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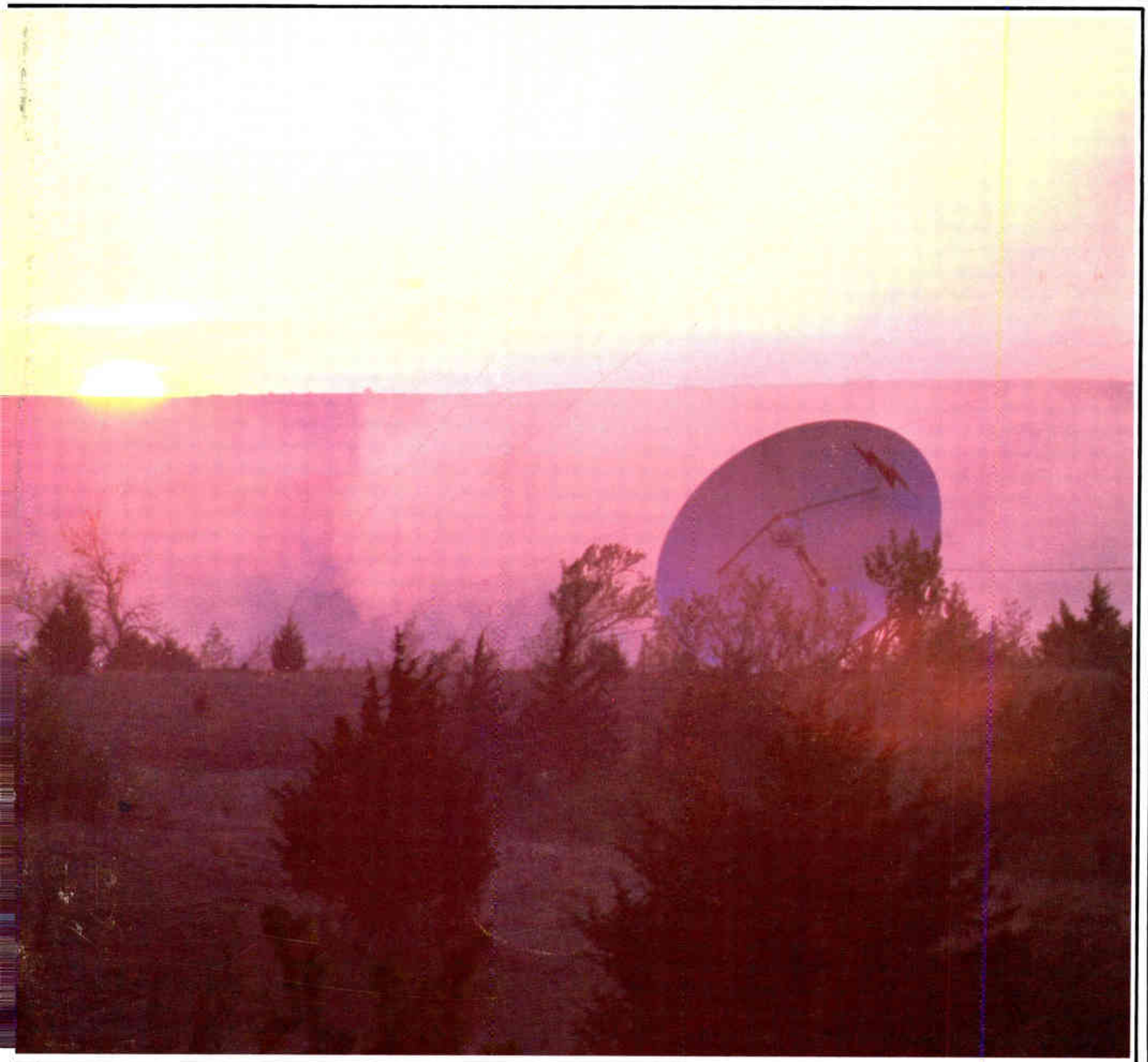

