C-ED

San Diego's AML Microwave Complex
Signal Leakage and Channel Response

Communications-Engineering Digest
Reporting the Technologies of Broadband Communications

November 1977
Volume 3, No. 11

When It Comes To Earth Stations We Try Harder!

Ask Our Customers

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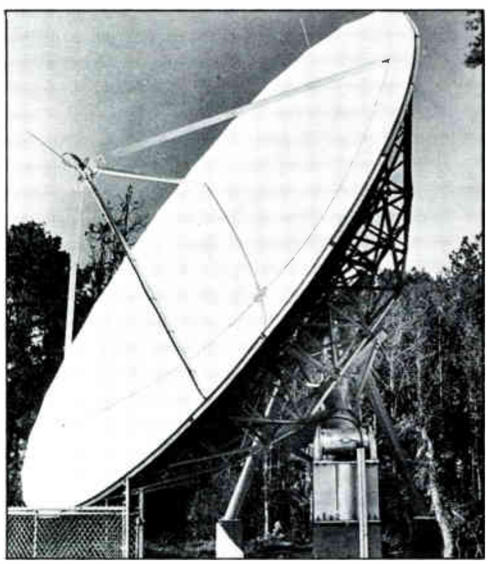

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C-ED News at a Glance

WASHINGTON, D.C.—The **Society of Cable Television Engineer's membership reached 1,000** at the Mississippi state association meeting October 21 in Biloxi, nearly doubling its membership since May, 1977. **S.Cratin Gautreaux,** a technician at G.E. Cablevision in Hattiesburg, MS **is the 1000th member joining SCTE.**

Two major MSO's, **Teleprompter and UA-Columbia, are underwriting SCTE dues for their technical personnel.** Teleprompter has enrolled almost 100 as SCTE members and UA-Columbia Cablevision has notified SCTE's Washington office that it wants 30 of its people signed up for 1978. This brings the **Society's total membership to over 1,100.** More operating companies are expected to join these two MSO's in enrolling their employees before the end of 1977.

WASHINGTON, D.C.—The **FCC Cable Bureau released five studies relating to** the issues taken up by **the "Inquiry into the Economic Relationship Between Broadcasting and Cable Television."** Using the most current data available, the Bureau's Research Division plans to apply "many of the economic data and concepts developed in these studies to research projects designed to treat more directly the issues of the Inquiry."

WASHINGTON, D.C.—The **final version of a bill on the pole attachments set for consideration soon by the full Congress** will contain a provision allowing the FCC authority to regulate rates where states choose not to do so. Yet to be resolved are two major differences in the bills reported by the Senate commerce committee and the House committee on interstate and foreign commerce. One is the House-proposed formula for "reasonable rates" to be applied to those states wishing to regulate; the other is the Senate provision giving the FCC fines and forfeitures authority over cable operators. Also, under the House bill, a "sunset" provision would allow for review of the entire proposal after five years and permit any state wishing to begin regulating poles to do so at any time, under the proposed formula.

According to Congressman Tim Wirth (D—CO), sponsor of the House version, "The Federal Communications Commission or state agencies must ensure that utilities will not take advantage of their monopoly control of poles to charge exorbitant rental rates to cable television companies. The present pole attachment rate abuses were clearly shown during our hearings, and the legislation . . . protects both the cable industry and the utilities, while reserving a large measure of autonomy for state regulators. The zone within which such rates may be set by the FCC or the states covers at a minimum all added costs associated with having the cable attached to a pole. At maximum, a utility can charge a price covering a proportionate share of all costs associated with erecting, capitalizing and maintaining the utility pole. This proportion is determined by the amount of usable space on a pole which is occupied by the TV cable."

Congressman Tim Wirth

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COVER: This space odyssey photograph was taken in San Diego on Cowles Mountain. Photographs for this story were provided courtesy of Hughes Aircraft Company's Microwave Communications Products.

Editor's Letter

When we sat down to map out this Western Show issue, managing editor Toni Barnett and I laid out three criteria: that it be timely, interesting and, considering the site of the Western Show, that it be apropos. Before long, one story above all others stood out as our logical choice—AML San Diego county which someone once described as "the guts of San Diego Cable." So we asked technical editor Ron Cotten, who we announced in our October issue has joined us, to tackle this complex tale of San Diego AML. With the combined efforts of Ron and Toni and artist Pat Isenberg who, by the way, is the artistic talent behind *C-ED*, we offer you this fascinating cover story, beginning on page 28.

There is much more too as our secondary features focus on channel response and signal leakage. You can find those on pages 11 and 38, respectively. Then, when you're done with that you can find out more about the San Diego story when you turn to this month's System Profile, which highlights Cox's Mission Cable.

We've also got a *C-ED* special report on the recent House communications subcommittee's hearings on fiber optics, and that's on page 14. And when you're through with *C-ED*'s other departments, we ask you to look forward to our December issue when we will bring you our Tech Review and post convention wrap-up, plus *C-ED*'s exclusive readership response survey.

Finally, we would again direct your attention to *C-ED*'s exclusive offer—simply turn to pages 18 and 19, fill out the *C-ED* card and get cable's number one technical magazine *for free.* We guarantee it's an offer you can't refuse.

Paul A. FitzPatrick

Notice anything different about the SCTE lately? If not, you sure haven't been reading your mail or magazines. I have often heard the old adage "A little change is good." As far as the SCTE is concerned, I think we can safely add "A lot of change is better."

Out of our long, long period of stagnancy, we are finally starting to move and it shows. Owners, operators, manufacturers and suppliers are becoming more and more aware of our existance. The biggest change that I have seen is in the people within the Society. We now have many active and dedicated people as officers, on the committees, as chapter officers, and most active of all, Judy Baer keeping us all on our toes. The more people who become involved, the more there are who want to become involved, and that's great! After all, the one thing that can make or break any organization is the attitude of its people. We are finally getting away from our old one-man show and into a sharing of talent and ideas. Let's keep it going that way and we will all benefit.

Many of the chapters (particularly the North Central, of which I am a member) have been realigned into smaller chapters in order to better serve the members. Until recently the North Central consisted of fifteen states. There was just no way to provide seminars or help for an area this size. It is now broken down into seven chapters, each consisting of about two states. We can now concentrate our activities in those states and everyone has a chance to attend and participate.

Several chapters have been formed, or are forming alliances with their state cable associations. This arrangement is proving to be beneficial to both groups. State newsletters carry announcements of our meetings as well as theirs and manufacturers are less reluctant to send speakers and/or representatives, since attendance is greater. And, best of all, joint seminar costs are less for both groups. I strongly urge any chapter which is not presently holding joint meetings to contact their state association officers. You will probably be surprised at how cooperative and friendly they are.

Another change that is going to occur early next year is the change of officers. It isn't too early to start thinking about the people that you want running your Society. I would also like to see us add at least two more vice-presidents, one to represent the South and one for the Midwest.

It has been commented on by many that attendance at our annual SCTE meeting, which is held in conjunction with the NCTA convention, leaves a lot to be desired. The few of us who do show up seem to be suffering from some strange malady which causes red eyes, headaches, bad breath and a tendency to yawn continuously. Needless to say, it's anything but a lively group. That, too, is changing. The next annual meeting is planned in conjunction with the reliability conference, and we all know that only sober, upright people attend reliability conferences. After all, if they aren't reliable, who is? Seriously, it is a good plan and I hope to see you all there.

Glenn Chambers, SCTE Eastern vice president

Pennsylvania Cable Television Association Elections

George F. Gardner, chief executive officer of TV Cable of Carlisle, was elected president of the Pennsylvania Cable Television Association at their annual membership meeting. The meeting was held on September 26 at the Penn Harris Motor Inn, Camp Hill, Pennsylvania.

Gardner, a graduate of Pennsylvania State University, has been active in the cable television industry since 1951. During his career, he has owned or founded ten CATV-related companies in Pennsylvania. Along with his Carlisle system, Gardner currently operates cable television companies in Mechanicsburg and Waynesboro, PA.

Gardner is a member of the Institute of Electrical and Electronic Engineers, the Society of Cable Television Engineers and a founding member of the National Community Television Association.

Other officers elected at PCTA's membership meeting include Samuel A. Buffone, Westmoreland Cable Company, New Kensington, vice president; Samuel M. Altdoerffer, Sr., Cable Associates, Lancaster, treasurer; and Yolanda G. Barco, Meadville Master Antenna, Inc., Meadville, secretary.

Charles E. Strink, Frank Scarpa, Walter A. Kinash and Frank Nowak were elected to a three-year term on the board of directors. William T. Charles will serve on the board for two years and Mark Weber for one year.

Russell W. Brong, Lightening Electric Company, Hershey, Pa. was elected associate representative at the Associates' annual meeting, held the second day of the PCTA fall meeting. Elected to the assistant associate representative slot was Robert Toner, Toner Cable Equipment Company, Horsham, Pa.

The PCTA elections were held at the beginning of this year's very successful fall meeting. The three-day affair included management workshops, technical seminars and discussions on current problems facing Pennsylvania's CATV industry.

Daniel Aaron, chairman of the National Cable Television Association, led a stimulating discussion of pending national and state CATV legislation during the convention's second day.

That night, PCTA members hosted a reception and dinner for members of the Pennsylvania General Assembly. Former NBC News White House correspondent Robert Goralski delivered a strong after-dinner appeal for the necessity of choice in our free enterprise system.

The convention ended the following day with additional workshops and a legislative review, under the direction of PCTA's Public Affairs committee chairman, Robert J. Tarlton.

Canadian Cable Television Association Call For Technical Papers

Again this year, the Technical Committee of the CCTA is sponsoring an enhanced technical program at the 21st annual Convention and Trade Show to be held at the Queen Elizabeth Hotel in Montreal, Quebec, May 30th to June 2nd, 1978. Original papers (not submitted elsewhere) are invited.

Papers are solicited from engineers, technicians and others in the technical field on any subject of cable television interest. The following general categories are suggested, but all practical and theoretical aspects of cable television technology should be considered as possible subjects:

- headend and control techniques
- distribution techniques
- antennas and masts
- test equipment and test methods
- maintenance problems and their solutions
- fiber optics
- satellite communications
- expanded channel techniques and equipment
- technical management and administration
- implementing BP23
- specific problems of the smaller systems
- safety

Papers should be of either ten minutes or twenty minutes presentation time, and in each case, ten minutes will be allowed for discussion. Papers in both French and English will be welcome.

Slide transparency projectors will be available and other audio/video aids can be made available upon request.

An abstract and a summary of each paper should be submitted to: Mr. K.E. Hancock, director of engineering, Canadian Cable Television Association, 85 Albert Street, Suite 405, Ottawa, Ontario K1P 6A4.

The abstract should be no more than 200 words, without illustration, and will be used for publicity and program purposes. The summary should be limited to 500 or 1,000 words and may contain a few illustrations, and will be used to aid the committee in selecting suitable papers for presentation.

The deadline for receipt of abstracts and summaries is NOVEMBER 30th, 1977. Authors of selected papers will be asked to submit their complete manuscript, including original illustrations, by FEBRUARY 28th, 1978.

Bud Desmond Takes SCTE To Mexico

Times Wire and Cable Company's Bud Desmond took a stack of SCTE literature to Mexico in late July for the Mexican CATV show. He volunteered over the telephone and within hours, 3,000 pounds of brochures and applications were on their way to Times in Wallingford, Connecticut.

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TV Communications
September 1977

It's true.

The Avantek SL-300 Signal Level Meter.

The Optimum Combination — Digital Frequency Display, Analog Level Display
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AC-DC Voltmeter	Calibrated for sine or square-wave AC (RMS) for measuring system power, and for DC to check amplifier test points.
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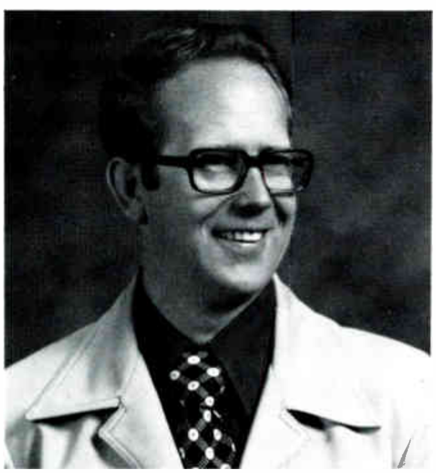
Channel Response Measurements Made EASY

By Gerald L. Bahr
Chief Engineer
Mission Cable TV, Inc.



Gerald L. Bahr is the chief engineer for Mission Cable TV, Inc., headquarted in San Diego, California. Mission Cable is the largest CATV system in the United States, with over 1,800 miles of plant, eleven AML receiver sites and 140,000 subscribers.

Introduction

Anyone who has tried to comply with the FCC requirements of in-channel response measurements realizes that it is a tedious job, often times producing less than satisfactory results. Typically, the "proof" pictures are poor quality, and correction of problems found can be a slow and cumbersome process.

The problem has been in displaying a clean, steady and accurate response of a modulator, processor or strip amplifier with other carriers present. It is particularly difficult to prevent a modulator carrier from saturating the detector and/or masking the sideband information, either of which makes it impossible to achieve satisfactory results using the typical sweep generator/detector techniques.

The above problem can be overcome through the use of a sweep system using a tracking receiver. This paper will specifically explain the method using the Avantek CT/CR-2000A; however, the techniques will work equally well for earlier Avantek models or for tracking systems produced by other manufacturers.

