and lose the use of the engineers for a period of time. This becomes a problem for smaller companies that are limited in funds or for government agencies that are experiencing budget cuts.

Some companies are using in-house short courses as a means to improve their managers' abilities without taking too much of the engineers' time. This way, the company can tailor the course to its specific needs and internal policies. This method tends to get expensive since the company must develop and teach the course on its own, which requires people dedicated to just training.

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to take courses on their own time at a local educational institution. This is a little easier on the company but is tougher on the employees who have to balance home, school and family priorities at the same time.

One alternative to the formal training method is an internship-type of program for new managers. The prospective engineer/manager works under one or several managers for a period of time to learn the methods used in handling the job properly. The advantage of working under several managers, especially when they are located in different departments, is that the engineer is exposed to different styles of management and different parts of the company.

Knowing what other people do and how they operate in other parts of the company is a big advantage, since a manager's decisions usually will have some effect on areas aside from one's own. It also gives the new manager a broader perspective of the company.

What is a good manager?

At this point the question becomes, what is a good manager? No single yardstick or set of personal traits can be used to describe a good manager, since the qualities needed in one situation can be a problem in another situation. In a manufacturing business, success can be measured in manufacturing productivity terms, but in a government agency these same terms become meaningless. The common denominator in each situation is that a good manager must be effective in motivating employees to achieve the company's objectives and must be adaptable to new situations as these objectives evolve.

Some basic skills that are helpful in becoming a good manager are: the ability to communicate and influence others through oral and written skills; the ability to work with people at different levels and in different situations; the ability to work within time and budget constraints; the ability to see beyond the immediate work at hand and visualize the whole picture of the project or company; and the ability to handle responsibility. These managerial skills are the basic tools to work with and need to be applied at the right time and place to be effective.

If all of this sounds like "liberal arts" subjects, that's because it is. Engineers need to broaden their backgrounds beyond the nuts and bolts of engineering if they want to succeed in a management position. Public speaking and writing experience will go a long way in helping develop some of these skills.

Any engineer can be a manager just by being in the right place at the right time. To be a good manager requires the engineer to know and be familiar with the proper use of the basic management skills. Although all engineers will not make good managers, those with management ability can and do make good managers. There are many well-run corporations in business today that are managed by engineers.

Chris Papas is an electrical engineer working for the MITRE Corp. in Bedford, Mass. This article is based on his personal observations of management and research work associated with pursuing a master's degree in business administration.

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Reader Service Number 30.

Baseband video performance testing

Part two of this series deals with the use of video waveform monitors.

By Jim Schmeiser
Staff Engineer

And Terry Snyder
District Field Engineer, Group W Cable Inc

Three different types of waveform monitors, the Tektronix 529 and 1480C and the Leader Model LBO-5860A/5861A, will be discussed in this article. The purpose of operation of the waveform monitors will be only to determine the video level and check for 1 volt peak-to-peak.

Looking at the back of the Tektronix 529 monitor, we find two input connectors labeled "video A" and "video B." Select one of the two inputs and plug in the video baseband signal. It doesn't matter into which one you insert the signal, as long as the other one is connected with a 75-ohm terminator. (We will not concern ourselves with any of the other inputs. Remember that we are not going to perform a video signal analysis, but just checking for 1 volt of video.)

Now for the front panel controls. Turn on the unit and allow for a suitable warm-up period before attempting to calibrate the monitor. Set the input switch to calibrate, the volts full scale to 1.0 and the center knob fully clockwise until the "CALIB" light comes on. Other switches also should be set: sync switch to "INT"; magnifier to X1; DC restorer to on; response to "FLAT"; and display to .125 H/cm. The screen should show two square waves (Figure 1). The top of the square waves should be on the 100 IRE line and the bottom should be on the −40 IRE line. If the square waves are too large or too small, adjust the gain control for the proper level. Next, flip the calibration switch to .714 F.S. and check to see if the square waves go from zero IRE to 100 IRE. Now put the input switch to A or B (whichever channel you have plugged the video into). In order to show two fields of video, put display switch in the two-field position (Figure 2).

For two lines of video, put the display switch in the two-line position (Figure 3). On the display switch .25 H/cm gives the display in Figure 4. Placing the display switch at .125 H/cm is shown in Figure 5.

To view the vertical interval test signal (VITS), put the display switch to line selector, .25 H/cm; the horizontal line selector to line 18; and the field switch to one. The display should be similar to Figure 6. Figure 7 shows the same line but on field two. Figure 8 is of field one with the display line selector set to .125 H/cm and the horizontal line selector set to line 18.

Expanded capability

The next waveform monitor to discuss is the Tektronix 1480C, an updated version of the 529 with expanded capability. Once again we have an A and B input on the back. And, again, it does not matter which one you choose to use as long as the video is terminated. Once you have inserted the video into A or B input go to the front of the monitor.

Put the response switch to "FLAT"; the input to A or B, "DC CPLD"; volts full scale to 1.0 and center knob fully clockwise to "CAL" ("UNCAL" light should be off). Push in DC restorer button labeled "FAST"; push in sync tip button; push in CAL button. Put magnifier switches to X1 and switch to the right of it to 5. Push in INT button and AFC pushbutton. In the bottom right corner are four buttons marked OFF, DIG, VAR and 15 LINES. Push in the OFF button.

The display of Figure 9 should appear on the CRT. Position this trace so the bottom line is on the −40 IRE line and the top of the trace is on

Figure 1: Waveform of square waves

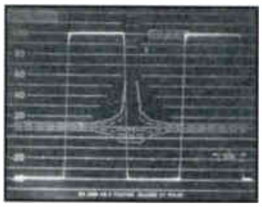


Figure 2: Two fields of baseband video

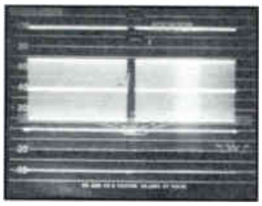


Figure 3: Two lines of baseband video

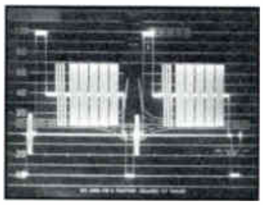


Figure 4: Two lines with .25 H/cm display

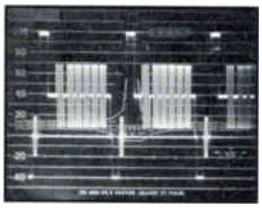


Figure 5: Two lines with .125 H/cm display

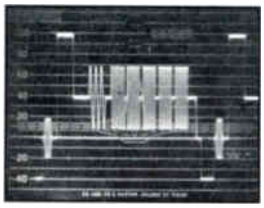


Figure 6: VITS signal of field one

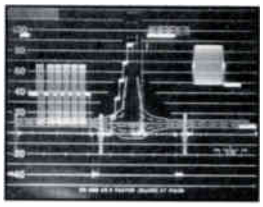


Figure 7: VITS signal of field two

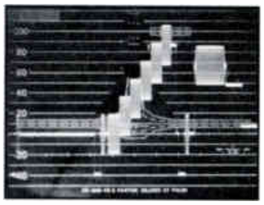


Figure 8: Field one at .125 H/cm

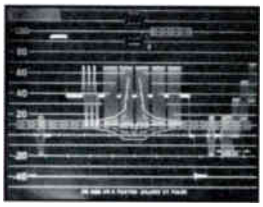
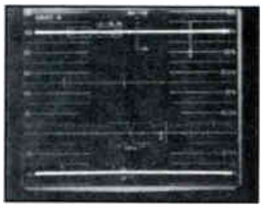


Figure 9: Video levels at "off" position



the 100 IRE line. If the display is not 1 volt peak-to-peak, then adjust the gain control for the proper display. Now push the back porch button. The display in Figure 10 should appear (0 IRE to 100 IRE).