Communications-Engineering Digest

Reporting the Technologies of Broadband Communications

September 1977
Volume 3, No. 9

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C-ED News at a Glance

WASHINGTON, D.C.—**White House aides** are reportedly **screening** a list of possible choices to fill the position as **head of Commerce Department's proposed National Telecommunications and Information Administration. One of the top contenders** for the position is House communications subcommittee councel **Harry (Chip) Shooshan III.** He is supported by Speaker of the House Tip O'Neill (D-MA) and Senator Ernest F. Hollings, chairman of the Senate subcommittee on communications. Others included in the list: **Nick Miller,** consultant to the Office of Telecommunications Policy; **Howard White,** general councel of ITT World Communications; and **Melvin Williams,** executive vice president of Educational Testing Service, Princeton, NJ.

PISCATAWAY, NJ—**RCA American Communications, Inc.** has **filed tariff revisions with** the **FCC** for satellite communications services to establish a new rate structure and expand service options (see News, page 26).

LONDON, ENGLAND—**British cable television operators** are presently **facing difficult times.** The proliferation of UHF transmitters which carry the two BBC programs and commercial (IBA) programs, in color, to the entire country limits the appeal of cable prevented by licensing restrictions from carrying programs other than those attainable off-air (see International Comments, page 49).

ALBANY, NY—**Governor Carey** of New York has **vetoed** the **"small CATV bill"**—Assembly Bill 8380-A. This bill established a new category of "small cable television "companies" under Section 812 of Article 28 of the Executive Law. Although this legislation was passed by both the Assembly and the Senate, Governor Carey vetoed the bill because: "The definition of 'small cable television company' is so vague that it would be impossible to determine the point in time at which a small cable television company ceases to qualify as such."

TRENTON, NJ—A **plan for interconnection of 270,000 subscribers in New Jersey** cable television systems was **announced by John P. Cleary,** director of the state's Office of Cable Television. Cleary cited the innovative efforts by the cable operators to provide New Jersey programming in the absence of adequate broadcasting coverage from New York and Philadelphia television stations. Envisioned is a one-way feed to over 90 percent of the state's subscribers. The proposed network would use CARS band microwave and common carrier microwave systems.

DENVER, CO—**Tele-Communicatins, Inc. selects Scientific-Atlanta to supply** this Denver-based MSO with approximately **60 earth stations.** Order is effective immediately with expected first TCI system to be Corpus Christi, Texas. S-A president Sidney Topol and cable communications division manager Jay Levergood were in Denver August 30 for contract signing. Agreement calls for delivery of earth stations over 30-month period.

S-A's Sidney Topol

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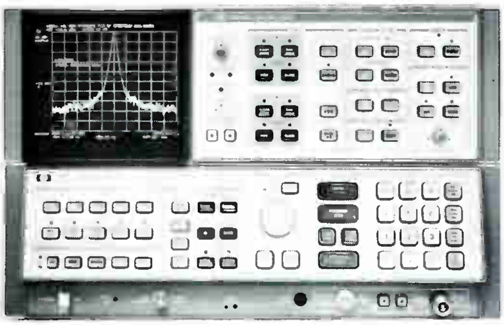

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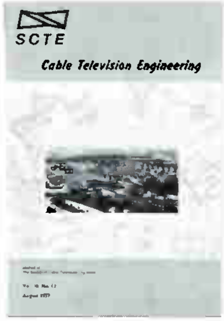

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FEATURES

DEPARTMENTS

OPINION

COVER: This issue focuses on earth stations. Gary Hine of Manhattan Cable TV Services, Inc. took the picture of Kansas' first earth station.

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Editor's Letter

Yes, this is still *Communications-Engineering Digest.* Only the looks have changed. Importantly though, the *C-ED* trademark of giving you the best coverage of technical advances in communications has not; our commitment to journalistic excellence, for which this magazine is known, remains.