Figure 1
Avantek CT/CR-2000A

Test Equipment Required

1. Avantek CT/CR-2000A or equivalent
2. marker generator (RCA-WR99 or equivalent
3. double balanced mixer (Anzac model MHF-1 or equivalent
4. VHF amplifier (may need two)
5. video amplifier (may not need)
6. assortment of pads, jumpers, etc.

Sweeping On-Channel Processors

Figure 2 is the setup for sweeping on-channel equipment. This method is similar to the typical sweep generator/detector method and does not use the double balanced mixer. The marker generator is used for marker reference only.

For further details refer to the Avantek manual, section 12, page 30 under

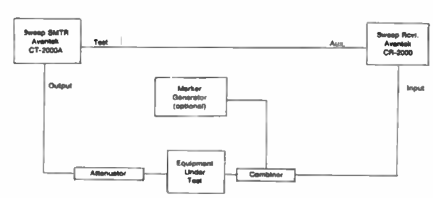
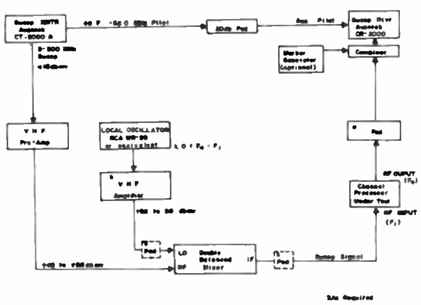


Figure 2
Set Up For Response Test Of On Channel Equipment

PROOF OF PERFORMANCE MEASUREMENTS.

Sweeping Off-Channel Processors

Figure 3 is the setup for sweeping off-channel processors. Note that the marker generator is used as a local oscillator. The generator is set to the difference in the channel input and output frequencies. The products of the DBM are both the sum and difference of the LO and RF frequencies. This setup will provide the proper input sweep for any channel conversion.

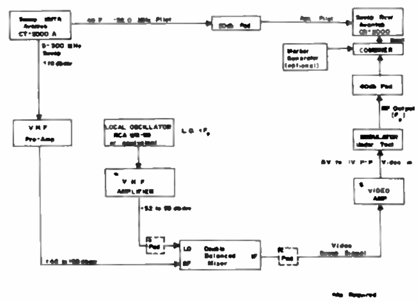


IF Input Sweeping

An IF input sweep uses the above setup as Figure 3 with the LO generator set at 45.75 MHz *above* the output channel frequency.

Sweeping Modulators

Figure 4 is the setup for sweeping modulators. Note that the generator is set to the same frequency as the output channel video carrier.



Double Balanced Mixer Cautions

A word of caution regarding the use of double balanced mixers: the DBM is a useful and versatile tool, and if used properly, it will provide excellent results. The first rule to remember is that the IF port must be terminated in a resistive load such as a pad, variable attenuator or an amplifier if the amplifier has a good input match well beyond the total bandwidth in question. Unless you know exactly what you are doing **do not** terminate the IF port directly into a bandpass filter. If the IF port is terminated into a reactive load the harmonic modulation products can vary as much as ± 20 dB with the conversion loss varying as much as ± 3 dB.

The LO port is the next most critical. The main caution here is to use a resistive load. The RF port is not critical as to the impedance that it sees.

For most DBMs used in CATV the local oscillator input level should be +52 dBmV to +58 dBmV.

A DBM impedance of 50 ohms represents a return loss of 14 dB when used in a 75 ohm test setup. If the above precautions are followed there should be no problems using a 50 ohm device.

Avantek Setup

It is necessary to modify the Avantek transmitter to remove the 49 MHz to 52 MHz pilot from the sweep to prevent overloading the VHF amplifier and/or the double balance mixer.

Refer to Figure 5 for the Avantek block diagram and make the following modifications:

1. Remove the jumper between T3-J3 (output of pilot amplifier/filter) and T4-J5 (input to hybrid combiner).
2. Disconnect the jumper at T4-J4 (one output of hybrid combiner) and reconnect at T3-J3 (output of pilot amplifer/filter).

This now sets the transmitter up so that only the pilot is available at the test point jack and only the sweep is available at the sweep signal jack.

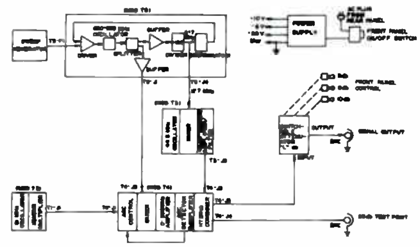


Figure 5
Avantek Block Diagram

Modulator Sweep Test Procedure

The modulator sweep test procedure is typically the most difficult of the headend units and, for the sake of brevity, will be the only procedure treated in detail in this paper.

Refer to Figure 4 and note that the sweep output of the Avantek transmitter is only +18 dBmV. This signal needs to be amplified approximately 30 dB to 40 dB. The higher the output of the amplifier the better, as long as the amplifier does not overload, and the combined sweep and LO powers don't burnout the DBM. (Some DMBs can handle combined powers of 65 dBmV to 70 dBmV without burning out.)

Feed this high level sweep signal into the RF port of the DBM. Connect the local oscillator (RCA-WR99 or equivalent) to the LO port of the DBM. If either the RF sweep or the LO level is low into the DBM it may be necessary to install a video amplifier between the IF output of the DBM and the input to the modulator, since 0.5 to 1.0 volt of video signal is necessary for proper modulation.

With the proper IF (video) signal level fed into the modulator, connect its output to the input of the Avantek receiver. Then connect the pilot tone from the Avantek transmitter (now located at the test point jack) to the auxiliary pilot input on the receiver.

The modulator is now set up for sweep testing. It may be necessary to pad the modulator output and/or the pilot tone to keep from overloading the Avantek receiver.

This test setup could be expanded to include the total cable system by inserting the Avantek transmitter pilot (at the proper level) into the trunk cable and taking the Avantek receiver out of the system.

If the headend has a multi-channel AML transmitter with transmitter monitoring, the AML transmitter can be included in the test. However, since the AML can't transmit the 49 MHz to 52 MHz pilot, the test could not run beyond the headend.

To perform the sweep test, set the Avantek receiver controls as follows: video filter to normal; sweep rate to remote lock; video gain to 10 dB per centimeter; and sweep width to full. Then, with the transmitter in the local control mode, tune F1 approximately 30 MHz below and F2 approximately 30 MHz above the output video carrier frequency as indicated by their respective dials. (These controls are internal ports on Avantek receiver models earlier than the 2000A.) The video carrier should now be displayed on the receiver CRT with the base line approximately two centimeters long and the video carrier near the center of the base line. Tune the center frequency control so that the tuning marker is under the video carrier and switch the sweep width to 1 MHz per division. The video carrier should now be displayed near the center of the CRT.

Using the center frequency control, move the video carrier two centimeters to the left of the center. Adjust F1 and F2 on the transmitter so that the base line just fills the full 10 centimeters of the CRT. Reduce the sweep rate on the transmitter to just above the flickering point, as viewed on the CRT. Now adjust the LO generator to the video carrier frequency. As the generator is tuned near the video carrier frequency the response of the modulator will begin to rise up from the base line. Tune the LO generator for maximum level on the response as viewed on the CRT. The LO is now tuned to the video carrier frequency.

As the LO generator is tuned for its maximum potential, it may be necessary to adjust the gain of the video amplifier, (if used), and/or the video modulation control to prevent over modulating the video modulator. It is best to adjust the modulation so that the sideband energy is approximately 6 dB below the carrier.

As can be seen in the response photographs (Figures 6 through 8), the display can be quite revealing. Figure 6 shows considerable reaction in the video bandpass area caused by the sound trap. Although it is desirable to have a video bandwidth of 7 MHz to 10 MHz, it can be a detriment in a CATV system if the upper sideband information is allowed to extend into the upper adjacent channel as indicated in the photograph. Keep in mind that the FCC channel response requirement is only from -0.5 MHz to 3.75 MHz with respect to the video carrier.

Figure 8 is the response of a channel processor. Although the video carrier is not present, a marker generator could be used (as shown in Figure 4) to show the location of the video and/or sound carriers if desired.

With the logarithmic display it is possible to see the rejection level of the vestigial sideband change 10 dB to 30 dB, depending on the proper setup of the equipment and the proper installation of modules and jumpers.

Depending on the tuning of the Avantek receiver, the tuning markers may not be as prominent as those in Figures 6 and 7.

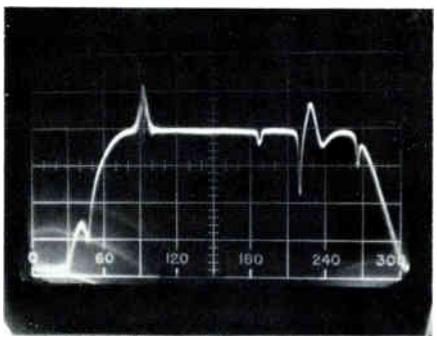


Figure 6
Vertical—10 dB/cm
Horizontal—1 MHz/cm
RCA CTM—10 modulator, bandpass filter and AML. Video carrier at the 90 MHz line. Tuning marker at the 190 MHz line. Sound trap at the 200 MHz line.

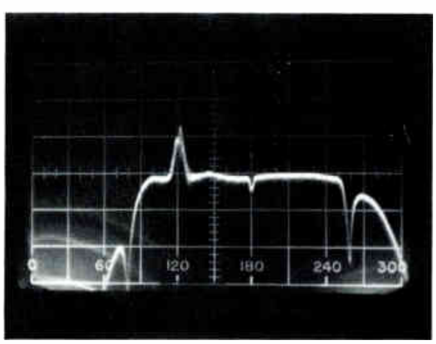


Figure 7
Vertical—10 dB/cm
Horizontal—1 MHz/cm
SA-6300—modulator, bandpass filters and AML. Video carrier at 120 MHz line. Tuning marker at the 180 MHz line. Sound trap at the 260 MHz line.

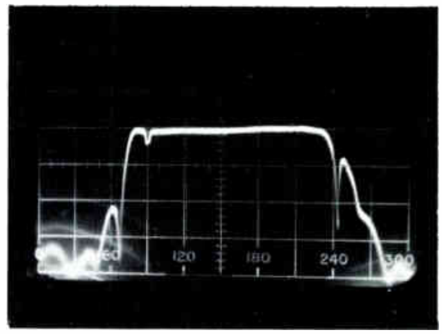


Figure 8
Vertical—10 dB/cm
Horizontal—1 MHz/cm
SA-6101—processor, bandpass filter and AML. The tuning notch at the 90 MHz line is the Avantek tuning marker.

Conclusion

The sweep generator with tracking receiver provides the means for fast and accurate in-channel response measurements. With two-way communications, two technicians can make the test from antenna terminals to the end of the system as one unit. C-ED

A C-ED Special Report

House Subcommittee On Communications Hosts Panel Discussion On Fiber Optic Technology

By Eileen Milton, Washington Correspondent

The House subcommittee on communications held an open panel discussion on fiber optic technology on October 3rd. Industry representatives presented a video demonstration on the state of the art of fiber optics and testified on the prospects of this new technology in the world marketplace.

An ITT video demonstration explained the capacity of fiber optics (for example, fiber optics can transmit all of the information in the Bible in 1/10th of a second), and it's compatability in any environment.

Another film showed a test being conducted in England by an ITT subsidiary, where the most complete system, utilizing fiber optics, has been operating for two years in conjunction with the British Post Office. The nine-kilometer route between Stebenage and Hitchin (thirty miles north of London) is the world's first high-speed, high-capacity repeater optical fiber telephone link. Optical repeaters (located at three-kilometer intervals) detect the signal, clean it up and retransmit it. Because the fiber has much lower bulk and weight than standard copper wire, in addition to higher traffic capacity and less electrical interference, installation was much simplier. The experiment also revealed that copper wires in the cable broke sooner that the fibers.

ITT's Dr. Charles Kao, who made the British experiment possible, told the subcommittee, "The wired city concept will become an economic reality." He predicted the fiber optics industry will reach the break-even point in the early 1980s because of the "enormous capacity" for a wide-range of applications. "Today repeaters are spaced at approximately three kilometers," Dr. Kao pointed out, "but in the 1980s repeaters are expected to be spaced at 50 kilometers." Due to these advancements, fibers will have greater trafficking potential and, Dr. Kao projected, "costs of implementing optical fibers will go down in time."

Bell Laboratories' Dave Thomas, executive director of Transmission Systems, maintained that emerging fiber optics technology "gives us hope about the duct problem underneath our cities." He informed the subcommittee about tests conducted by Bell Laboratories in Atlanta and Chicago that revealed how this technology has advanced in the last few years. According to the tests in Chicago, fibers proved to be 99.999 percent error-free per second—four hundred times that of the early 1970s.

The Chicago experiment linked two telephone buildings and a commercial building in a stretch of one and a half miles using twenty-four fibers. This system transmitted voice data (six hundred messages per fiber), and a video link with a picture-phone to New York City, San Francisco and Washington, D.C. A mass splicing technique was used that aligned the fibers precisely so that light passed alternately between the fibers. These tests showed a ½ dB loss in the fiber, which Thomas termed "not a large loss at all."

When questioned by Congressman Lou Frey (R-FL) as to when optical fibers will become economically competitive, Thomas claimed, "We're very close to being there now." Thomas suggested the advantages of a communications vehicle with a "higher capacity than wires can provide" will make "new services more economically attractive. There's no doubt," he added, "that this is a portent of the future."

Corning Glass, which manufacturers and supplies fiber optics, was represented by Dr. David Duke, general manager of Corning Glass' Optical Message Transmissions division. He explained his company's involvement in experimenting with optical fiber, which had undergone a "significant breakthrough" in 1970 when fibers reached attenuation levels of less than twenty dBs. This development made fiber optic applications more practical. "The primary message," Duke told the subcommittee, "is that this technology is moving out of the laboratories into manufacturing, into the plants and into the field. It's becoming a practical reality," Duke stated.