To measure video levels, push in the buttons OPER and sync tip. For viewing video put the right-hand switch under magnifier to two field (Figure 11), 10 (Figure 12) or 5 (Figure 13). Remember that if the video has a subcarrier present to put the response switch to IRE.

To obtain the VITS signals push in the DIG button, magnifier to 5 and line selector to whichever line you wish to view. Now push in both buttons marked 1 under the field switch. This will display the VITS on field one (Figure 14). By pushing in both of the buttons marked 2, you will display the VITS on field two on the same line (Figure 15). If the video level is low or high, adjust the video level on the piece of equipment that you are testing.

Leader LBO-5860 calibration

For the Leader LBO-5860, the procedure is the same as the other two types of waveform monitors. First we have to calibrate the waveform monitor: power on; volts full scale to CAL (1V); variable knob fully counterclockwise (red light off); sweep pushbutton 2H in; response to "FLAT"; sync on "INT"; DC restorer on; line selector off.

The CRT should display four square waves. These square waves should go from −40 IRE to 100 IRE (Figure 16). If the calibration square wave is not 1 volt peak-to-peak, refer to the manual for the internal gain adjustment.

Once again, on the back of the monitor is a video input A and video input B. Choose either input and insert the video signal to be measured, making sure the looped through leg is terminated into 75 ohms.

Set the front panel volts full scale switch to the appropriate channel (A or B) in the 1 position. Moving to the sweep pushbuttons, 2H will give the display of Figure 17. One microsecond per division will expand the display. Button 2V will display two fields (Figure 18) and 2V MAG expands the display.

To display the VITS, move the line selector switch to lines 7-21 on field one or field two and turn the intensity knob fully clockwise. Then, make the required adjustment to the device under test.

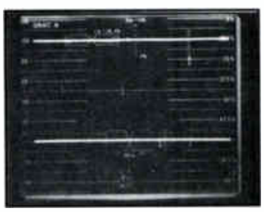


Figure 10: Back porch at "off" position

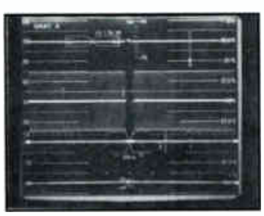


Figure 11: Two fields of video

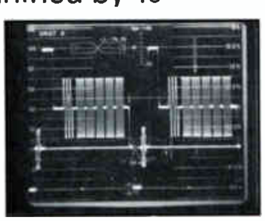


Figure 12: Two lines magnified by 10

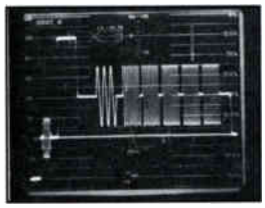


Figure 13: One line magnified by 5

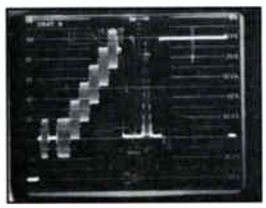


Figure 14: VITS signal of field one

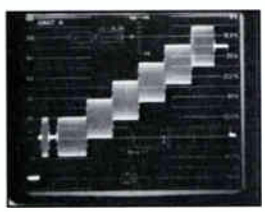


Figure 15: VITS signal of field two

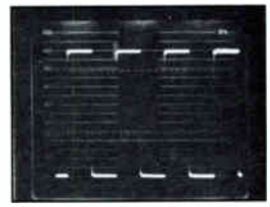


Figure 16: Four square waves, calibrated monitor

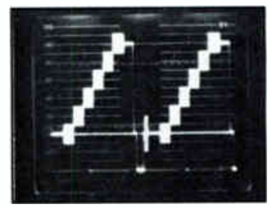


Figure 17: Sweep waveforms at 2H setting

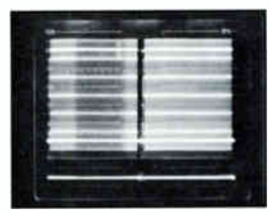


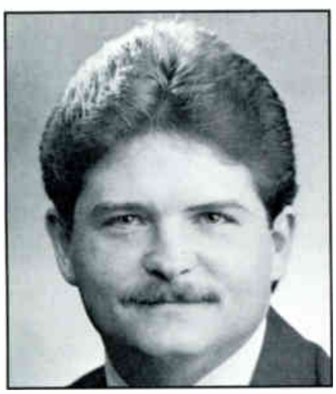
Figure 18: Sweep waveforms at 2V setting

The third installment in this series will deal with waveform analysis.

Corvo

Louis Corvo has been appointed vice president, engineering for the **Jerrold Distribution Systems Division** of General Instrument Corp. He will be responsible for engineering research and development at Hatboro, Pa., and Brea, Calif. Corvo previously was director of engineering at Magnavox CATV. Contact: 2200 Byberry Rd., Hatboro, Pa. 19040. (215) 674-4800.

General Instrument announced **J. Lawrence Dunham** has been named executive vice president and general manager of its **VideoCipher Division**. He previously was vice president, corporate strategic planning and business development for M/A-COM. Contact: 3013 Science Park Rd., San Diego, Calif. 92121, (619) 457-2882.



Unverzagt

Pioneer Communications of America announced the promotion of **John Unverzagt** to director of engineering for the cable television division. He will be responsible for managing Pioneer's field support department and supervising the division's converter hardware and controller software, as well as coordinating engineering projects with company personnel and the Tokyo-based manufacturing facility. Previously, Unverzagt was field service manager for the division.

Also, Pioneer promoted **Glenn Sigler** to field service manager in its sales support department. He will be responsible for field support organization, handling demonstrations of new products, installation of addressable hardware and the day-to-day support of the company's addressable base. Sigler previously was field service supervisor in the sales support department.

Finally, **Fae Kopacka** and **Michael Callahan** have joined Pioneer as national accounts managers in the company's new headquarters in Upper Saddle River, N.J. They will be responsible for managing a select group of the company's cable converter accounts throughout the United States. Previously, Kopacka was an information management specialist with Tri-Star Pictures in New York; Callahan was previously responsible for sales of microprocessor-based telephone support equipment for Science Dynamics. Contact: 600 E. Crescent Ave., Upper Saddle River, N.J. 07458, (800) 421-6450.

First Data Resources announced the promotion of **Jay Oxton** to president of the Cable Services Division. Prior to this, Oxton was vice president and general manager of the division.

Also, **Stan Durey** has been promoted to marketing manager for the Cable Services Division. Prior to this, Durey was manager of addressable systems and systems communication for the division. Contact: 7301 Pacific St., Omaha, Neb. 68114-5497, (402) 399-7000.

Pico Macom announced the promotion of **John McClosky** to vice president of operations. Prior to this, he served as operations manager for the company.