We chose this particular issue to unveil the new *C-ED* look because September marks an important month on the Titsch Publishing as well as the Society of Cable Television Engineers' calendars. It was one year ago that we had the good fortune to acquire *C-ED,* believing we, together with the SCTE, would continue the editorial excellence of the magazine's previous ownership and further strengthen the publication as a significant marketing vehicle. We believe we have. And so, with the rapid changes over the past twelve months, and with this our first anniversary, we thought we would re-dedicate ourselves to that commitment by giving you a publication with the same technical emphasis . . . but one that is more pleasing to the eye.

A lot of thought and considerable effort went into planning the "new" C-ED. A lot more time will be devoted to improving and expanding upon our editorial features, departments and opinions. We think you will find we have already moved in that direction. And we should point out that no small part in this effort will be played by managing editor Toni Barnett, who comes to us from Jerrold. More importantly, however, the largest part of the continued success of *C-ED* rests not in our hands but in yours, our readers. Let us know what you're thinking—good or bad—and tell us about potential stories.

Paul A. FitzPatrick

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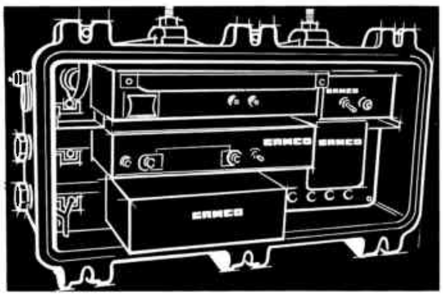

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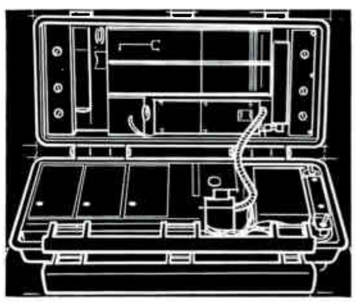

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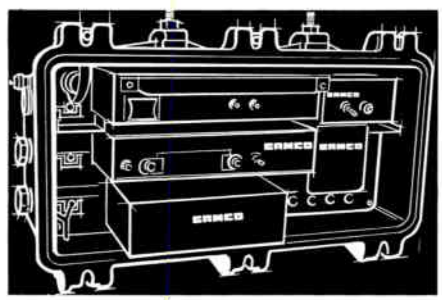

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It's appropriate that this issue of C-ED appear at this time in an upgraded and expanded format. After all, isn't that what's really happening throughout our industry? The SCTE itself is going through a year of rapid development, growth and improvement in both membership and value to the industry. The technical side of the industry is getting recognition and gaining momentum in many places where it has previously been inappropriately submerged. The FCC may soon have an engineer as commissioner. The SCTE is placing its engineering functions and attention to engineering recognition in proper perspective also. The industry, in general, is in an expanding mode. It is also in a technical personnel shortage mode with technical salaries reaching parity with others.

This new issue format is also the result of a more closely defined and interdependent relationship between the SCTE and Titsch Publishing—a relationship that has been valuable to each other over our history, but one that was expanded in definition and reinforced at the recent SCTE planning conference in Washington. We hope you like the changes and that members will submit comments, recommendations, technical papers and letters in support of the ultimate objective of any communications medium: the reflection of the needs and views of its audience. C-ED's audience is the technician, the engineer and the technical management people in the industry. We estimate this to be 8,000 to 10,000 strong.

It's also fitting that technological changes in the magazine come at a time when technological changes in the hardware portion of business are cascading down upon us. We have the examples of the cordless set-top converter, the emerging technology of fiber-optics (most recently eyewitnessed at an SCTE tech session), the operation of point-to-point laser radios transmitting quality video that you would expect in your system. In addition, we have the technology surrounding the cost reduction advantages of the microwave gunflexor circuit recently demonstrated at the CCOS show in Lake Eufaula, Oklahoma and in Atlantic City. This technology brings the cost of point-to-point radio systems in the CARS band down from the $12,000-$15,000 to the $4,000-$6,000 range. Coupled with an anticipated expansion of CARS frequency domain into the broadcast auxiliary spectrum to 13.25 GHz, possibilities for landline transportation become myriad.