In the last 12 years, Corning has more than doubled its manufacturing capacity and intends to open another plant in 1978 "to meet the incredible demand from around the world." Duke, like the other witnesses, expects a "continuing decline" in the cost of fiber optics. As the volume of demand increases and the market develops, "we can bring the cost down very rapidly," Duke added.

According to Duke, the most immediate uses would include cable trunkline applications which are now in the process of actual implementation. "We will see even more commerical applications," Duke stated, "in the next couple of years." He also contended a system designer today could plan a system with all the equipment necessary to be confident.

In his closing remarks, Duke emphasized, "Fiber optic applications are really here; it's happening and it's going to develop rapidly."

From left-to-right are Dave Thomas and David Duke. On the far right is Dr. Charles Kao.

The House subcommittee prepares to convene the fiber optic session.

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FCC Chief Engineer To Keynote Singapore Telecommunications Conference

WASHINGTON, D.C.—Federal Communications Commission chief engineer Raymond E. Spence, Jr. will be keynoting the first U.S./Southeast Asian Telecommunications Conference and Exhibition to be held in Singapore, January 19-21, 1978.

Sponsored by the Electronic Industries Association's Communications Division, the event will include technical application seminars and associated telecommunications equipment displays and will draw attendees from the Southeast Asian region.

Accordiog to John Sodolski, staff vice president of EIA's Communications Division, "This unique program is being undertaken with two objectives in mind; one, to expose the Southeast Asian telecommunications officials to the latest in U.S. telecommunications product developments and technoloy; and two, to bring together representatives of the various Southeast Asian Posts, Telephone and Telegraph (PT&T) administrations as well as other appropriate communications entities with representatives of the American telecommunications industry."

Display and seminar participation is open to American firms. Sodolski expects more than forty firms to exhibit in the show including many smaller firms as well as major systems and equipment suppliers.

GenRad Delivers 1000th 1657 Digibridge To Sanders

CONCORD, MA—GenRad vice president Howie Painter presented a plaque commemorating the sale of their 1000th microprocessor-based model 1657 Digibridge™ impedance tester to Jack Bowers, president of Sanders Associates.

The GR 1657 is used for testing resistors, capacitors, inductors and other similar types of electronic components by engineering, quality control and incoming inspection departments.

Howie Painter (left) presents plaque to Jack Bowers.

C-COR Replaces Trunk Amplifiers In McGehee And Lake Village, Arkansas

STATE COLLEGE, PA—C-COR Electronics, Inc. has supplied amplifiers to Delta Cablevision, part of the Texas Community Antennas group, for the replacement of trunk amplifiers in its cable television systems in McGehee and Lake Village, Arkansas.

The 32 dB spaced amplifiers with modulated pilot control will upgrade service and improve overall system reliability.

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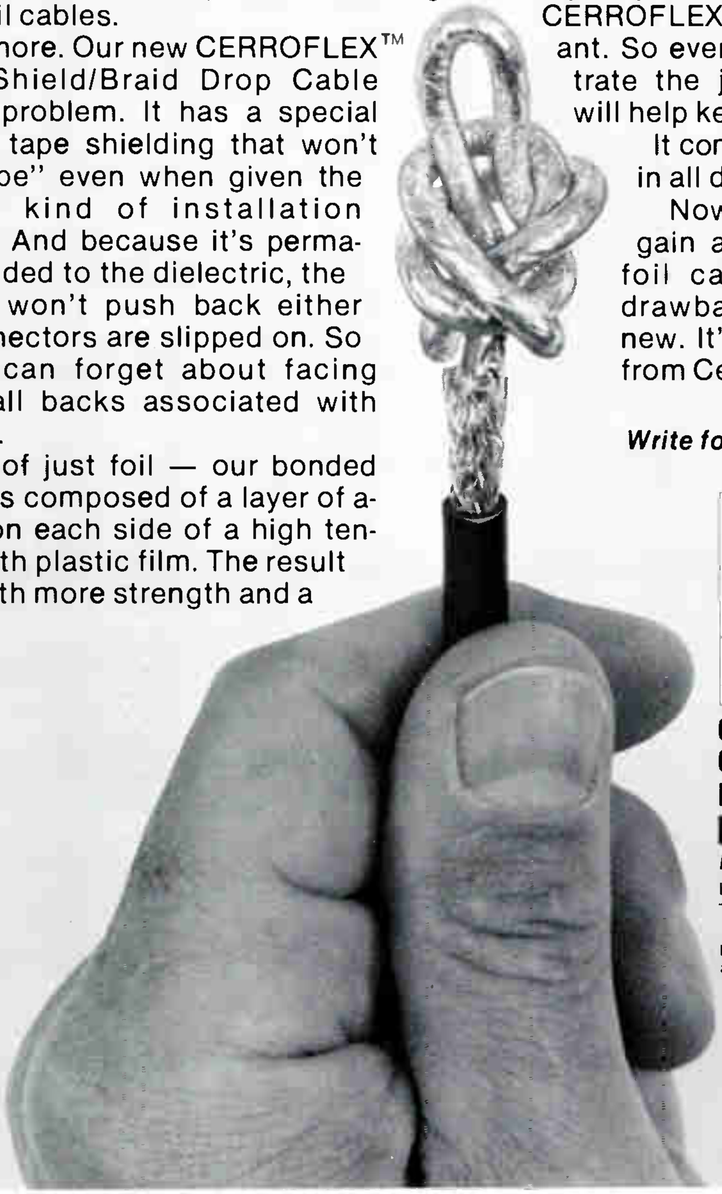

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Belden's Sales Training Program Graduates Seven Electronic Specialists

RICHMOND, IN—Seven electronic specialists graduated from the professional sales training program of Belden Corporation's Electronics division, and have been assigned to sales and marketing posts with the Richmond, Indiana-based electronic wire and cable manufacturer.

The graduates are Wallace M. Johnson, Lonnie A. Kerchief, Kimberly A. Lyon, Donald S. Moore, James R. O'Brien, Bruce C. Stanley and James W. Stedman. Six of the graduates will become field sales representatives for the Electronic division, reporting to Michael J. LaPorte, vice president, sales and marketing. Lyon will continue as a marketing specialist on the staff of divisional marketing manager Ronald L. Stier.

The sales training program, under the direction of Leonard G. Cebol, sales training and development manager, provides intensified education in the principles of sales as well as market-oriented instruction in product selection and application.

Oak CATV Division Names White Radio Ltd. As Canadian Sales Rep

CRYSTAL LAKE, IL—The CATV division of Oak Industries, Incorporated, announced the appointment of White Radio Ltd., Burlington, Ontario, as its exclusive sales representative in the Canadian cable television market.

White will warehouse and market across Canada all converter products manufactured by the CATV division. These products will include varacter converters (13 to 35 channel capability); single and multi-channel converter/decoders, and scramblers.

Indiana CATV System To Get Hughes Satellite Terminal

TORRANCE, CA—Clark County Cablevision, Jeffersonville, Indiana, CATV system operator, has awarded a contract to Hughes Aircraft Company's microwave communications products for a satellite video receiving terminal.

The contract calls for a completely integrated system consisting of a 4.5-meter-diameter antenna, low-noise amplifier, video receiver, and all necessary power supplies, cables, waveguides and integration hardware.

Clark County Cablevision will use the new receiving terminal to provide the Jeffersonville area with an optional premium programming service offered by Home Box Office, plus Channel 17 and Christian Broadcasting. Delivery of the terminal is scheduled for later this year, pending FCC approval.

Norman Weinhouse, left, earth terminal manager for Hughes Aircraft Company's microwave communications products, congratulates Gordon Rock, general partner of Clark County Cablevision, on the purchase by the Jeffersonville, Ind., CATV system operator of a Hughes satellite video receiving terminal. Looking on is Ben Forte, Hughes regional sales manager.

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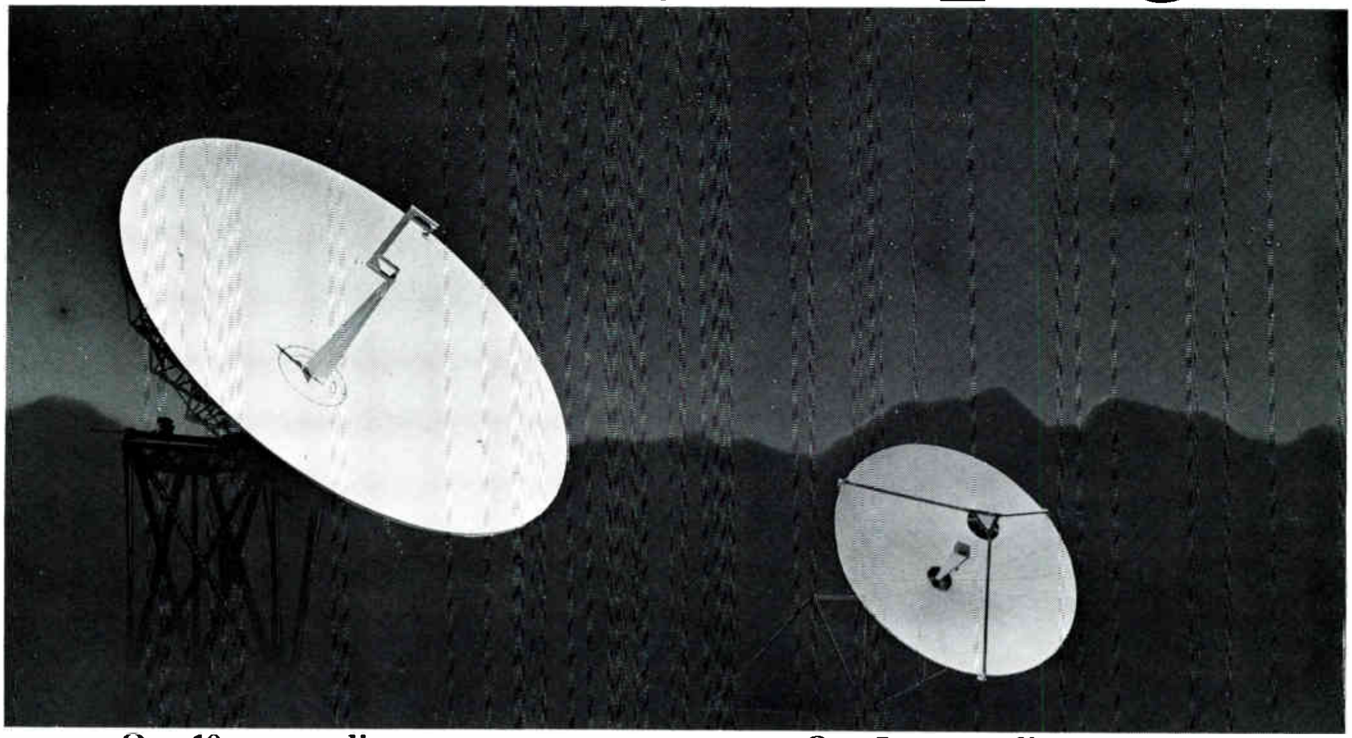

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Dynasciences Selects Five New Distributors

HORSHAM, PA—Dynasciences, a subsidiary of Whittaker Corporation, has announced the expansion of its video products distributor organization with the appointment of three distributors to serve the international market, and the addition of two distributors to the existing domestic organization.

Video Logic Services International has been appointed to cover Bolivia, Chile, Ecuador and Peru in Latin America, as well as Hong Kong, the Republic of China (Taiwan), and the Philippine Republic in the Far East. Video Logic Services International is located in Los Gatos, California.

Video Equipment Corporation of America, in San Diego, has been appointed to distribute Dynasciences video products in Mexico.

Representing the Dynasciences product line in the West Indies, Trinidad and Tobago, and in the remaining Central and South American countries, except Argentina, will be Comex Corporation, headquartered in Washington, D.C.

In the New England area, M.G. Associates of Portland, Maine has been appointed to serve Maine and eastern New Hampshire.

A new West Coast distributor, Video Systems Network, Inc. of Los Angeles, will serve Bakersfield, Fresno, Los Angeles, Ventura and San Bernardino counties.

NCTA Call for Papers

WASHINGTON, DC—The National Cable Television Association is developing an innovative technical program for its 27th annual National Cable Television Association Convention and Exposition to be held at the Rivergate Convention Center, April 30 through May 3, 1978, at New Orleans, Louisiana.

Papers are welcome from all aspects of the industry on any subject of cable television interest. Of special interest are the following categories:

- small earth stations
- testing and maintenance
- significant foreign cable developments
- rural distribution of CATV signals
- training and continuing education
- interference
- two-way
- small system problems
- protection of service and privacy
- pay cable
- fiber optics
- low cost microwave
- signal leakage
- advanced techniques
- Plus any other topic in the technical field of interest to cable television

Papers should be prepared for fifteen-minute presentation time. Additional time will be provided for discussion.

Slide and transparency projectors will be available, and other audio-video aids can be arranged upon request.

Persons interested in preparing a paper for the technical sessions are requested to express their interests by submission of a one-page (150 words) abstract no later than NOVEMBER 30, 1977. (Abstracts will be used for publicity and program purposes.)

If your paper is selected, you will be notified by DECEMBER 28, 1977. Your complete paper will then be due February 28, 1978 for publication in the NCTA Official Convention Transcript.