Also, **Glenn O'Connell** has been promoted to vice president of marketing. He previously served as sales manager for OEM Sales, a division of Pico Macom. Contact: 12500 Foothill Blvd., Lakeview Terrace, Calif. 91342, (800) 421-6511 or (818) 897-0028.

Rauscher

The **National Cable Television Association** named **Louise Rauscher** head of its new Department of Industry Communications. The new department will focus on direct communication with the national trade and consumer press as well as coordination of materials for use by cable operators at the local level. Rauscher has been president of the public relations firm Rauscher & Associates for five years. Contact: 1724 Massachusetts Ave., N.W., Washington, D.C. 20036, (202) 775-3629.

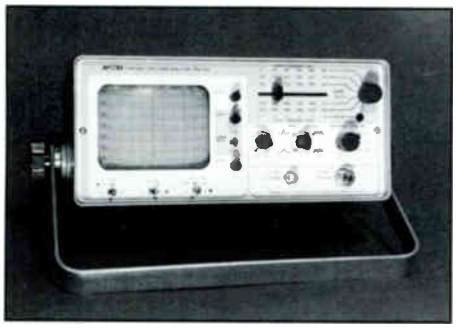
B. James Gleason, corporate vice president of audit and currently serving as acting chief executive of the Austin Division of **American Television and Communications Corp.** (ATC), has been named the division's new president.

Carl Rossetti was named to the position of vice president, new business. Previously he was president of the New England (Portland) division of ATC.

Stephen Hattrup has been elected vice president, financial planning. He was formerly vice president of finance of ATC's national division.

Finally, **Marjorie Null** has been named manager of corporate public relations. Prior to this, she was a communications specialist with the MSO. Contact: 160 Inverness Dr. West, Englewood, Colo. 80112, (303) 799-1200.

Reader Service Number 46.



Spectrum analyzer

The PSA-35A portable spectrum analyzer from Avcom offers frequency coverages of 10 to 1,750 MHz and 3.7 to 4.2 GHz for checking signal strength, in-band attenuations, terrestrial interference, filter alignment, faulty connectors, LNAs, feedhorn isolation and cable loss at all commonly used satellite communication frequencies.

According to Avcom, the product features a built-in DC block with 18 VDC for powering LNAs and European BDC frequencies, calibrated signal amplitude display, and internal battery with built-in charger. Applications include research and development, locating hidden transmitters and CATV measurements.

For more details, contact Avcom of Virginia Inc., 500 Southlake Blvd., Richmond, Va. 23236, (804) 794-2500; or circle #89 on the reader service card.

Ad insertion system

Adams-Russell Video Information Systems Division has introduced its Compact automatic commercial insertion system, designed specifically for smaller ad sales operations. It comes pre-assembled in one rack, operates in a random access mode and can service a number of remote headends from a central location. As ad sales grow, the system can be expanded from one channel to four or more channels.

For more details, contact Adams-Russell Video Information Systems Division, 300 Second Ave., Waltham, Mass. 02154, (617) 890-5850; or circle #98 on the reader service card.

Remote converter

Pioneer Communications of America has introduced its IR remote converter Model BC-4500, said to be 40 percent smaller than its previous model and the only standard converter with 550 MHz channel capacity as a standard feature. It also offers an options selector, a hand-held IR transmitter that can modify functions without opening the converter or utilizing a PROM.

According to Pioneer, the options selector can enable and disable subscriber options such as parental control, IR remote and barker channels. It also changes spectrum allocations from HRC, IRC and standard. In addition, the transmitter programs channel allocations to enable remapping the frequency tuned vs. the channel displayed.

The BC-4500 offers the company's frequency-synthesized phase lock loop circuit to maintain accurate tuning, a SAW resonator to maintain stable output frequency, and capristors to guard against currents and power surges.

For more information, contact Pioneer, 600 E. Crescent Ave., Upper Saddle River, N.J. 07458, (800) 421-6450; or circle #99 on the reader service card.

Power supply

Lectro Products, a division of Burnup & Sims, has introduced an improved version of its Sentry II standby power supply, the Sentry II Super. According to the company, the product has all the modular features of the earlier model and is 92 percent efficient in normal mode over a wide range of loads. The Super Ferro module also can be retrofitted to existing Sentry IIs.

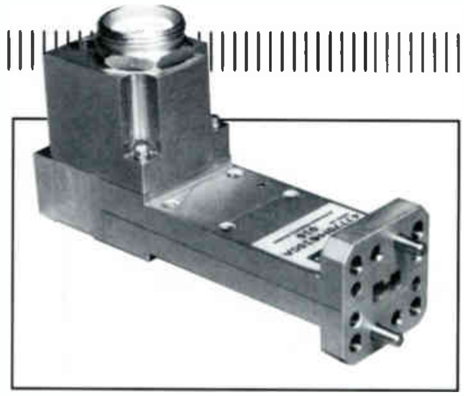
For more information, contact Lectro Products Inc., 420 Athena Dr., Athens, Ga. 30603, (404) 353-1159; or circle #100 on the reader service card.

Jacket stripper

The Model CS-27 cable jacket stripper from Lemco Tool is designed to remove polyethylene jackets from both trunk and feeder coaxial cable. According to the company, one tool fits cable sizes .375 through 1 inch and ensures quick and proper sheath stripping.

The steel swivel blade automatically changes from a circular to a lengthwise cut. Also, the cutting depth can be adjusted to the thickness of the sheath. A spare blade is supplied with each stripper.

For more information, contact Lemco Tool Corp., R.D. #2, Box 330A, Cogan Station, Pa. 17728, (800) 233-8713; or circle #85 on the reader service card.



Microwave sensor

Hughes Microwave has introduced its single-power sensor, Model 47770H-6100, able to measure power over the 18 to 40 GHz frequency range. The product is said to provide 60 dB of dynamic range and measures power levels from −50 to 10 dBm. According to Hughes, the sensor is calibrated every 1 GHz with a basic accuracy of ±0.5 dB at 33 GHz.

For more information, contact Hughes Microwave Products Division, P.O. Box 2940, Torrance, Calif. 90509-2940, (213) 568-6307; or circle #86 on the reader service card.

Pay TV meter

SaskTel has introduced to the U.S. market its Penny Pincher, a system that meters subscriber use of pay TV. Its components are a set-top control and an outside meter. The set-top allows subscribers to tune into a pay channel whenever they wish and interfaces with a VCR. The outside meter allows the signal into the home; it records in three-minute intervals the amount of time the subscriber watches pay TV. Each month the cable operator reads the meter and records information that is transmitted over phone lines to the billing system.

For more details, contact SaskTel International, 2121 Saskatchewan Dr., Regina, Saskatchewan S4P 3Y2, Canada, (306) 347-4509; or circle #88 on the reader service card.

Receiver/descrambler

The VideoCipher Division of General Instrument Corp. is offering to consumers its VideoCipher II Model 2500R, an integrated satellite television receiver and descrambler. With this product, consumers can purchase authorization to receive descrambled signals of channels currently scrambled. Also, the 2500R comes standard with a wireless remote control.

Other features include two methods of parental control, a built-in terrestrial interference filter, programming for 24 C-band and 32 Ku-band channels, and digital stereo audio. An optional antenna positioner power supply lets users program up to 21 satellites in memory and program 10 channels on any satellite by remote control.

For more details, contact VideoCipher Division, General Instrument Corp., 3013 Science Park Rd., San Diego, Calif. 92121, (619) 457-2882; or circle #91 on the reader service card.