Combined with satellite earth station technology and cost reduction in these areas, CATV networking also becomes a real, practical objective. The office of cable television in New Jersey, for example, has recently proposed a statewide network to cable operators in the garden state to connect New Jersey's 300,000 cable subscribers to a common point. The **key** point, however, is that this interconnection, while it is now technically cost-effective, is essential to our survival. Networking is essential for advertiser underwriting of commercial products. The political arena—and our interaction with it—are also extremely essential to our growth and survival.

SCTE welcomes the new C-ED format and will encourage its members and affiliates to participate in the vitality of this magazine. C-ED is an integral part of the process that the CATV industry must undertake to upgrade its educational and professional status.

Bob Bilodeau, President

Eastern Quebec Chapter Meets

The **Eastern Quebec SCTE Chapter** held its last meeting June 18, 1977, it was reported by secretary-treasurer Camille Gelinas of La Belle Vision in Shawinigan. More than thirty SCTE members attended the meeting and 15 new members have joined the Chapter recently, bringing the membership to fifty-three, an all time high.

Topics discussed at the June meeting included behavior of second and third order beats and composite triple beats; the use of line extender amplifiers instead of trunk amplifiers; and, compliance with system performance using a digital level meter when an analyzer is not available.

The Eastern Quebec Chapter will hold its next meeting in September. For information, contact Gelinas at 819-537-1849.

New Jersey CATV Association And SCTE Meet— Microwave, Converters and Lasers

The **New Jersey CATV Association** met in Atlantic City at Howard Johnson's Regency on August 11-12. The program, organized in cooperation with the central chapter of SCTE, provided cable operators and their technical personnel an opportunity to review and learn about advancements in the fields of optical fibers, transmission, short haul microwave, converter repair, and a new terminal device—the cordless converter.

Herbert Berkowitz, staff consultant for Times Fiber, gave an update on optical fibers, specifically addressing problems and advancements in the manufacturing process, amplification electronics, plant construction and maintenance of glass fiber.

Two modes of short haul microwave were reviewed. George Maier, sales engineer for Microwave Associates, described in detail the design and practical use of MA's newly introduced low power, short haul (5-20 miles) solid state microwave system. American Laser Systems demonstrated its infrared optical carrier TV transmission set and Tektronix supplied video information with its 147 generator and 3/4" tape.

George Fenwick, vice president of Katek, Inc., a major converter repair company, demonstrated simple workbench converter repair procedures, but stressed that repair of the module itself should be handled out of the home.

Ed Ebenback of Jerrold and Howard Pearl of Selectra discussed the new generation cordless converter. Selectra now has 15,000 units operating in Toronto and Jerrold's cordless converter is expected to be introduced to the U.S. market in September.

SCTE Redefines Chapters

During the June 22 SCTE reorganization study committee meeting in Washington, a new chapter structure for the Society was approved. The United States now has 27 chapters, and Eastern Canada has two chapters. In restructuring the chapters, the SCTE hopes to increase its participation with state and regional CATV associations and improve its communication with its membership. At this time, not every chapter has a slate of officers, but within the next few months, each area will receive direction and assistance from the Washington office in program development, membership recruitment and chapter business management, according to Judith Baer, executive director.

"Each new member will now receive the name of a local SCTE contact," says Baer. "When we mail out membership cards, which we're current and up-to-date on, we'll be including a letter with important information about SCTE and the name of the most local SCTE person for the new member to get acquainted with. The SCTE contact or local chapter officer also receives a listing each month of new members in his area, and these people should start talking to each other."

"We're providing as much help as is possible from the headquarters office, and if this system doesn't improve our local activities and communications, we'll just keep trying until we get it right," Baer concluded.

SCTE Polls Suppliers

More than 150 letters and questionnaires have been mailed to CATV industry suppliers asking for information on possible programming for SCTE chapter meetings, regional and state association conventions and national events. Questions included are product line description, specialties, availability for SCTE meetings and format, facility information, films and tapes, level of expertise, frequency of sessions and more.