Submit your abstracts to: Robert A. Luff, vice president - engineering, NCTA, 918 - 16th Street, N.W., Washington, D.C. 20006.

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San Diego's AML Microwave Complex

By Ron Cotten, Technical Editor

When Theta-Com (at the time owned by Hughes) introduced the Amplitude Modulated Link microwave in 1972, one of the promises held out for the AML system was to provide a relatively inexpensive, high performance point-to-point distribution to replace long haul trunking of signals by cable. The AML system was seen by the industry as a key element in the development of large markets as well as a means of bringing cable to smaller markets that were considered to be nonviable. The smaller markets were considered nonviable due to the high cost and/or technical limitations of such alternate methods of signal transportation as FM microwave, sub-low trunking, etc.

The AML system was designed to transport a large number of of VHF signals over relatively short path lengths (when compared to FM systems) to a large number of inexpensive receiver sites. While the technical performance of the AML system was not on a par with conventional FM microwave, it was far superior to an equivalent coaxial cable trunk. The AML system was, of course, far less expensive than a conventional FM system. This system also had a large advantage in terms of the number of television signals it could carry because it used only 6 MHz of spectrum space for a single channnel as compared to 25 MHz in conventional FM systems. With these advantages, it was inevitable that the AML system would become common place in the industry.

This has indeed happened. To date, there are 180 systems in operation world-wide. Of these 180 systems, probably none illustrates AML's utility and versatility better than the complex of three multichannel transmitters and twenty-three receivers used by Times-Mirror, ATC and Cox Cable to distribute cable signals throughout the San Diego area. This microwave complex has over 240 path miles and provides signals to cable systems that

AML microwave transmitter site.

serve over 150,000 subscribers. Figure one provides a graphic representation of the total area served and, to some degree, an idea of the complexity of the system. The area covered by the AML system is approximately fifty miles by twenty miles.

The three transmitters are located, from north to south, on Mount Whitney, Poway Hill and Cowles Mountain. These transmitters are owned by Times-Mirror, ATC and Cox Cable, respectively.

Technician aligns antenna to bring in path signals to receiver site.

The following is a general description and data chart for each transmitter and receive site.

Poway Transmitter Site

The Poway transmitter site is shared by Cox Cable and Southwestern Cable (ATC). Cox uses the site as a receiver site to feed subscribers in San Diego county while Southwestern Cable houses their 22-channel transmitter at Poway Hill. Southwestern serves the communities of Soledad, Claremont, Mira Mesa and Rancho Bernado from Poway. In addition to the local stations, the Los Angeles signals are picked up off-air for distribution by AML. Southwestern also takes a feed from the Cox receiver for their local origination and shoppers guide. These signals are reprocessed at Poway before being transmitted to Southwesterns' systems.

A unique aspect of this installation is the use of both group C and group D frequencies at the same location (see Figure 2). Cox Cable receives 24 television channels at Poway from their transmitter site on Cowles Mountain. These 24 channels are received on group D which covers the spectrum of 12,759.7 MHz to 12,945.7 MHz. Southwestern's transmitter carries 22 television signals on group C, which covers the spectrum of 12,700.5 MHz to 12,898.5 MHz (the frequency of the highest channel used by Southwestern). As can be readily seen in Figure 2, there is an overlap of frequencies and therefore a potential for crosstalk. This overlap occurs between channel 3 through the FM band on the received signals and channel A through channel H on the transmitted signals; between channel A through channel 9 on the received signals and channel 8 through 0 on the transmitted signals.

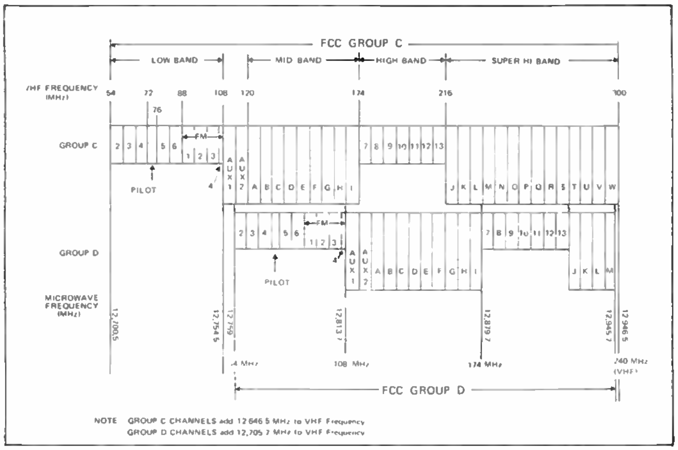


Figure 1

There are, however, offsets provided in the frequency assignments of group C and group D which avoid the worst case "zero beat" situation between carrier frequencies. Channels 3 and 4 in group D are offset from the corresponding channels A and B in group C by -0.8 MHz; channels 5 and 6 in group D are offset from channels D and E in group C by -2.8 MHz; and channels A through 9 in group D are offset from channels 8 through 0 in group C by -0.8 MHz.

Through careful selection of antennas with superior sidelobe rejection and cross polarization discrimination to achieve additional isolation, it has been possible to receive signals on group D while transmitting on group C at the same site.

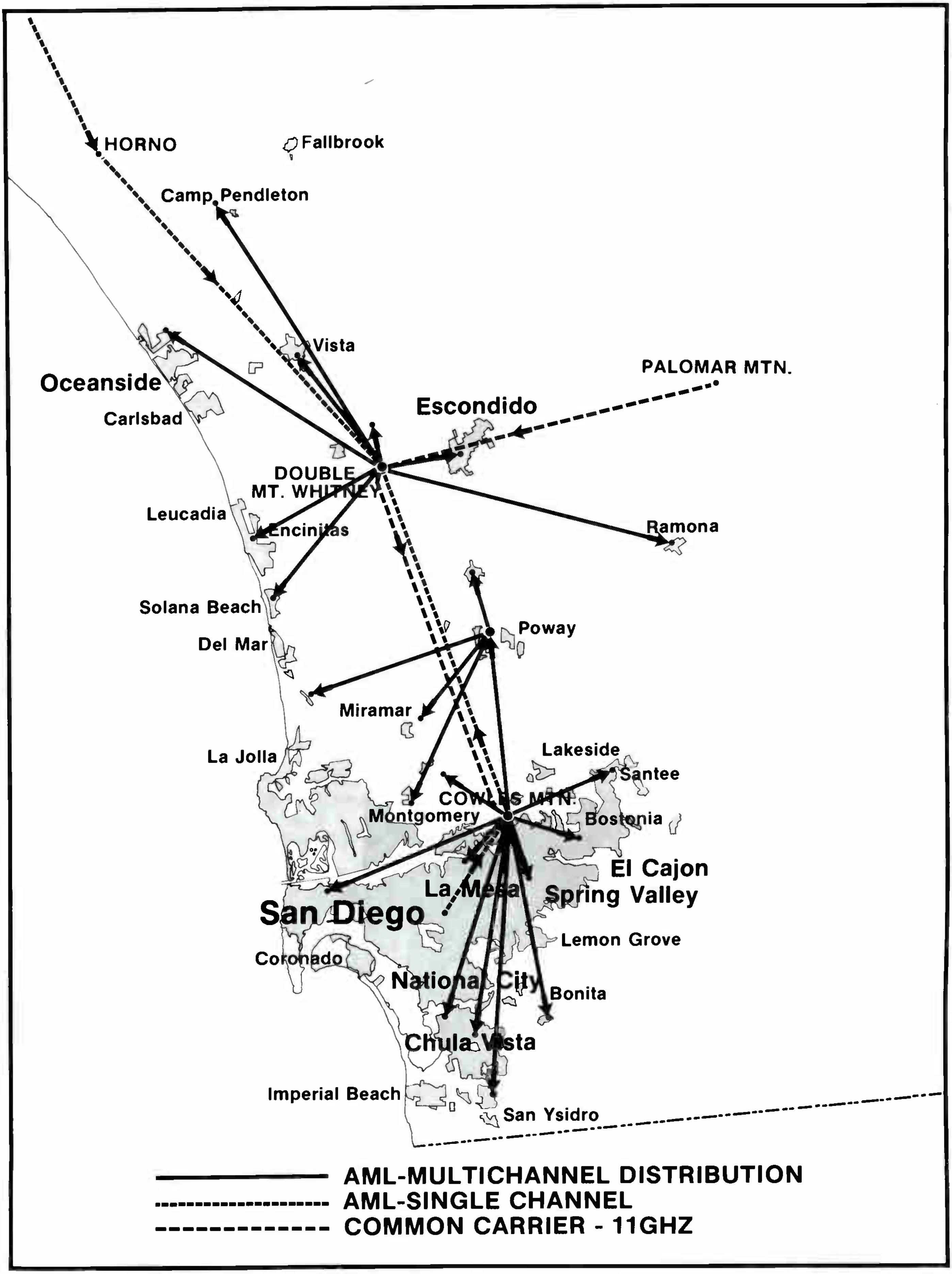
One minor case of crosstalk did occur but was quickly resolved by building a partial shroud out of copper screening on one of the transmitting antennas.

Further complicating the crosstalk problem is an FM CARS band signal being transmitted to Poway from Southwestern's office location. This microwave link carries HBO's pay television signal to Poway from their ten-meter earth station located near their office in San Diego. The combination of low power, frequency modulation and a shrouded high performance receiving antenna has prevented crosstalk problems from occuring.

Not all of Southwestern's systems carry the complete 22 channels due to system channel capacity or FCC regulations. Rancho Bernado gets the standard 12 channels but does not carry pay, mid or superband signals. Likewise, Pacific Beach, which is fed from the Soledad receiver, does not receive mid or superband signals. In both cases, selective filtering is done at the receive site at VHF frequencies.

Site	Path Length (Miles)	Antenna Input Power (dBm)	Antenna Size (Ft.)	Fade Margin (dB0 to 35 dB SNR	Tower Height (Ft.)	Miles of System	Subscribers	Maximum Cascade
Soledad	12.9	+ 8.1	Tx 10 Rx 10	22	Tx 40 Rx 15	158	9,764	32
Claremont	11.3	+ 8.1	Tx 10 Rx 10	21	Tx 140 Rx 132	130	9,740	23
Mira Mesa	3.3	+ 5.9	Tx 6 Rx 6	28	Tx 40 Rx 35	13	442	14
Rancho Bernado	3.3	+ 6.0	Tx 6 Rx 6	28	Tx 20 Rx 12	74	6,200	26
TOTALS	30.8					375	26,146	

System Data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AML-MULTICHANNEL DISTRIBUTION
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COMMON CARRIER - 11GHZ

Figure 2

Future plans for the system include one additional receive site and the construction of a screen room at the Soledad receive site to overcome maintenance problems created by the close proximity of the local television transmitters. The transmitting towers are located approximately 100 yards from the receiver, and while there are no problems when the receiver housing is closed, VHF ingress is a major problem when the housing lid is opened for maintenance.

Cowles Mountain Transmitter Site

Mission Cable operates perhaps the largest AML system in existence in terms of number of receive sites. The 24 channel transmitter is located on Cowles Mountain, just north of San Diego, and feeds signals to 11 receive sites located throughout the San Diego area. These 11 receivers provide signals to a staggering 94,096 subscribers connected to 1,269 miles of plant. The total size of Mission Cable is even larger when those portions of plant not fed by the AML system are included: 142,000 subscribers and 1,972 miles of plant. Of this 1,972 miles of plant, 600 miles is limited technically to 12 channels at the present time. Filtering of the midband and superband signals feeding the 12 channel plant is done at VHF frequencies at the receiver outputs where necessary. It is planned to convert the remaining 600 miles of 12 channel plant to 30 channel capacity by 1980. No modification of the AML system will be necessary except for the removal of filters.

When Mission Cable commenced pay TV operations in 1973, they decided to use the Oak scramble/descramble system for security. The Oak system was quite effective in controlling the security of the pay signal. But because the descrambling keying information was amplitude modulated onto the sound carrier of the pay signal, it was necessary to run the pay audio carrier 10 dB below video level rather than the normal 17 dB down. Although this created no particular problems on the cable system, the multichannel AML transmitter was sensitive to this increase in sound level and developed intermodulation distortion. The solution was to use a Hughes high power, single channel, amplitude modulated transmitter which could handle a moderate increase in audio level. The high power transmitter output was mixed into the multichannel transmitter waveguide network after being attenuated to the same power level as the multichannel transmitter. The result was a distortion-free pay signal with the sound level down 10 dB from video. No changes were necessary at the receive sites.

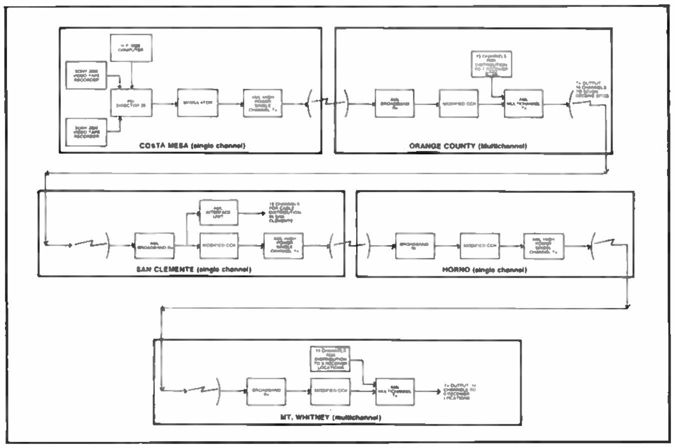


Figure 3

Times-Mirror operates a high power, single channel, AML transmitter at the Cowles Mountain site to deliver Cox Cables' local origination signal to the Times-Mirror AML site at Mount Whitney. This is a fairly long path of 21.6 miles and has performed reliably. A third single channel AML transmitter is in use to transport the San Diego county school system's programming to the Cowles Mountain site for distribution to cable subscribers.