Video control center

Designed for cable installations where shielding, extended frequency range and high isolation are required, Pico Macom's Model HVC-1A home video control center features four inputs that allow independent selection of a VCR or TV set. According to the company, it also features high port-to-port isolation, wide frequency range, high return loss, shielding of internal parts and wood encasement.

For more details, contact Pico Macom Inc., 12500 Foothill Blvd., Lakeview Terrace, Calif. 91342, (800) 421-6511; or circle #87 on the reader service card.

Microwave multiplier

Channel Master has introduced the Model 6650 microwave multiplier to its line of MicroBeam system products. The multiplier allows the addition of microwave paths to a single transmitter location without the need for high-powered, tube-type equipment. Microwave paths can be added as needed, with the 1 watt unit delivering 60 channels up to 14 miles and the 5 watt up to 20 miles.

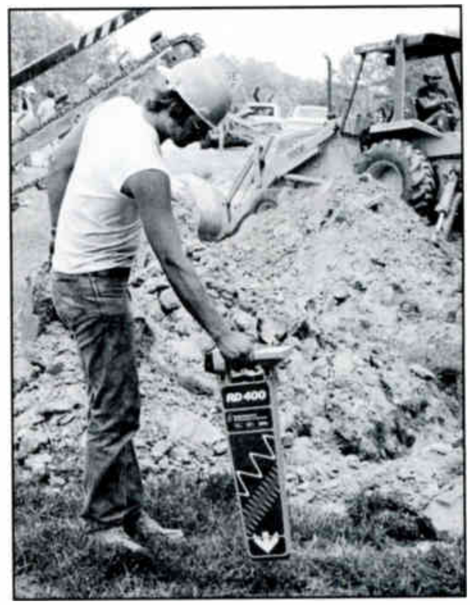
The product utilizes a 1 or 5 watt GaAs FET output and covers the entire 500 MHz CARS band. The AGC range of 30 dB is said to maintain constant output power and distortion ratios over temperature. A bandpass filter ensures only CARS band signals are passed. The entire unit may be pressurized to keep all components dry at any humidity level.

For further information, contact Channel Master, P.O. Box 1416, Industrial Park Dr., Smithfield, N.C. 27577, (919) 934-9711; or circle #94 on the reader service card.

Cable, pipe locator

Radiodetection has introduced its RD400 cable and pipe locator built from surface-mount electronic components. This design is said to provide total reliability in service with physically rugged construction, simplifying maintenance and calibration.

According to the company, the product consists of a lightweight receiver and transmitter made of polyethylene, both enclosures water resistant. The instrument can locate four modes: 60 Hz signals, 22 kHz radio signals, and 8 and 33 kHz transmitted signals. This combination is said to give precise location with or without using the transmitter. The product is equipped to give depth measurement of 10 feet.



For more information, contact Radiodetection Corp., P.O. Box 623, Ridgewood, N.J. 07451, (800) 524-1739; or circle #90 on the reader service card.

F connectors: The two-way bane

By Peter Sclafani
Cable Resources Inc

Cable television technology works! Existing equipment and cables meet the performance specifications needed to attain the highly profitable "blue sky" cable systems we have read about in the last decade. The reliability factor of the latest generation of amplifiers and power supplies, when maintained properly, exceeds requirements. Connectors, when installed correctly, have evolved into trouble-free parts of the puzzle. Addressable and programmable converters, along with signal security, have been improved dramatically in the last two to three years. The business office computer/addressable controller wirelink works like a charm.

Transmitting data via cable in either direction has been working under test conditions with speed and error rates that put the phone system to shame. There is even a small percentage of systems actively using their two-way capabilities. A few years ago, systems introduced two-way services into existing cable operations with much fanfare. However, the plants had deteriorated to such a degree that the new services experienced too much trouble. The initial press was very negative and no one had a quick solution. With these poor first showings, it almost seems that the industry decided two-way cable systems do not work and stopped trying.

Many believe the problem was and is the accepted quality of day-to-day job tasks by the industry as a whole. Look around most offices or cable trucks and you will see unsightly piles of converters and line electronics. The industry accepts work, as satisfactorily completed, in much the same manner as it handles its equipment.

Two-way's weakest link

The main offender is the F connector, the weakest link in two-way cable systems. It is the single most important piece in the puzzle, yet quality control is an ongoing, unsolved problem. F connectors are put together—or more aptly thrown together—by the thousands every day. Rating engineering functions on a scale of one to 10, most F connector installations would score a three or four if checked. What would be a 10 and how can we ensure every connector is assembled in the eight to 10 category? Attention to detail, proper training and a demanding quality level are the keys. Every F connector installation should meet the following criteria:

1) The cable jacket is cut back three-quarters of an inch without severing any of the braid. The cut should be uniform, making it hard to see the beginning and end of the cut into the jacket.

2) Spread the braid out evenly around 360 degrees of the cable. When the "umbrella look" is achieved, bend the braid back over the jacket creating a "film" of braid around the head of the cable. The foil is removed cleanly or left on, depending on the cable type.

3) The dielectric is trimmed. Here again, the cut must be precise, making it hard to see a beginning and end. The surface of the trimmed dielectric should be flat. The center conductor cannot be scored at its base and must be cleaned of any dielectric. Check and make sure no stray braids wrapped around the center conductor. The distance between the bare center conductor and the jacketed cable cannot exceed the recommended distance. For 59 connectors, it is usually a quarter of an inch. As well, the

remaining dielectric cannot be longer than specified.

4) The cable is ready for connector installation. A primary factor in deciding if the cable has been prepared correctly occurs when the connector is pushed on. Twist the cable and connector in opposite directions, while pushing them together. If the internal metal sleeve of the connector does not slide in evenly or binds up in the braid, cut the cable and start over. Forcing the connector on at this point is a major shortcut taken in the industry. Every connector should go on with the same feel.

5) When the connector is fully installed, the dielectric should be flush with the inside surface of the fitting. It is critical for the braid to be under the ring when crimped to ensure pull strength performance.

6) Using the correct crimping tool, firmly crimp the ring. Trim the center conductor if needed so that it sticks up over the connector one-sixteenth to one-eighth of an inch.

The connector now is assembled; the job is half complete. The fitting has to find its mate.

All F connections should be hand tightened and then an additional third to half a turn applied with a wrench. *Do not* overtighten. To ensure the tightness and integrity of the splice, two checks are needed. First, grab the cable four to six inches back from the fitting. Rock the cable side to side; if the male connector's crimp ring rocks with you, there is a problem. It never should rock back and forth. Stage two of the test requires holding the cable in the same manner and twisting it in a circular motion. The cable should twist at least 45° without the crimp ring spinning along with it. If the back of the connector rotates easily, there is a problem.

> *'Look around most offices or cable trucks and you will see unsightly piles of converters and line electronics'*

To rectify these problems, check the threads of the connectors for evidence of cross threading or burrs. If there is nothing obvious and you are sure the connection is tight, remake the fitting and try again. If that doesn't work, try another port. When an over- or undersized port is found, replace the offending splitter or ground block and try again. Where the problem is a tap port, usually one of the other ports will be OK. Make sure to report the defective tap so it can be replaced.