Every supplier received a stamped, self-addressed envelope to return the questionnaire by July 30, 1977, so that the information may be compiled and distributed to SCTE chapter officers and contacts. The listing will be made available to other interested parties for a minimal charge.

Many SCTE Members On IEEE AdCom

The **Institute of Electrical and Electronics Engineers, Broadcast, Cable and Consumer Electronics Society Cable Administrative Committee** met in Washington on July 12. Terms of officers of the BCCE Cable AdCom were designated as follows: Terms ending December 31, 1978, Bert Arnold, RCA-CTS; Robert Powers, FCC; H.J. Schafly, TransCommunications; I.S. Switzer, Switzer Engineering; and Archer Taylor, Malarkey Taylor. Terms ending year 1979 are Frank Bias, Tele-Vue Systems; Gay Kleykamp, UA-Columbia; Robert Bilodeau, Suburban Cablevision; Jacob Shekel, Jerrold; and James Stilwell, CPI. Terms ending in 1980 include Alex Best, Scientific-Atlanta; Nick Hamilton-Piercy, Cablesystems Engineering; Don Levenson, Wheeling Antenna; Clifford Paul, New Jersey State CATV Office; and Kenenth Hancock of the Canadian Cable Television Association. James Herman of Motorola is serving an indefinite term of office at this time.

Election of officers found Archer Taylor as chairman, Robert Bilodeau as vice chairman, Robert Powers as secretary and Sruki Switzer, treasurer and At-Large Delegate to the BCCE Board of Governors.

Nearly all of the AdCom members are members of SCTE and this continues the relationship established in 1976 of the IEEE/BCCE and SCTE members, involving close coordination of standards, procedures and other technical matters concerning the industry.

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INTRODUCTION

This article will present cost versus performance guidelines to the CATV operator who is considering the design of an earth station. The text in Section I addresses the basic problem of establishing a high grade carrier to noise ratio from the *Antenna* and *Low Noise Amplifier* for a minimum cost. Then, in Section II, it discusses the receiver choice versus cost as it relates to operator requirements and plans.

The CATV operator is faced with a multitude of decisions when considering the installation of a *Satellite Earth Terminal*. He is usually bombarded by a host of people all trying to sell "their thing." After trying to boil it down to fundamentals, he quickly comes to the conclusion that there is no simple solution and tends to go on faith, word of mouth, or seat of pants, mixed with a little home brew engineering. This article is intended to give the potential buyer some simple guidelines, which though not exact, will put him in the ball park of the correct choice of equipment for his location and program plans.

The typical *Receive Only Terminal*, which we have all seen before, consists of three fundamental elements as shown below—*Antenna*, *Low Noise Amplifier* and *Receiver*.

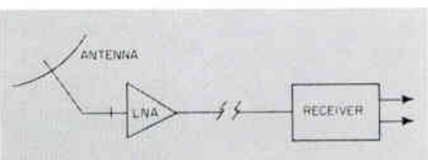


Figure 1 Basic R/O System

Supporting equipment such as cables, pressurization systems etc. are required but are not a part of this review as their impact on cost and performance is minimal.

Antenna and LNA Selection

The objective is to select a combination of antenna size and low noise amplifier (LNA) which will provide adequate margin for high quality service at minimum cost.

A few basic facts must be established before the analysis can be performed. First, the basic engineering elements of the microwave link must be known. In order to avoid heavy calculations, a simplified version of the link equation expressed in terms of carrier to noise ratio is used and it is:

$$C/N = EIRP + G/T - 42.37$$

where

EIRP = power radiated by the satellite toward the earth station

G/T = combined quality factor of antenna and LNA

42.37 = a constant which takes into account all other parameters, all basically noncontrollable.