The off-air pickup point for four of the Los Angeles signals is located on Palomar Mountain, north-northeast of Cowles Mountain. The four Los Angeles signals are brought by Mission Cable's common carrier FM microwave (11 GHz) from Palomar Mountain to Mount Whitney and then on to Cowles Mountain.

Two additional channels of FM CARS band microwave are in use by Mission Cable to bring two of the local signals to Cowles Mountain. This installation was necessary due to the severe VHF fading encountered at the Cowles Mountain site on these local channels.

Standby power is provided at the transmitter site and at all receiver sites to enhance reliability. Remote switching of the hot standby Klystron is to be installed in the near future. Mission Cable is also planning to add a twelfth receive site within the next two years.

Site	Path Length (Miles)	Antenna Input Power (dBm)	Antenna Size (Ft.)	Fade Margin (dB) to 35 dB SNR	Tower Height (Ft.)	Miles of System	Subscribers	Maximum Cascade
Lakeside	7.2	+10.0	Tx 8 Rx 8	23	Tx 25 Rx 20	163	11,464	22
El Cajon	4.9	+ 7.0 Rx 6	Tx 10	18 Rx 29	Tx 26	29	2,000	20
La Mesa	4.2	+ 7.0	Tx 6 Rx 6	14	Tx 55 Rx 20	177	12,416	21
Bonita Vista	12.5	+ 7.0	Tx 8 Tx 10	17	Tx 44 Tx 37	13	600	6
South Bay	8.2	+ 7.0	Tx 10 Rx 10	19	Tx 46 Rx 20	93	6,539	17
Palm City	15.9	+10.0	Tx 10 Rx 10	16	Tx 26 Rx 20	100	7,022	24
Chula Vista	11.7	+10.0	Tx 10 Rx 10	20	Tx 37 Rx 135	280	19,710	27
Central San Diego	7.2	+10.0	Tx 8 Rx 8	21	Tx 36 Rx 35	239	16,820	24
Point Loma	12.2	+10.0	Tx 10 Rx 10	17.5	Tx 26 Rx 50	48	8,579	17
Poway	10.5	+ 7.0	Tx 8 Rx 8	14	Tx 25 Rx 20	101	7,086	32
Tierra Santa	3.8	+ 7.0	Tx 8 Rx 6	31	Tx 26 Rx 10	26	1,860	12
TOTALS	**98.3**					**1,269**	**94,096**	

System Data

Mount Whitney Transmitter Site

Times-Mirror distributes 14 television signals from the Mount Whitney multichannel transmitter site to six northern San Diego county communities and to two locations on the Marine base at Camp Pendleton. Showtime's pay TV is carried in the midband.

The other 12 channels are on standard frequency assignments. The 12 channel service consists of local signals, received off-air; the Los Angeles signals (four of which are delivered to Mount Whitney from Palomar Mountain by Cox Cable's 11 GHz common carrier microwave); and Cox Cable's local origination signal, delivered to Mount Whitney by a high powered AML transmitter located at Cowles Mountain. In some respects, the Mount Whitney AML system is typical of many standard two-bay AML installations.

In another respect, however, the system is quite atypical. Showtime's pay television signal is originated at Costa Mesa, located about sixty miles to the northwest. It is delivered to Mount Whitney through five hops of AML microwave equipment in both the single channel and multichannel configurations. Two Sony 2800 video cassettes are managed by a Hewlett Packard 9825 computer and a PSI, Inc., Director 20 changer at the originating studio. This signal is then transmitted by a single channel AML transmitter from Costa Mesa north to Long Beach and south to Orange County where it is received on a standard broadband AML receiver. The signal is then reprocessed through a modified heterodyne processor and fed into Times-Mirror's multichannel AML transmitter which provides service throughout Orange County.

Channel Commander II's are used to reprocess the pay signal at four sites before the signal finally arrives at Mount Whitney. The Channel Commander II's have had their sound traps removed and their frequency response widened to 10 MHz in order to avoid an excessive accumulation of group delay distortion through the five hops. The pay signal is carried in the midband on the Orange County multichannel transmitter with a 12 MHz guard band left vacant on both sides to avoid adjacent channel filtering and the resultant group delay. Thirteen other signals are carried on the same transmitter for distribution to seven receiver sites.

One of the seven outputs of the Orange County AML transmitter sends signals to San Clemente where the pay signal is reprocessed through another modified Channel Commander II and fed into a second high powered AML transmitter. One additional repeater is incorporated at Horno before the signal arrives at Mount Whitney, once again utilizing a broadband receiver, modified Channel Commander II's, and another high power, single channel transmitter. Figure 3 is a flow chart of the entire circuit.

Site	Path Length (Miles)	Antenna Input Power (dBm)	Antenna Size (Ft.)	Fade Margin (dB) to 35 dB SNR	Tower Height (Ft.)	Miles of System	Subscribers	Maximum Cascade
Solana Beach	10.5	+10.0	Tx 8 Rx 8	24	Tx 20 Rx 20	30	1,217	10
Romona	18.0	+13.0	Tx 10 Tx 10	27	Tx 20 Rx 20	28	671	11
Escondido	5.6	+ 7.0	Tx 8 Rx 6	23	Tx 20 Rx 20	230	17,537	30
Vista	5.4	+ 7.0	Tx 6 Rx 6	18	Tx 20 80 Rx 20	5,100	29	
Camp Pendleton Hospital	19.6	+13.0	Rx 10	Tx 10 26	Rx 20	Tx 20 7	188	6
Camp Pendleton Wire Mountain	15.1	+10.0	Tx 10 Rx 10	23	Tx 20 Rx 20	30	330	3
Encinitas	7.4	+ 7.0	Tx 8 Rx 8	24	Tx 20 Rx 20	45	1,826	18
San Marcos	3.5	+ 7.0	Tx 6 Rx 6	22	Tx 20 Rx 20	59	3,736	12
TOTALS	**85.1**					**482**	**30605**	

System Data

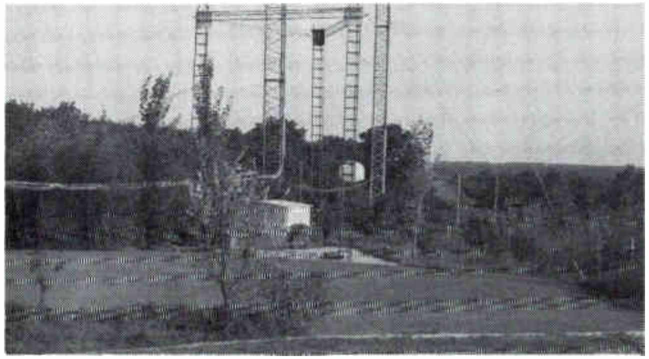
The entire five hop system is subjectively transparent and is an excellent example of innovative enginnering by the Times-Mirror staff.

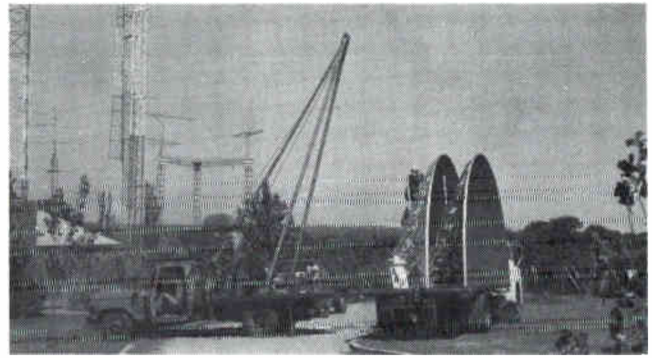
One final touch is added at Mount Whitney where the pay sound is reprocessed through an Orbin parasound stereo synthesizer and added to the FM band. This service has received favorable acceptance by Times-Mirror's subscribers in the San Diego area. **C-ED**

A NEW WORLD'S TVRO RECORD?

USTC challenges every other supplier of CATV TVRO's to equal or surpass this feat.

Start with a bare piece of ground at 11 AM in the morning. And produce 52 dB (+) signal to noise TVRO pictures on HBO transponder 24 before 8 PM that evening. That's bare ground to a permanent TVRO installation (with poured concrete foundations!) in 8 hours, 48 minutes and 30 seconds. That's the record. And it says a great deal for the USTC 6 meter polar mount antenna, the experience and ability of the USTC TVRO installation crew, and how really non-complex a six meter TVRO antenna system **can be**. . .if you know what you are doing, and how to do it!





10:59 AM/THE SITE. . . Stakes in place, at 11 AM USTC will appear with a transit and locate the base center line. The terminal will go just behind the small tree left of center.

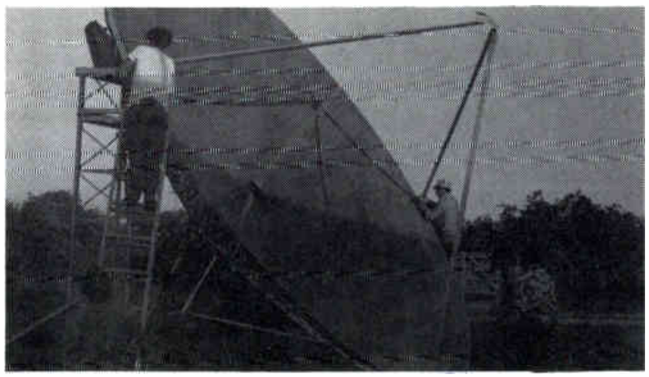
12:22 PM/READY FOR CONCRETE. . . Three concrete piers will be poured using 5.5 cubic yards of 3500 pound (2% calcium for quick-drying) concrete. 3,000 pounds of steel TVRO will sit here in six hours.

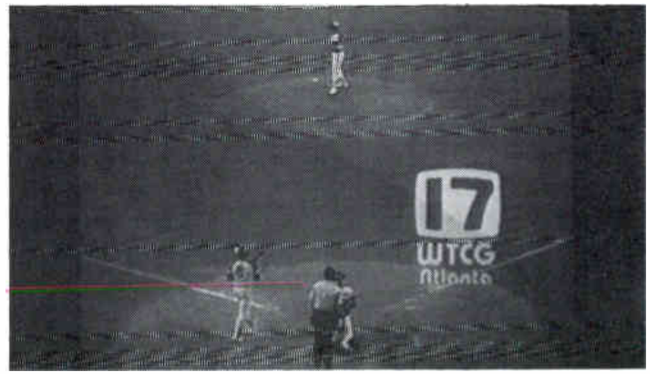
1:33 PM/OFF LOADING TVRO. . . Now the concrete is drying and the twin half-sections of the USTC SAT/FLECT I steel TVRO are off loaded from the lowboy trailer and placed into position adjacent to the poured base piers.

6:44 PM/PREPARING THE FEED. . . With 1.5 tons of terminal in place on the USTC polar mount the sun is setting as the feed-horn struts are bolted into place. Waiting for the concrete to dry has used up at least an hour at this point. **We could have been sixty minutes quicker!**

8:38 PM/INSTALLING LNA. . . The Scientific Communications 50-D 150°K low noise amplifier is mounted in place. That's a half-moon (the real moon!) just to the left of USTC President 'Stormy' Weathers, but this job will be done before the sun goes down.

8:48 PM/THE PICTURE. . . The six meter SAT/FLECT I terminal was within 0.2 dB of optimum C/N when power was applied to the LNA. And there it was, the Atlanta Braves vs. the Houston Astros in living color on 'Super-17'! A quick check revealed CBN (transponder 8), HBO (transponders 20 and 24) alive and well.





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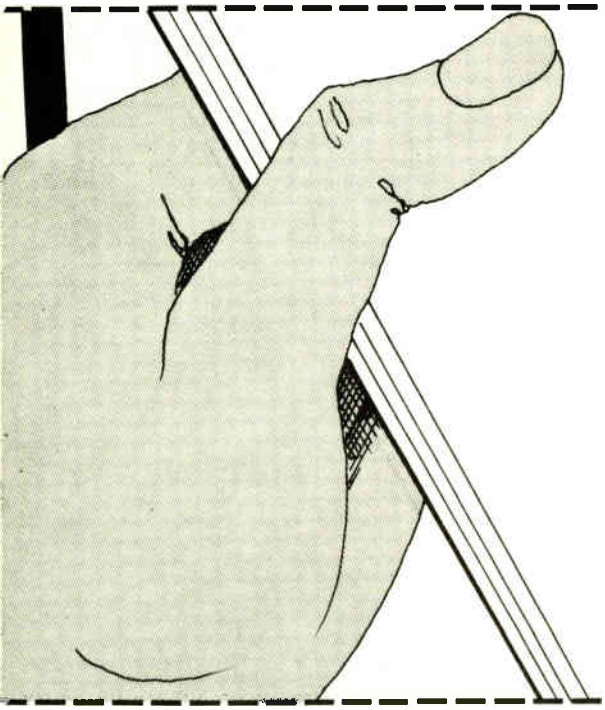

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TRANSMISSION LINE LEAKAGE

By Richard L. Shimp
Director of Research and Development
ComSonics®, Inc.
Harrisonburg, Virginia

ABSTRACT

A transmission line is defined simply as the means of transferring radio signals from a source to a load in an efficient manner. Applied to CATV it is the method of transporting signals received at the headend site to each subscriber with minimum loss and distortion. This transportation system mechanism and leakage phenomenon will be discussed in this article.