Understanding that a certain percentage of work performed will be done more than once is a key principle that applies to most engineering functions. A 10 to 20 percent replacement rate during F-fitting assembly is healthy and indicative of proper job completion and quality.

Don't settle for second best

If all F connector installations were subjected to this type of scrutiny, signal leakage and the ability to use your cable system for two-way transmissions would improve dramatically along with the reliability of services delivered. Attention to detail and demanding the highest quality and consistency of work for all job functions is the key to the industry's future and well-being. The industry has to address the basics of system operations. It is long overdue.

CALENDAR

February

Feb. 10-12: Jerrold technical seminar, Holiday Inn Central Park, Orlando, Fla. Contact Seminar Administrator, (215) 674-4800.

Feb. 10-12: Magnavox CATV training seminar, Lincoln, Neb. Contact Amy Costello, (800) 448-5171.

Feb. 11: SCTE Miss/Lou Meeting Group BCT/E review course on Category IV-Distribution Systems and tour of Daniels headend systems, Prince Murat Hotel, Baton Rouge, La. Contact Rick Jubeck, (601) 932-4461.

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

Feb. 18-19: Blonder-Tongue SMATV/MATV/CATV/TVRO technical seminar, Hilton Gateway Inn, Orlando, Fla. Contact Bill Benscik, (904) 732-9775, or Sharon Leight, (201) 679-4000.

Feb. 18-20: Texas Cable Show, Convention Center, San Antonio, Texas. Contact (512) 474-2082.

Feb. 18-20: Magnavox CATV training seminar, Albuquerque, N.M. Contact Amy Costello, (800) 448-5171.

Feb. 20: SCTE Chesapeake Meeting Group seminar on signal leakage and tour of FCC leakage patrolling vehicle, Sojourner-Douglass College, Baltimore. Contact Tom Gorman, (301) 321-6093.

Feb. 24: SCTE Satellite Tele-Seminar Program, "Video and Audio Signals and Systems," Part I, 1-2 p.m. EST on Transponder 7 of Satcom IIIR. Contact (215) 363-6888.

Feb. 24-26: Magnavox CATV training seminar, San Antonio, Texas. Contact Amy Costello, (800) 448-5171.

Feb. 24-26: C-COR Electronics technical seminar, Pittsburgh. Contact Tammy Kauffman, (800) 233-2267 or (814) 238-2461.

March

March 1-3: Caribbean Cable TV Association annual meeting, Casa de Campo, Dominican Republic. Contact Andrea Martin, (809) 774-2080.

March 1-3: Oregon Cable Communications Association annual meeting, Chumaree Hotel, Salem, Ore. Contact Mike Dewey, (503) 362-8838.

March 4-6: Magnavox CATV training seminar, New Orleans. Contact Amy Costello, (800) 448-5171.

March 11: SCTE Shenandoah Valley Meeting Group review on BCT/E Category II—video and audio signals and systems, Blue Ridge Community College, Verona, Va. Contact David Lisco, (703) 248-3400.

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

March 17: Ohio Cable Television Association annual meeting, The Hyatt on Capitol Square, Columbus, Ohio. Contact Dan Helmick, (614) 461-4104.

March 23-25: North Central Cable Television Association annual convention and trade show, Radisson St. Paul Hotel, St. Paul, Minn. Contact Mike Martin, (612) 641-0268.

March 24-26: C-COR Electronics technical seminar, Portland, Ore. Contact Tammy Kauffman, (800) 233-2267 or (814) 238-2461.

March 25-27: Virginia Cable Television Association annual convention, The Homestead Resort, Hot Springs, Va. Contact Lorraine Whitmore or Dick Carlton, (804) 780-1776.

Planning ahead

April 2-5: SCTE Cable-Tec Expo '87, Hyatt Hotel, Orlando, Fla.

May 17-20: NCTA annual convention, Convention Center, Las Vegas, Nev.

July 20-22: New England Show, Dunfey's Hyannis Hotel, Hyannis, Mass.

Aug. 30-Sept. 1: Eastern Show, Merchandise Mart, Atlanta.

Sept. 21-23: Great Lakes Expo, Indianapolis Convention Center/Hoosier Dome, Indianapolis.

Oct. 6-8: Atlantic Show, Convention Center, Atlantic City, N.J.

AD INDEX

FIRST CALL FOR ENTRIES SCTE 1987 NATIONAL ACHIEVEMENT AWARDS

SCTE
1987
AWARDS
PROGRAM

NOMINATION/APPLICATION FORMS

OBJECTIVE: To recognize outstanding individuals involved in all levels and job categories in their relationship to the technical requirements of the CATV industry.

Striving for excellence is what the 1987 SCTE Achievement Awards are all about and they will honor those specific individuals for taking that extra effort to be the best.

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

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

DEADLINE: All entries must be received by Monday, March 16, 1987, at the SCTE national office so as to be considered for the 1987 National Achievement Awards presentations at Cable-Tec Expo '87.

ENTRY PROCEDURE

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

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

3) All entries are to be mailed to:
Attn: 1987 Awards Committee
Society of Cable Television Engineers
669 Exton Commons
Exton, PA 19341

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

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

NOMINATION/REFERENCE FORM 1987 SCTE ACHIEVEMENT AWARD

File No. ____________
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(This form is to be used for the nomination of any National SCTE member and is also to be used by persons submitting reference material in support of any SCTE member's individual application for award. Reverse side must also be completed for entry to be processed.)

Nominee
Name ____________
Phone ____________
Address ____________

Submitted by
Name ____________
Phone ____________
Address ____________

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

APPLICATION FORM FOR 1987 SCTE ACHIEVEMENT AWARD

☐ Self Nomination
☐ Nominee Reference
(Please check one.)

File No. ____
Date Recv'd. ____ / ____ / ____
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Name ____
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Started in CATV ____ / ____ / ____
SCTE Member since ____ / ____ / ____
National SCTE Status No. ____
Local SCTE Chapter or Meeting Group Name ____
SCTE Certification — Broadband Communications:
Technician ____ (enter certified categories)

Employer ____
Phone (____) ____
Address ____

Employed here ____ / ____ / ____
Supervisor
Name ____
Title ____

Engineer ____ (enter certified categories)

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

Equipment/Services Supplier
__ Field Eng'r/Tech
__ Field Sales Rep
__ Equipment/System Designer
__ System Const. __ Foreman __ Mng'r
__ Chief Engineer
__ Corporate Management

Please answer the following (Use additional sheet if necessary):

1) Describe what you like about your work activity in the CATV Field.

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

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

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

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

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

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

Reader Service Number 39.

It's a team effort

By Rick Cole
Plant Supervisor, Indianapolis Cablevision

Consider yourself preparing for a long awaited and well-deserved vacation. Your plans include a trip beginning in Chattanooga, Tenn., and ending on a lake in northern Minnesota. There's obviously one important thing that you don't want to overlook (besides bringing your fishing tackle). You certainly don't want the amount of time you spend at your favorite fishing hole shortened because you are delayed by an unexpected breakdown halfway between Duluth and International Falls. A visit to your friendly mechanic for a checkup sets your mind at ease, and you're on your way after the walleyes!

Well, the same school of thought applies to CATV. You can spend a lot of time and effort in designing, constructing and marketing a top-notch cable system, but don't overlook a planned and organized preventive maintenance program.