C/N is carrier to noise ratio and is a measure of the ratio of carrier relative to noise that will be delivered to the receiver for processing. C/N relates to receiver video and audio performance. Typical video performance is shown in Figure 2. Certain minimum standards of carrier above receiver threshold are being established in an effort to insure a good quality signal under all conditions. The FCC provides guidelines in their small antenna ruling, Home Box Office and others provide standards, suppliers provide proposed standards to their customers to fit their own equipment, and it seems that a combination of engineering, politics and salesmanship results in a mixed picture. However, for this analysis I have used a C/N minimum of 14.68 dB. This is based on 3.68 dB margin above the standard 11 dB receiver threshold. This margin is representative of good engineering practice but is not an overkill. If the reader should choose a different margin, the analytical procedure to be presented can be modified by simply using the chosen margin. As we will see, the parameter is fundamental and has a great impact on the cost of equipment to be chosen.

This C/N will yield video and audio signal to noise ratios of about 52 dB provided we ignore interference from terrestrial sources and adjacent satellites and presume a near perfect up link. In the practical world, this value of S/N will be degraded by about 1 dB.

It should also be noted that the use of video threshold extension receivers is not considered in the analysis. Such receivers effectively lower the video noise threshold 2 to 3 dB. Use of such a receiver would permit operation at a C/N which is 2 or 3 dB lower than 14.68 while still maintaining the specified 3.68 dB margin. However, the commonly used circuit in most threshold extension receivers does not lower the audio threshold and therefore results in the possibility of degraded audio performance. Also note that both video and audio S/N will be reduced one dB for each dB that C/N is reduced toward threshold. It is presumed here that the operator wishes to maintain 51 to 52 dB S/N ratios and further that he prefers to maintain an audio margin above threshold similar to the video margin.

EIRP is simply a measure (in dB above one watt) of power radiated by the satellite in the direction of the earth station. Its value is determined by referring to "footprint" maps. A typical example is shown in Figure 3. These maps are