PHYSICAL REQUIREMENTS

Minimum loss in the CATV case is not negligible and more than one subscriber must be served requiring that the coaxial cable transmission line be periodically interrupted. The aluminum sheath used as the cable outer conductor must be somewhat soft to allow an economic method of storing between manufacture and installation as well as facilitating the various bends required during actual use (drip loops, etc.) This requires that a soft grade aluminum be used, enhancing structural weakness.

Single shielded drop cables, poor sheath to "F" fitting contact, cracked or broken DT housings as well as the previously stated facts form the basis for some of the radiation problems each CATV system is "blessed with". The transportation system mechanism and leakage radiation phenomena will be discussed in order to help create a better understanding of the task each system is required to control.

TRANSMISSION LINE LUMPED PARAMETERS

Transmission lines used in the CATV industry are 75 ohm constant impedence type consisting of two conductors, each placed at a strategic distance from the other.

Each conductor contains series resistance and series self-inductance. Collectively, the two conductors form the plates of a shunt capacitor.

The dielectric represents a shunt resistance. Per given length then, an equivalent circuit section may be made by lumping these distributed parameters together. (Figure 1)

It is also possible to represent a long transmission line by simply adding equivalent sections. (Figure 2)

If a battery was connected to the left end of Figure 2, C1 must charge through L1, causing a time delay. The moment C1 is charged, the voltage is applied to R1, L2 and C2 again presenting the very same situation and so on down the line. The time required for the signal to completely charge the line is called the **velocity of propagation**.

TRAVELING WAVES

An RF signal of given amplitude when applied to one end of a transmission line causes:

1) electromagnetic lines of force created by current passing through the conductors' inherent inductance and;
2) electrostatic lines of force created by current passing through the capacitance formed by the proximity of the two conductors with respect to one another. The speed at which these force fields travel through the transmission line is based entirely upon the dielectric material used to support the center conductor. If it were possible to have no support structure and the line was in a vacuum, the fields would travel at the speed of light (186,000 miles per second). However, since this is impossible, a velocity of propagation something less than the speed of light is obtained.

Traveling waves propagated down a transmission line occupy a definite physical length per cycle. Each cycle is called a **wavelength**.

If a signal with a frequency of 217.25 MHz is injected into a properly terminated air dielectric cable, electromagnetic and electrostatic force lines comprising one wavelength would occupy 54.35 inches. However, because the center conductor must have support, the propagation velocity, and, therefore, the length occupied by one wavelength is shorter by a factor dependent entirely on the type of dielectric material used.

If, then, one wavelength of 217.27 MHz was introduced to the source end of a one mile length of properly terminated foam dielectric (propagation velocity = 85 percent) cable, the leading edge of the energy would reach the load 6.33 microseconds later. (85 percent of 186,000 miles per second = 834.77 feet per microsecond.) The traveling wave, while moving down the cable, would occupy 85 percent of 54.35 inches or 46.20 inches per wavelength. (Figure 3)

STANDING WAVES

Electrostatic (voltage) and electromagnetic (current) flux generated in a transmission line terminated with the characteristic impedence of the line are in phase. Energy contained in the flux fields at the output terminal will be completely absorbed by the termination because its value satisfies the resistance required to completely deplete both energy fields. Any deviation from the line's characteristic impedence will disturb both fields as the load resistance will demand more from one field than can be supplied, and one field will contain an excess of energy with no place to go.

The two worst case conditions for line mismatch are a short (Figure 4) and open (Figure 5) termination. When the flux lines contact a shorted line for example, much more current is demanded than the electromagnetic flux can deliver. Since no voltage can be developed across a short, the electrostatic flux are left dangling. This flux must have a path in which to deplete and, therefore, reverses its direction of travel for satisfaction. As a result of discharging back into the line, a current is generated causing a build-up of electromagnetic flux one quarter wavelength or 90 degrees behind the electrostatic flux which originally reversed direction.

Voltage and current values on the line created by the downstream and reflected flux add instantaneously However, since they are both traveling at the same rate of speed and in opposite directions, there is no resultant wave travel, thus the term "**standing waves**" The same effect is created by an open

FIG. 1

Single transmission line equivalent section; L1 = Series inductance, C1 = Shunt capacitance, R2 = Dielectric loss, R1 = Series resistance.

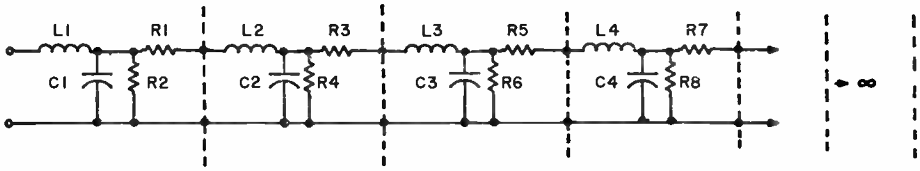


FIG. 2

Transmission line represented by multiple lumped sections.

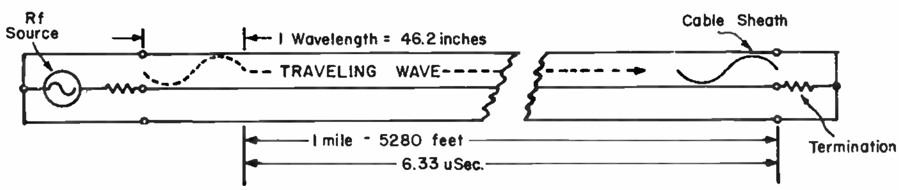


FIG. 3

One mile section of coaxial cable indicating traveling wave timing and direction.

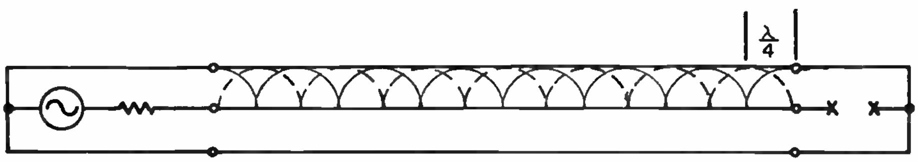


FIG. 4

Section of coaxial cable indicating effective voltage (solid line) and current (dotted line) distribution with open terminal end. λ = wavelength.

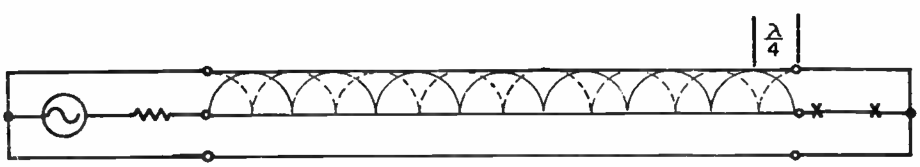


FIG. 5

Section of coaxial cable indicating effective voltage (solid line) and current (dotted line) distribution with shorted terminal end. λ = wavelength.

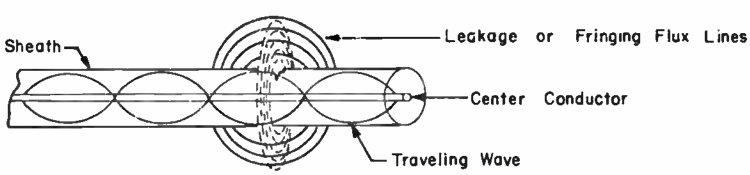


FIG. 6

Section of coaxial cable indicating flux leakage from crack. The traveling wave energy bundles consist of electromagnet and electrostatic lines of force that escape from any opening in the cable sheath.

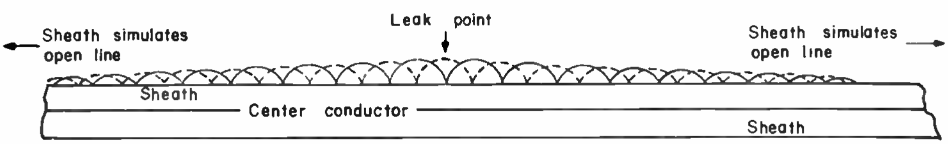


FIG. 7

line except that the current flux is forced to collapse back into the line generating an electrostatic flux lagging by 90 degrees. As the termination approaches the characteristic impedence of the line from either a short or open, the effective magnitude of the standing waves decreases.

LEAKAGE FLUX ESCAPE

Until now we have dealt with the theory of a perfect transmission line. Electrostatic and electromagnetic fields are nicely contained within the outer conductor. What happens when the sheath becomes cracked, a loose connector makes a high resistance sheath coupling or any other mechanical fault in the outer conductor surface?

Electron movement begins on the outer surface of the sheath. Fringing electrostatic and electromagnetic fluxes escape and, in short, another source is formed. (Figure 6)

Normally, cracks that occur are inefficient as aperatures because the physical size is much smaller than a half wavelength at CATV frequencies. It is safe to assume that the amount of radiated energy from the crack itself is negligible.

However, since the fringing fluxes do escape onto the outer surface of the sheath, they are free to travel in both directions from the crack. (Figure 7)

There is no second line with equal and opposite force fields to contain the fluxes, therefore, radiation will occur. The sheath appears as an open line causing standing waves. Moving away from the source of leakage, the fields are eventually lost due primarily to energy given up in the form of radiation, the loss in the jacket and surface corrosion. Thus, flux densities are strongest in the vicinity of the leak source.

Minor reflections are caused as the wavefront strikes a surface 90 degrees to the direction of travel, further concentrating and complicating the immediate leak area. If the leak occurs a half wavelength from a reflective surface, the radiation efficiency is improved.

Searching for a leak by using a device designed for reception of the radiated field can soon become frustrating. The radiated or Fraunhofer field dies very slowly, at the rate of simply the inverse of distance, i.e. 1/D. If a search technique is confined to the Fresnel or near field, energy disappears at a rate equal to the reciprocal of distance squared, i.e., D ½ allowing rapid localization of individual leaks, and less confusion about which direction the leak came from. C-ED

MISSION CABLE TV'S MICROWAVE SYSTEM

Mission Cable TV, owned by Cox Cable Communications, Inc., provides signals to a staggering 142,000 subscribers and uses 1,972 miles of plant. This system is probably the largest AML microwave system utilizing eleven receiver sites.

The system is operated from four offices, with the corporate offices and support facilities located near the center of the system. All requests for service, inquiries concerning individual accounts and trouble calls are handled at the central office, and then dispatched to the other offices.

Mission Cable TV maintains its own overhead and underground crews for small projects and emergency repairs. Major projects are contracted and supervised by their respective departments. Normally, Mission Cable is involved in 250 to 350 projects in some form of construction at any given time.

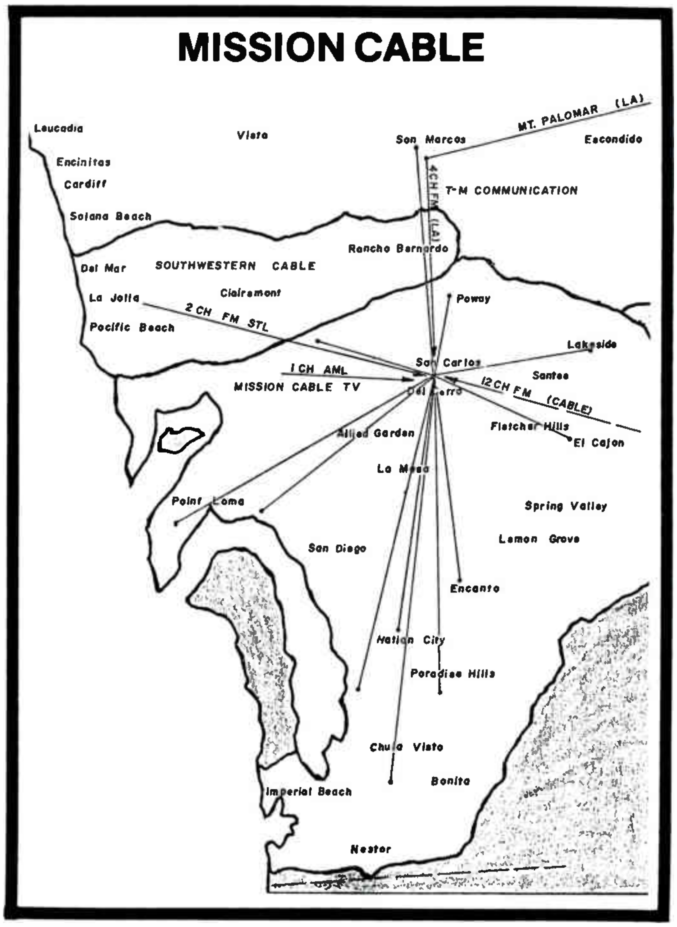
The microwave system used by Mission Cable TV features a 24 channel AML transmitter with eleven receive sites. Six channels of Microwave Associates FM Equipment (four channels from Los Angeles and two channels from local station feed) are also used. The microwave equipment includes one AML high power from San Diego schools, and one ITFS channel from San Diego State University.

In addition to the off-air channels, there are twelve channels of Catel FM equipment which carries HBO, Madison Square Gardens, local origination and character-generated channels from Mission Cable's El Cajon office to their Cowles Mountain headend site.

Satellite equipment is provided by Scientific-Atlanta's ten-meter dish with four each 414 S-A receivers.

The headend and system equipment is supplied by RCA, Catel, Telemation and Scientific-Atlanta. Of the 1,972 miles of plant used by Mission Cable, 450 miles are underground and 1,522 are overhead. 600 miles ae planned to be rebuilt by the end of 1980.

Comm/Scope cable is used throughout the system. The amplifiers are supplied by Anaconda CATV Ltd., Jerrold Electronics Corporation and Vikoa. The directional taps used are Jerrold's FFT and Magnavox' MX-3700. LRC Electronics and Gilbert Engineering supply the fittings. In addition, Oak Industries provides standard and multi-code converters.