Due to the fact that cable plant is exposed to constantly changing weather conditions—heat, cold, wind, ice and snow—it is very susceptible to failure. Of course, these failures always seem to occur at the most inappropriate times.

It becomes our responsibility as installers, technicians, engineers and managers to recognize the need for solid preventive maintenance programs and the implementation of these programs in a strategic fashion.

Installers—During a routine install, it takes very little time to look at the physical condition of the tap, F connectors, traps, strand, lashing wire and hardware. Installers should get accustomed to checking any "re-connects" thoroughly. Don't overlook broken ground wires, corroded F connectors at the ground block, old ground rods, bad drop wire, etc.

Technicians—After the installer's job is completed, the technician's job begins. The same procedure applies to technicians during routine trouble calls as applies to installers during routine installs, i.e., checking for potential problems from the pole to the television. However, the technician's responsibility continues back to the trunk station.

The technician must be assigned a minimum amount of cosmetic and technical plant maintenance to be achieved on a scheduled basis. The cosmetic maintenance would consist of inspecting an assigned portion of the distribution plant for broken or loose lashing wire, kinked or damaged trunk or feeder cable, loose traps, broken or non-existing vertical grounds, bonds, etc. Technical maintenance consists of balancing the distribution plant from the trunk station to the point of termination. It is very important that the assigning of distribution plant to be balanced is coordinated in conjunction with the trunk sweep response program.

Sweep technicians—Much to some people's misbelief, sweep technicians don't spend their day chasing the elusive "dB" around with a whisk broom. The sweep technicians or mainte-

Line extenders

Record all readings required to complete the line extender flow chart. Begin checking input levels to line extender. If input levels are correct (as stated in print), balance line extender to correct output levels (also as stated in print). If input levels are low in comparison to print, begin troubleshooting feed leg on input side of line extender. Check for bad tap, water in tap, bad connectors, loose seizure screws, incorrect tap valves and design errors. If a design error is found, write up the discrepancy and submit a copy to your supervisor. If input levels are high with respect to print, check previous line extender or bridger for proper output levels. If previous device is running properly, check for incorrect DC, backward DC or design error. Again, if design error is found, note the discrepancy and submit to supervisor.

Line extender flow chart

Date ________ Headend ________ Tech # ________

LE # ________ Location ________ Map # ________

LE value ________ Equalizer value ________ Pad value ________

Output % Hum: High pilot ________ Low pilot ________

Voltage AC ________ DC ________ Power ________

Levels:

Channel	Frequency	Input	Output
2	55.25 MHz	______ dB	______ dB
LP	109.25 MHz	______ dB	______ dB
9	187.25 MHz	______ dB	______ dB
HP	301.25 MHz	______ dB	______ dB

Standard output levels: (unless stated otherwise in print)

(1)	Cascade LP	44 dB	
	HP	48 dB	
			(300 MHz)
(2+)	Cascade LP	42 dB	
	HP	46 dB	
(1)	Cascade LP	38 dB	
	HP	42 dB	
			(400 MHz)
(2+)	Cascade LP	38 dB	
	HP	42 dB	

Comments: ________

Signature ________

Trunk stations

Record all readings required to complete trunk amplifier flow chart: trunk input and output levels, power (AC, DC bulk, DC regulated) and percentage of hum. After recording the levels, balance bridge amplifier as specified in print. Record all bridger levels.

If trunk output levels are not correct, *do not* adjust trunk amplifier. Note any irregularities and bring them to the attention of the field maintenance supervisor or the maintenance technician in the area that you are working in.

Amplifier flow chart

Date ____________

Location: ____________ Map # ________ Tech # ________

300 MHz ☐ 400 MHz ☐ Equalizer ______ Pad ______ Cascade # ______

Trunk out S/N HP ____ LP ____ % Hum HP ____ LP ____ AGC ____ Manual ____

Voltage AC ________ Power ________ DC bulk ________ DC reg. ________

Levels	Input	Output	Bridger output	
Ch. 2	______	______	______	55.25 MHz
Low pilot	______	______	______	109.5 MHz
Ch. 13	______	______	______	211.25 MHz
High pilot	______	______	______	301.25 MHz
Peak-to-valley	______	______		

Standard output levels:

Amplifiers:		300 MHz			400 MHz
Trunk	Low pilot	28	109.5 MHz	Low pilot	26
	High pilot	32	301.25 MHz	High pilot	30
Bridger	Low pilot	44	109.5 MHz	Low pilot	36
	High pilot	48	301.25 MHz	High pilot	40
Input levels:	High pilot	9-12		High pilot	9-12

Signature ________________________

nance technicians perform the vital task of ensuring that each trunk amplifier in the system is operating within its manufacturer specifications and design parameters. Due to improved test equipment technology, we are able to continually test our systems for proper frequency response with a minimum amount of interference (if any) to the subscribers' television receivers.

Along with the system sweep program, the sweep technician may be assigned the task of monitoring and repairing signal leakage throughout the system. Cosmetic maintenance is also an ongoing concern of the sweep technician. Every little "ding" or "kink" makes life somewhat miserable when trying to achieve an acceptable sweep response. Often times, sweep technicians also are utilized in tower maintenance to check for water in bulkheads, corroded jumpers, broken antenna elements, antenna alignment, tower structure cracks, etc.

Depending on the structure of the technical department, either service techs or sweep techs are utilized to conduct power supply maintenance. Standard power supplies should be checked for proper bonds and grounds, surge protection, voltage and current draw. In addition to the procedure performed for standard power supplies, standby supplies must be checked on a regular basis for proper float voltage, battery condition, alarm function and physical condition. Of course, we all know we never experience "brownouts" or "blackouts" related to the power company.

Engineers/managers—It is the engineer's responsibility to continue quality training to the field personnel. After the installer or technician understands the strategy and purpose of the preventive maintenance program, they tend to become more cooperative in striving to achieve PM goals.

Structuring and monitoring of the preventive maintenance program must be a priority. Establish reasonable goals and strive to reach them as a team. The performance of your system is directly related to the performance of your technical staff as a *team*.

You certainly don't want to be worrying about how many failures you are having while you are concentrating on the important things in life, like catching fish. ■

Trigonometry in cable television

By Ron Hranac and Bruce Catter
Jones Intercable Inc.

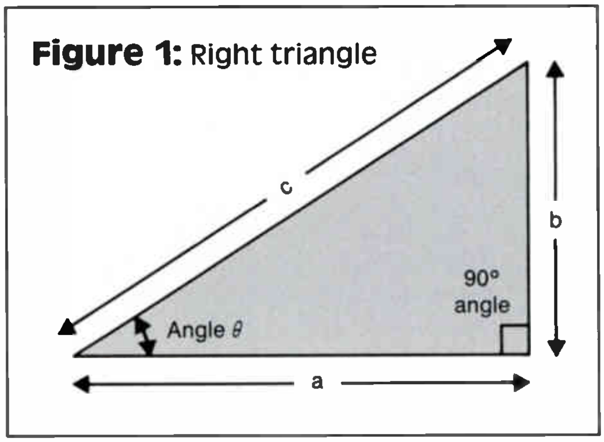
In any right, or 90°, triangle (Figure 1), if angle θ is between 0° and 90°, the sine, cosine and tangent are ratios of the sides of that triangle, as described by the most common trigonometric ratios:

$$\text{the sine of angle } \theta = \frac{\text{side b}}{\text{side c}}$$

$$\text{the cosine of angle } \theta = \frac{\text{side a}}{\text{side c}}$$

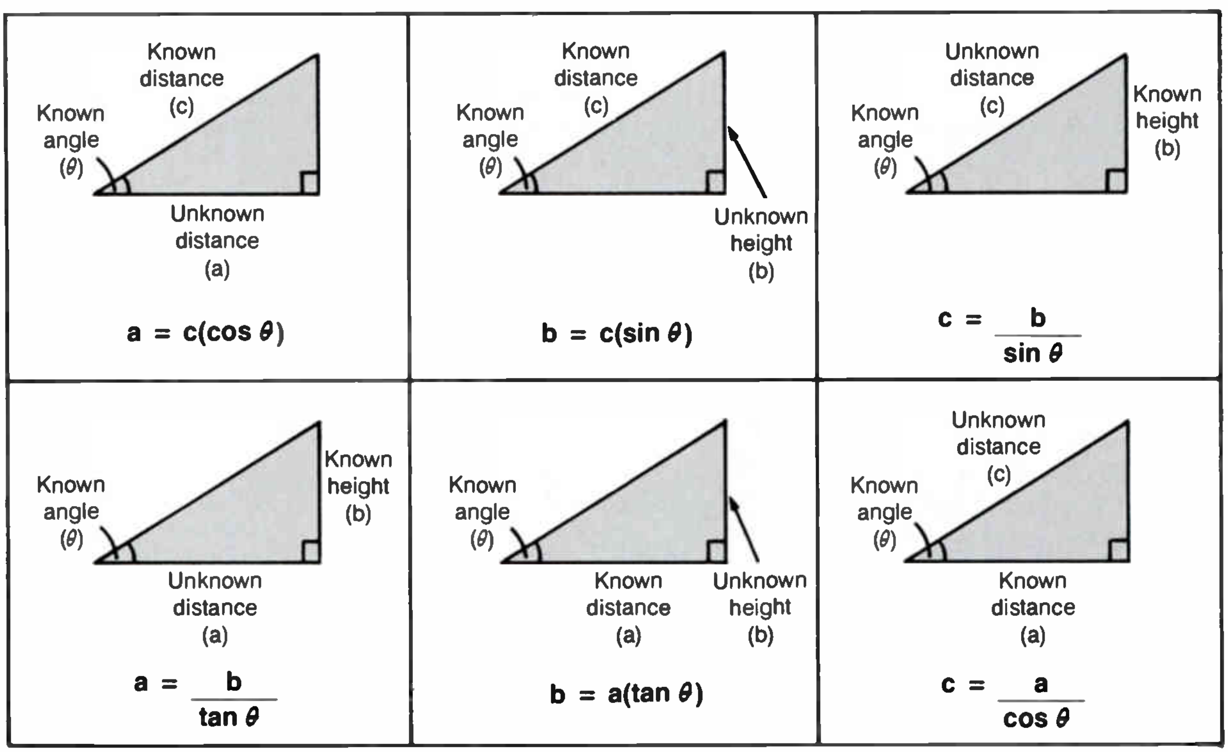
$$\text{the tangent of angle } \theta = \frac{\text{side b}}{\text{side a}}$$

Figure 1: Right triangle

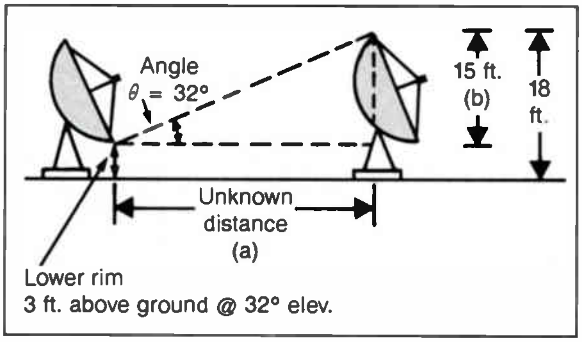


From these ratios, formulas can be derived (Figure 2) to determine solutions to problems that occasionally crop up in CATV engineering. Examples of the application of some of these formulas are on the next page.

Figure 2: Trigonometric formulas



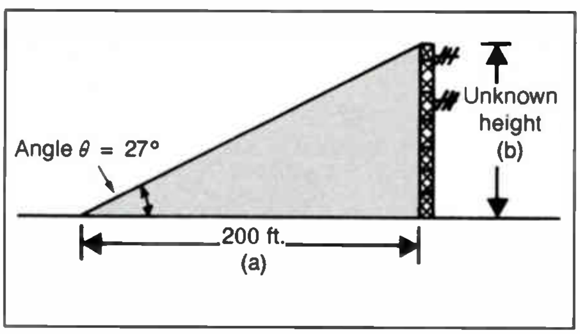
Problem:
A programmer's move to another satellite requires the installation of a new dish at your headend, but the configuration of the site only will allow installation behind the existing dish. Assuming the existing dish is 18 feet high, the minimum antenna pointing elevation to any satellite in the visible geosynchronous arc from your location is 32°, and the lower rim of the new antenna will be 3 feet off the ground at that elevation, how close behind the existing dish can the new one be installed?



Solution:
Subtract the new dish's lower rim height (3 feet at the minimum usable elevation) from the height of the existing antenna. The result, 15 feet, is the height of the "b" side of the triangle being used to solve this problem. Then, use the formula

$$a = \frac{b}{\tan\theta} = \frac{15\text{ feet}}{\tan 32°} = \frac{15}{0.6249} = 24\text{ feet}$$

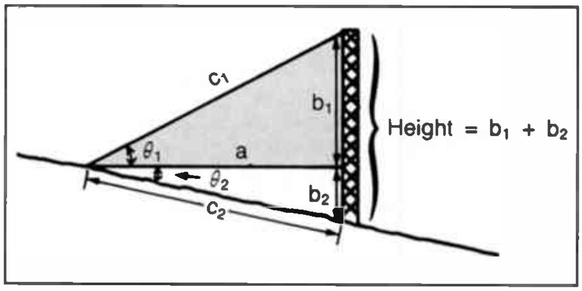
Problem:
Your company has just purchased a cable system, and you have been asked to verify the height of the tower at the new system's headend. With an accurate measuring wheel, you locate a spot 200 feet from the tower. From that spot, using an Abney level or a surveying transit, you measure the angle from the base to the top of the tower, and find it to be 27°. What is the height of the tower?



Solution:
Use the formula

$$\begin{aligned} b &= a(\tan\theta) \\ &= 200\text{ feet }(\tan 27°) \\ &= 200\ (0.5095) \\ &= 101.9\text{ feet} \end{aligned}$$

Note: The measurement of the angle θ must be made at the same level as the base of the structure being checked, or the calculated height will be inaccurate. If this is not possible, then additional calculations, such as those in the next example, will be necessary.



To calculate the height of the tower in this situation, first measure c_2 with an accurate measuring wheel; also measure angle θ_2 from level down to the base of the tower, and angle θ_1 from level up to the top of the tower. (Assume c_2 = 200 feet, θ_2 = 8°, and θ_1 = 25° for this example.)