Mission Cable TV's AML microwave service.

Standby power is available at the transmitter site and at all receiver sites. According to one spokesman at Mission Cable, "Our goal is immediate response to any outage with next day service to all other complaints."

Test Equipment

Texscan's 7270 Signal Level Meter

Texscan Corporation's model 7270 SLM is a frequency selective voltmeter which covers the 5-216 MHz range. Optional coverage of 210-300 MHz and 450-960 MHz is available via plug-in adapters.

The 7270 features a new "true peak" detector, pat. pending, for outstanding accuracy regardless of modulation levels. Typical accuracy is ±0.5 dB. This unit also features a 90 dB rotary attenuator permitting measurements from -40 dBmV, (98.8 dB, 10 uV), to +70 dBmV (+21.1 dBm, 3V).

The 7270 is a rugged, field portable unit incorporating nickel cadmium batteries to provide in excess of 8 hours continuous use.

This unit also features a 600 kHz IF bandwidth and 46 dB rejection of adjacent TV sound carrier levels. The operating temperature range is -18° C to +60° C with accuracies typically ± 1.5 dB.

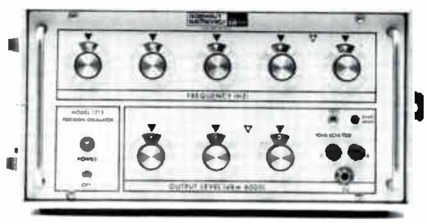
Precision Oscillator Introduced By Northeast Electronics

Northeast Electronics, a division of Northern Telecom, Inc., has introduced its model 1715 precision oscillator. Capable of generating audio test signals with extreme frequency and level accuracy, this single instrument can replace separate oscillators, counters and level meters in many applications.

The new unit, manufactured to Western Electric specification KS21715, incorporates an advanced frequency synthesizer design. It allows precision frequency selection (100.0 to 9999.9 Hz in 0.1 Hz increments) and precision output level selection (-39.9 to +9.9 dBm in 0.1 dB steps).

These features, coupled with low noise and distortion characteristics, make the model 1715 an ideal signal source for all test/calibration applications which require precisely selectable, accurate, stable output frequency and amplitude performance.

Priced at $1,350, the model 1715 allows all of the advantages of precision audio frequency synthesis in a practical, economic instrument designed for everyday testing and calibration of telephone and other audio-frequency equipment.



A Computing Network Automates Biddle Digital Radar Cable Test Sets

Two new radar cable test sets from the James G. Biddle Co., offer simplified operation and true digital readout. These units utilize the pulse reflection principle and are easy to use: set range and dial-in the insulation, move scope market to fault, depress "Read" button, and distance to the fault is shown on a digital display. Simplified operation is the result of a built-in computing network that eliminates time-consuming zero alignments, insulation calibrations and distance calculations.

Security

Jerrold's Starpack™ Security System

The Jerrold Starpack™ security pay-TV system provides a complete equipment concept with all the elements necessary for success; low cost, signal security, equipment security with outdoor descramblers and compatibility with existing CATV systems.

To accomplish these goals, the Starpack equipment for the subscriber utilizes two units: the outdoor descrambler, model SRD-*, and the indoor control unit, model SC. The scrambled pay-TV signal is originated at the headend using the scrambler, model SSE-200, in conjunction with a Jerrold or other standard modulator.

Miscellaneous

New SPDT Coaxial Relay

Dow-key division of Kilovac Corporation has announced the availability of the model 402 SPDT coaxial relay, capable of isolation up to 100 dB with low VSWR and insertion loss. The operating frequency is DC to 12.4 GHz with RF power ratings to 100 watts. Nominal coil voltage is 26.5Vdc with a variety of alternate coil voltages available. Maximum operating time is 20 ms.

The model 402 coaxial relay may be used for opening, closing or diverting the signal path in a coaxial transmission line by remote control. The compact, high performance device has a wide variety of applications for both laboratory and severe operational environments, where excellent impedance matching and isolation are required at microwave frequencies.

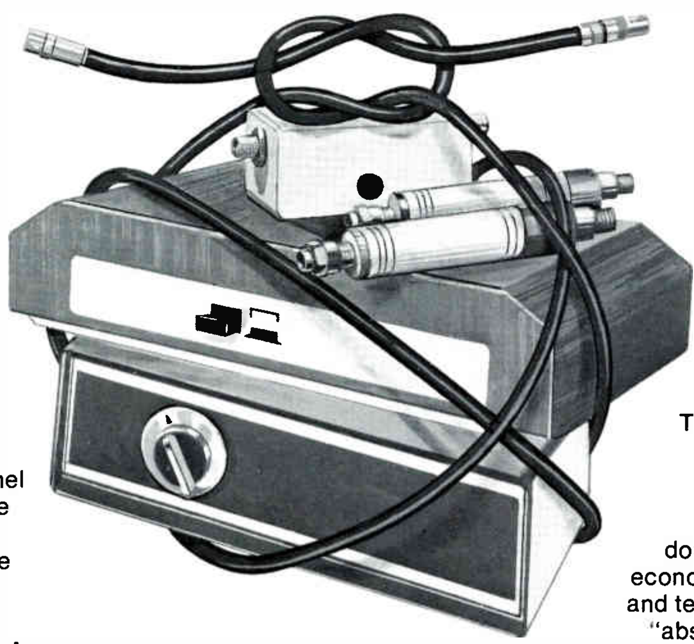
Amtron's Compact Portable Color Monitor/Receiver

Amtron Corporation has announced the addition of a new 8-inch model to its product line.

Designated the TR-8P, the new monitor/receiver has an 8-inch screen (actually 7.7-inches measured diagonally) and operates on batteries or AC power. Weighing less than 20 pounds, the TR-8P is particularly adaptable to portable VTR and VCR operations, as input connections accept direct audio and video signals in addition to full VHF/UHF reception.

The TR-8P is priced under $675 and is available for delivery within 30 days.

Negative vs Positive Systems
Audited vs Unaudited Systems
Cable Traps vs Descramblers
Lowest Overall Costs vs
Lowest Front End Costs
Single Channel or Multi-channel



Negative vs Positive System

There's no doubt about it . . . the Negs have it over the Pos. The greatest deterrent against theft of service is to not allow the premium channel into the home where it can be reconstituted . . . to trap the signal of all non-payers at the pole where it is least subject to tampering.

VITEK Cable Traps ***look like drop cable***, provide deep-notch depth (typically greater than 70dB), superior environmental stability and durability, are maintenance-free — and are ***on the pole!***

Audited vs Unaudited Systems

Auditing is easy with VITEK Cable Traps. Simply count your traps and compare with your current subscriber list. No contact with the subscriber is necessary. Since (Pos) descramblers are located in the home, installation records are your only clue as to who your "customers" really are. Gaining access to the residence can be difficult and may require numerous visits.

Cable Traps vs Descramblers

If "they" don't pay . . . reconnect the cable trap . . . on the pole! Recovery and replacement of descramblers is time consuming, costly and may require legal action.

Any way you look at it... VITEK is the answer for PAY TV Security!

VITEK

Descramblers can also be "loaned out" depriving you of additional income . . . but VITEK Cable Traps stay put . . . ***on the pole!***

Lowest Overall Cost vs Lowest Front End Costs

You get what you pay for, so don't be misled by the apparent economies of (POS) descramblers and terms like "self-amortize" and "absorbed costs". The larger the installation, the more economical VITEK Cable Traps become. You save on maintenance and service calls, recovery or replacement of equipment and in the end, there is nothing more foolproof and reliable than a VITEK Cable Trap to prevent theft of service . . . and that's what PAY TV Security is all about.

If you're successful, you'll outgrow the short-term economics and inadequacies of descramblers as others have and change over to VITEK's Cable Traps.

It's simply a matter of . . . Pay us Now . . . or Pay us Later.

For additional information call or write:

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200 Wood Avenue, Middlesex, N.J. 08846
Tel: (201) 469-9400

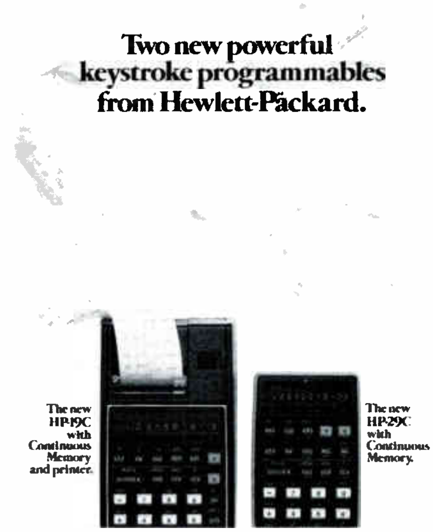
Hewlett-Packard Offers Brochure on Programmable Calculators

Hewlett-Packard Company is offering a new six-page brochure on the HP-19C and HP-29C programmable handheld calculators.

The HP-19C and HP-29C are keystroke programmable advanced scientific calculators that feature ninety-eight fully merged program steps, continuous memory, full editing and storage functions and thirty data registers. The HP-19C also features a quiet, built-in thermal printer.

Included in the free brochure are sections describing the advanced programming features of the two calculators—including branching, subroutines, indirect control functions and editing—a summary of keyboard features, physical specifications and the HP warranty.

Free copies may be obtained by writing to the Inquiries Manager, Hewlett-Packard Company, 1507 Page Mill Road, Palo Alto, California 94304.



Hewlett-Packard Brochure

Practical Guide To Using Frequency Counters In Communications Applications

How to use frequency counters in applications below 1.3 GHz is the subject of the new technical note, *Straight Talk On Frequency Counters In Communications Applications*, from Hewlett-Packard Company.

Written for the technician and repairman, this eight-page note omits detailed technical design discussions of counters. Instead, this literature zeros in on how to get the signal into the counter, how to interpret the answer and how to keep from damaging the counter.

The literature is well-illustrated with typical counter hookups, examples, two conversion charts and a list of references.

To receive this new technical note free, send inquires to the Inquiries Manager, Hewlett-Packard Company, 1501 Page Mill Road, Palo Alto, California 94304.

Book Reviews

CATV System Maintenance, First Edition
Robert B. Cooper, Jr.
189 pages, Soft Cover
$12.95 from TAB Books
Blue Ridge Summit, PA 17214

CATV System Maintenance, now in its fourth printing, was first printed in 1967. It has not been significantly revised, thus it deals with 12 channel strip amplifier systems, thereby limiting its applicability to today's technology.

The book was written primarily to introduce technicians to the then current aspects of cable system design, operation and maintenance. It is a basic book covering antenna selection, headend construction and trouble-shooting, outside plant construction and maintenance, drop installations, system testing, some typical multi-outlet subscriber installations and a section on the importance of the technician's role in customer relations.

Throughout the twelve chapters of *CATV System Maintenance* the author introduces subject matter in basic terms, develops it, gives examples of problems and possible solutions and concludes with a brief summary. Additionally, the author gives examples of costs for construction of the various subsystems that make up a complete cable system. Those examples, while not valid today, do provide a basis from which equipment lists and current prices may be developed.

Some of the charts and tables require careful thought to avoid confusion over what was intended to be illustrated. For example, the table (3-A) on page 29 may lead the novice technician to conclude that high signal levels indicate poor signal-to-noise ratios, when the intent is to show that higher received signals are required where headends are constructed in noisy locations.

CATV System Maintenance concludes with a brief Appendix on cable system powering, power supply installation and several charts related to typical cable losses, dipole lengths, drop levels and conversion from dBmV to microvolts, etc.

CATV System Maintenance is a primer for cable technicians. It is easily read, regrettably contains no mathematical solutions to design or maintenance problems, but is well illustrated by photographs, charts, tables and the typical system layout diagrams. As such it serves as an introductory text for persons who may wish to broaden their knowledge of basic system operation and maintenance.

Kenneth L. Foster, Chief
Telecommunications Division
New York State Commission
On Cable Television

A Canadian Eight Kilometer Fiber-Optic Cable Television Trunk System

By Kenneth Hancock, Director of Engineering

In May 1977, the title for the Canadian column was "Rewards or Rainbows" and talked about fiber optic technology. It is perhaps indicative of expanding technology that in six short months we have gone from talking to doing. As the title for this column indicates, work is now starting on the first Canadian cable TV fiber optic trunk.

Five major Canadian cable television companies and a Canadian manufacturer have banded together to form BCN Fibre Optics Limited. The purpose of this organization is, in cooperation with the Canadian government, to construct a six fiber transportation trunk approximately eight kilometers in length. For comparative purposes, the link will parallel a very high quality conventional coaxial supertrunk. Installation is scheduled for mid 1978, in London, Ontario, and will be followed by one year of operational testing.

The capacity of the fiber optic trunk will be fifteen TV channels and twelve stereo FM channels. Looping will simulate rural trunking up to forty-eight kilometers. The system will use digitally encoded video, and digital to analog conversion at any mode will permit interfacing with a conventional coaxial system for distribution to homes.

One of the major purposes of this project is to demonstrate to both Canadian and foreign markets that Canadian industry has the necessary capabilities, expertise and experience to design, engineer, construct and operate a complete fiber optic trunk system for the cable TV industry.