Calculate b_2 with the formula

$$\begin{aligned} b_2 &= c_2(\sin\theta_2) \\ &= 200\text{ feet }(\sin 8°) \\ &= 200\ (0.1392) \\ b_2 &= 27.8\text{ feet} \end{aligned}$$

Calculate a with the formula

$$a = \frac{b_2}{\tan\theta_2} = \frac{27.8\text{ feet}}{\tan 8°} = \frac{27.8}{0.1405}$$

$$a = 197.8\text{ feet}$$

b_1 is found using the formula

$$\begin{aligned} b_1 &= a(\tan\theta_1) \\ &= 197.8\text{ feet }(\tan 25°) \\ &= 197.8\ (0.4663) \\ b_1 &= 92.2\text{ feet} \end{aligned}$$

The height of the tower, $b_1 + b_2$, is 120 feet.

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Reader Service Number 41.

Understanding low levels on C/N

By Paul D. Deckman
Project Manager, Warner Cable

When I ask what the effect will be on the subscribers' pictures if the input to a line extender drops 10 dB, the average technician will respond, "Snowy pictures." If I ask where the noise (snow) develops, the response usually is: "At the input stage of the line extender."

We are going to explore a typical situation and, in doing so, give a little better insight to what really is happening. To pursue this, a little mathematics is in order. There are three calculations involved:

1) computing the carrier-to-noise (C/N) of an individual amplifier,
2) computing a cascade of amplifiers having the same C/N and
3) computing C/N when C/N ratios are different.

These all can be computed quite easily on a scientific calculator with a few instructions.

Computing amplifier C/N

Let's cover the formulas first. Manufacturers list a noise figure for their amplifiers; to determine the C/N of the amplifier we use:

$$59 - NF + \text{input} = C/N \qquad (1)$$

where: nf = noise figure
input = input level in dBmV

Example: The noise figure of a trunk amp is 9 dB and the input is 10 dBmV: 59 − 9 + 10 = 60 dB C/N.

Example: The noise figure of a line extender is 10 dB and the input is 20 dBmV: 59 − 10 + 20 = 69 dB C/N.

Although the noise figure is worse in the trunk amp than in the line extender, the C/N is better. This simply is due to a higher input level.

To compute a number of amplifiers having the same C/N, the formula is:

$$SU\ C/N - 10\log N = \text{cascade } C/N \qquad (2)$$

where:
SU C/N = single unit C/N
N = number of amplifiers in cascade

For a cascade of 25 trunk amps (Figure 1) with a 60 dB C/N: 60 − 10log25 = 46 dB C/N. The formula is saying "60 minus 10 times the log of 25." With the scientific calculator it would be [25] [log] [×] [10] [=] [−] [60] [=]. Try it; it's as easy as it looks.

We now have calculated the single unit C/N and used that number to compute cascade C/N. Let's add a bridger and two line extenders. First we determine the single unit of each. Typically the NF on a bridger is 10 dB and the input is 19 dBmV. Using Formula 1: 59 − 10 + 19 = 68 dB C/N (bridger).

Two line extenders in cascade are derated for distortion improvement, so we will use a 17 dBmV input instead of the typical 20 dBmV. With an NF of 10 dB the C/N will be: 59 − 10 + 17 = 66 dB C/N (line extender). We now use Formula 3 to combine the different C/N ratios:

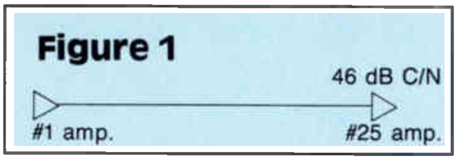

Figure 1

$$10\log\left(10^{\frac{-T}{10}} + 10^{\frac{-B}{10}} + 10^{\frac{-1LE}{10}} + 10^{\frac{-2LE}{10}}\right) \qquad (3)$$

where:
T = trunk cascade C/N
B = bridger C/N
1LE = first line extender C/N
2LE = second line extender C/N

In our example it would be:

$$10\log\left(10^{\frac{-46}{10}} + 10^{\frac{-68}{10}} + 10^{\frac{-66}{10}} + 10^{\frac{-66}{10}}\right) = 45.89 \text{ dB}$$

It is apparent that the bridger and line extenders, having such a high C/N ratio, contribute very little noise (46 − 45.89 = .11). Lowering the input to the second line extender 10 dB can be seen by reworking the formula using a −56 dB C/N for the second line extender in the formula. We use −56 dB because the change in C/N is one-for-one in Formula 1 (59 − 10 + 7 = 56 dB).

$$10\log\left(10^{\frac{-46}{10}} + 10^{\frac{-68}{10}} + 10^{\frac{-66}{10}} + 10^{\frac{-56}{10}}\right) = -45.52$$

The 10 dB lower input resulted in only a .37 dB change in the C/N ratio and that in itself is not going to create "snowy" pictures.

Converter C/N

The next active device the signal "sees" is a converter, or the television receiver itself. The following steps also can be taken with a receiver but in our example we will use a converter. A typical addressable converter has a 14 dB NF and a standard converter usually has a 12 dB NF. If we use 4 dBmV as a typical input to an addressable converter, Formula 1 can determine the C/N of the converter: 59 − 14 + 4 = 49 dB C/N.

Using Formula 3 to *combine* the −45.89 dB C/N (for normal system levels) with the −49 dB for the converter we will find:

$$10\log\left(10^{\frac{-45.89}{10}} + 10^{\frac{-49}{10}}\right) = 44.16 \text{ dB C/N}$$

It should be noted that the converter had a worse effect (.73 dB) on the C/N than the combined effect of a bridger and two line extenders (.11 dB). This would provide a noise-free picture.

Now let's consider the effect of the 10 dB drop at the line extender. The input to the converter is 10 dB lower (−6 dBmV), so the C/N of the converter is now 59 − 14 + −6 = 39 dB. If we combine the −45.52 dB (C/N of the system) with the −39 dB (C/N of the converter):

$$10\log\left(10^{\frac{-45.52}{10}} + 10^{\frac{-39}{10}}\right) = 38 \text{ dB C/N}$$

We now are in trouble with our picture quality. We still have not considered the C/N of the headend (minimal) or of the television receiver. The picture quality varies from subscriber to subscriber as the signal, even under normal conditions, varies due to different tap values, different drop losses, splitters in the drop, etc.

As can be seen in Table 1, we have one condition (10 dB low levels) having different effects on different subscribers. If the bridger output was 10 dB low, the effects would be similar but spread over a greater number of subscribers — thus possibly confusing the technician relying on picture quality as the only diagnostic tool. Determining that "the problem ain't here because the pictures are good" is just plain foolish. If we do away with the converter and just consider the noise figure of the TV set itself, we are faced with the same problem. You possibly could have side-by-side subscribers, both with a −10 dBmV signal, having totally different picture quality due to one set having a much better noise figure.

Understanding the effects of abnormal situations on your system is the key to troubleshooting quickly and effectively.

Table 1: Effect of low levels on picture quality

Subscriber	Normal set level	Conv. C/N	10 dB lower	Conv. C/N	Total C/N	Picture quality
Jones	4 dBmV	−49	−6 dBmV	−39	−38	Poor
Smith	10 dBmV	−55	0 dBmV	−45	−42	Good
Brown	−1 dBmV	−44	−11 dBmV	−34	−33.7	Very poor
White	8 dBmV	−53	−2 dBmV	−43	−41	Fair
Johnson	−3 dBmV	−42	−13 dBmV	−32	−31.8	Very poor

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