The major tasks to be carried out as part of the project are:

- The design and manufacturing of a fiber optic cable suitable for pole mounting that will stand the stresses of normal cable installation and the rigors of the Canadian climate.
- To design a system to integrate this fiber optic cable with electro-optic and electronic equipment at data rates suitable for the transmission of television and FM channels.
- To build and laboratory test the equipment prototypes (transmitters, repeaters, receivers, fault locators, etc.)
- To assemble and test a representative system of equipment, cable and connectors in a laboratory environment.
- To install, test and commission the complete system in a cable TV network.
- To train regular cable TV personnel in all aspects of system design, operation and maintenance.
- To operate and maintain the system for one year after commissioning.
- Throughout the commissioning and operating periods, to perform a series of tests to measure all technical, performance and economic aspects of the system. A series of tests and assessments will also be made to gauge the ability of the technical staff to cope with the technological change-over.
- During the one year test period, similar measurements will be made on the parallel high quality conventional coaxial supertrunk to provide a reference against which the fiber optic tests can be evaluated.

The design to be implemented resulted from examination in detail of the number of signal transmission schemes, including base-band digital, FM/IM analog and IM analog systems. Comparisons were made between the performance of the different systems and the various economic trade-offs. The selection of a digital system took into account total system topology, system type (ie: cable TV trunking), hardware availability and costs.

It is expected that the system will prove that a digital fiber optic trunk will overcome the cost/reach limitation of cable TV by delivering studio quality TV signals over distances up to several ten's of kilometers. It will also show what changes can be expected in the parameters of optical fibers and equipment during the installation of the cable and over repeated cycling of temperature, humidity, vibration, snow and ice loading and other environmental parameters that can be expected in the harsh Canadian environment.

The commencement of a cable field test with a nominal one kilometer of fiber optic cable is well underway. The cable has been constructed and will be installed on poles before the onset of the Canadian winter.

Each fiber optic cable will carry three full bandwidth composite (video and sound) NTSC 525 line color TV signals, plus three full bandwidth stereo FM broadcast signals.

As work progresses on this project, "Canadian Column" will, from time to time, give readers of *C-ED* further information on this state-of-the-art system.

New C-ED Look

Dear Paul & Toni:

Congratulations.

First, to you Toni, on your appointment to the post of Managing Editor, C-ED.

Second, on the new and exciting look of the September issue. Harbinger of more good things to come, I'm sure.

The transition in your publication during the last year has been interesting. Although it has become more of a marketing vehicle, it has not lost its ability to impact on technical matters.

You folks at Titsch have done a beautiful job of adding interest without changing the thrust of the publication.

Al Springfield
The Michener Company
Philadelphia, Pennsylvania

Dear Toni:

I was happy to hear you are now an important member of Bob Titsch's winning team. Congratulations.

In our old days at Jerrold, you did one helluva great job of coordinating and managing what was then a very extensive advertising, sales promotion and marketing communications program.

I'm positive you will do the same kind of outstanding job for C-ED and CableVision. Best of luck.

Wm. N. Redstreake
Redstreake Industrial Marketing
North Wales, Pennsylvania

Dear Mr. FitzPatrick:

Received my September issue of C-ED and I like what I see.

The format, layout and content should put the publication on the "Most Wanted" list. We also feel the addition of Toni Barnett to your staff will greatly enchance your fine publication.

To put it mildly, "you've got a winner."

Robert J. Shevlot
Vice President Marketing
Texscan Corporation
Indianapolis, Indiana

The Grounding Issue

Dear C-ED:

Until quite recently, the CATV industry was not particularly concerned with the grounding issue. However, as a result of more stringent application of the National Safety Code, and rulings by state and federal regulatory bodies and the pole owners, every CATV operator has become embroiled in some manner in this critical issue. Some, like myself, have complied fully in grounding substantially all subscriber drops, per applicable rules, laws and contractual agreements. Our grounding program had always been sort of a low priority item, but since essentially universal application of the rules, we must admit to being startled by the many related problems that have come to light, and which appear to be directly related to full compliance.

We have historically employed pressure taps and inserts in our systems, and like everyone else, on rare occasions, suffered an occasional burned out insert during a storm. Since our universal grounding of drops, however, this problem has multiplied considerably, usually with several inserts being burned out in every storm, and, in some instances, the drop cable being similarly burned and melted. The marked increase in this problem has prompted some looking into the possible causes and analysis of the circumstances with others who are technically oriented. One possible cause has emerged, this bearing immediate study:

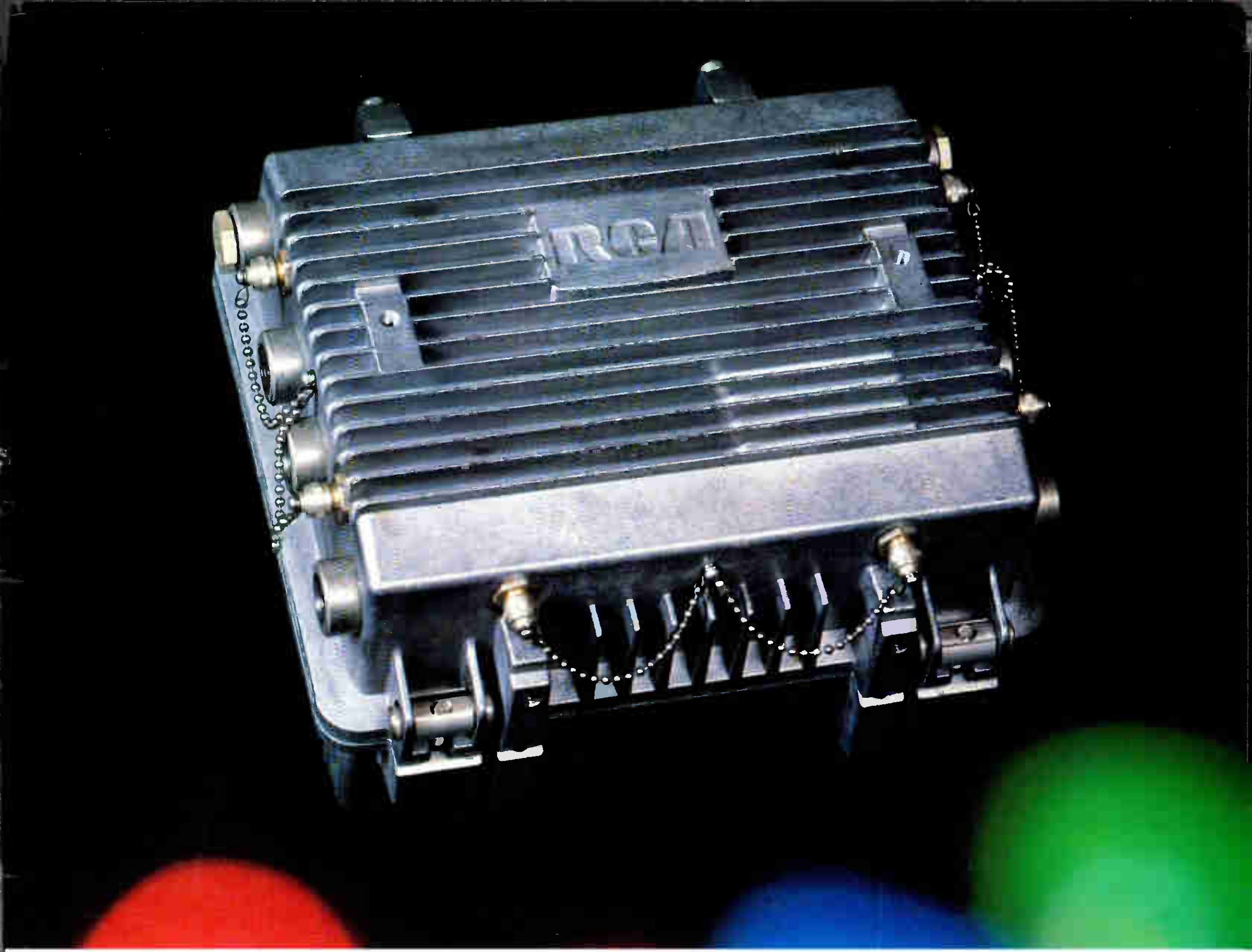
It is felt that CATV, generally being the newest service installed in a dwelling unit or building or on an existing pole plant, very conceivably has the best ground or the one of lowest resistance. Hence, when stray electricity, due to either a bolt of lightning, or a surge from the power lines (a co-existing problem to which CATV is subject), is induced, it is generally accepted that it seeks the best, shortest or straightest route to ground; as a result, the CATV system will too often sustain damage. This leads one to think about the existing telephone and electric grounds with which CATV must be interconnected both in buildings and on the pole lines.

Certain other problems we have encountered are internal rather than external. Some TV receivers are built with one side of the chassis "hot," i.e. connected to one side of the power line (and if the isolation network and/or the insulation breaks down, to ground, if the plug happens to be in correctly). Also, frequently TV receivers have no isolation capacitors between the input to the tuner RF transformer and the antenna terminal strip (here, again, the CATV industry assumed the onus, with the introduction of cable-to-TV matching transformers containing isolation capacitors as a safety feature). Unfortunately, though, the effectiveness of these set transformers may be negated by still other newer TV receivers which provide a connector for direct 75-ohm coaxial cable connection, but no isolation between TV tuner and coaxial drop. Finally, the older electric outlets typical of all buildings more than a couple of decades old tend not to be polarized, and some buildings may still use ungrounded two-wire drops. All of these situations add up to problems for the CATV industry and its subscribers (and non-subscribers alike). And, while some rules on these points may and do exist, little allowance is made for human nature.

These are not small problems—they can be lethal. It is with this thought in mind that these comments are written. We can only hope that the various bodies, organizations and individuals within the communications, power and related industries will investigate these problems with a view toward providing and enforcing proper safety standards and instructing the general public on this crucial issue.

J. J. Mueller, President
EMCO CATV, Inc.
Manchester, Vermont

Ad Index



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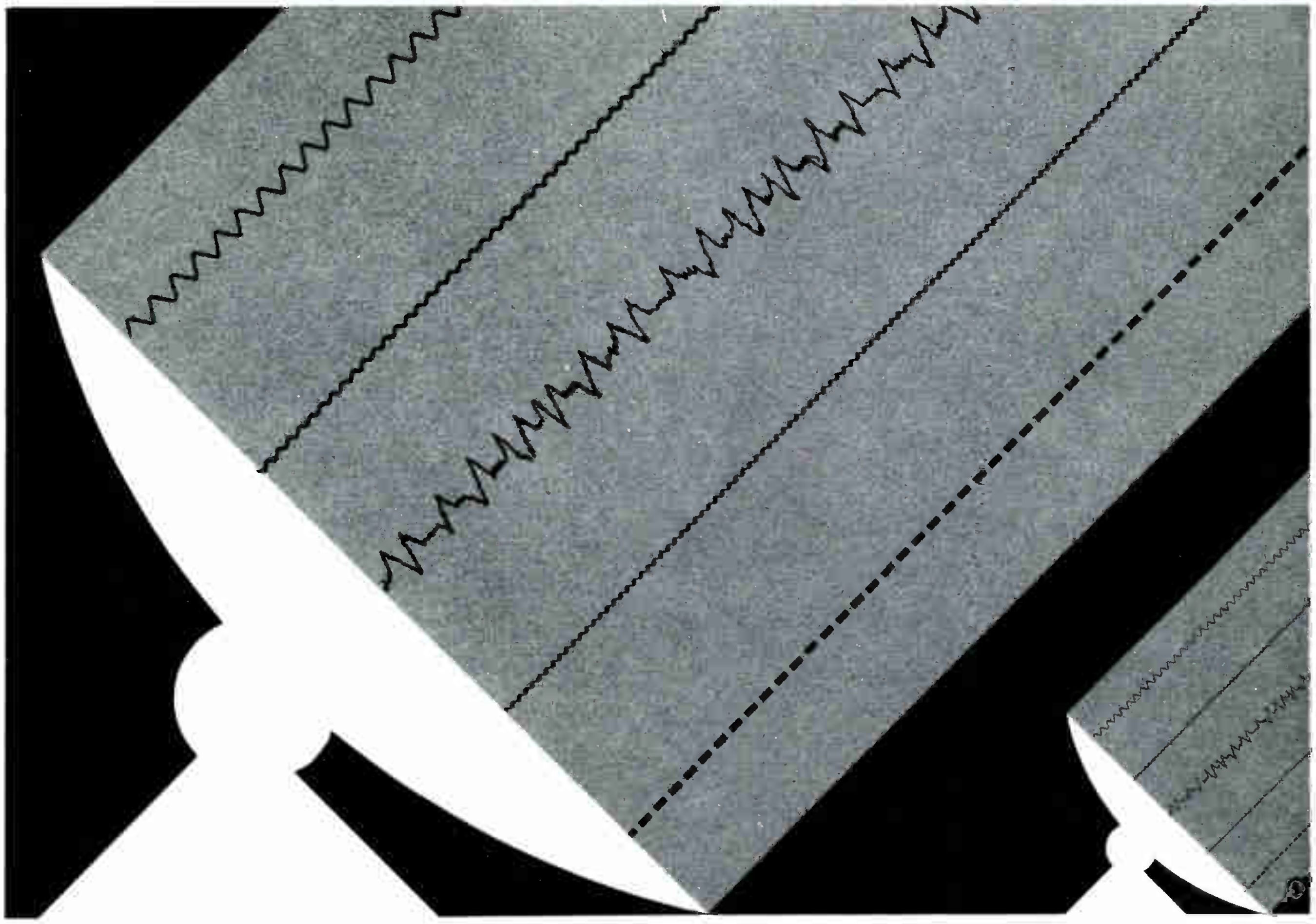
A WISP OF SIGNAL

IN A UNIVERSE OF NOISE



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