h Terminal
& Cost Analysis

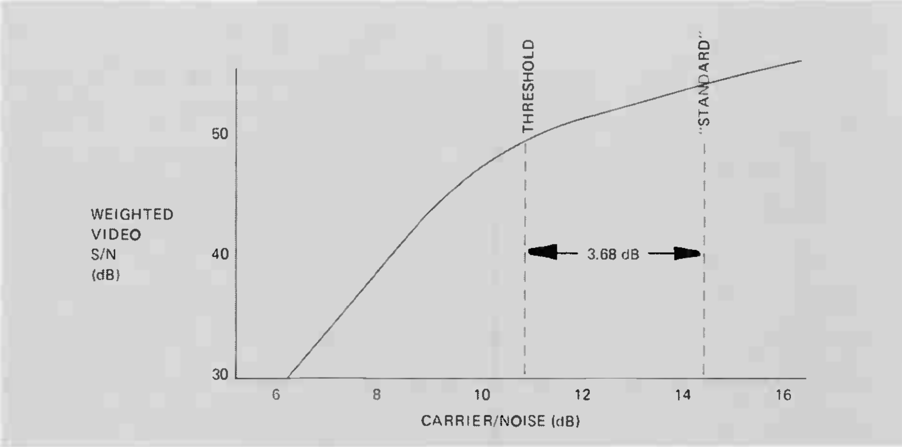


Figure 2 Typical Signal to Noise Performance as a Function of C/N

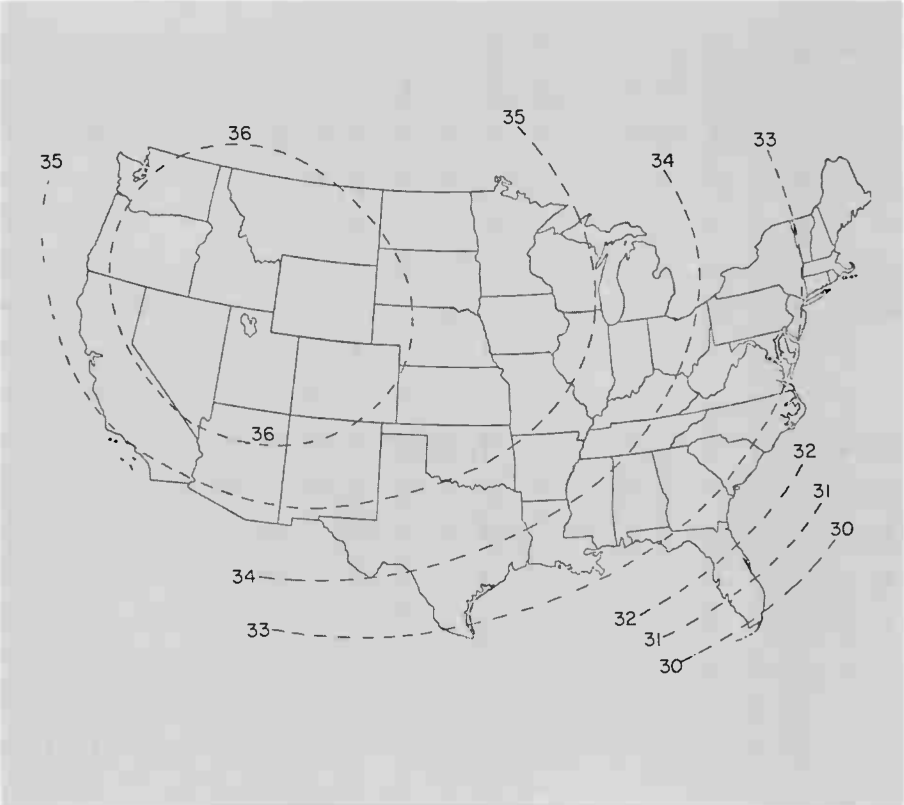


Figure 3 Typical Satellite Footprint Showing EIRP in dBW

available from earth station suppliers or from the satellite owner. The earth station builder must design for the worst case situation—lowest power transponder from the weakest satellite. He has no choice and must live with what the satellite provides.

G/T is a measure of the overall quality factor associated with the rf side of the earth station, or in other words, is a measure of how well the antenna and LNA "capture" the EIRP. G/T is the parameter which is controlled by the buyer and the supplier in their selection of antenna and LNA.

$$G/T = G - 10 \log Ts$$

where

G = antenna gain in dB

Ts = total system noise temperature in degrees Kelvin.

There are three things which contribute to Ts.

LNA Noise Temperature—Lower noise temperature equals lower noise figure. For reference, noise figure is:

$$nf = 10 \log \quad 1 + \frac{T}{290}$$

Antenna Noise Temperature—The antenna noise temperature depends on the cleanliness of its side lobe pattern (horns are very low noise antennas), its look or elevation angle, and sky conditions. Antenna manufacturers suppy data which usually is similar to that shown in Figure 4. If the antenna is a dish and meets FCC pattern requirements, there is little to choose from since for a given size antenna, they will all exhibit approximately the same noise.

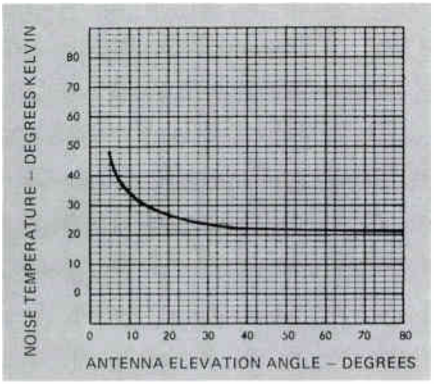


Figure 4

System Loss—Waveguide loss between the antenna feed horn and the LNA will add to system noise. This is usually not a factor in receive only stations where the LNA is coupled directly to the antenna. Coax loss from the LNA to the receiver is not a contributing factor since the LNA gain in all but the most unusual cases will overcome the cable loss. Without the LNA, cable loss adds directly to receiver noise figure and results in typically 17 dB system noise figure. This is high enough to almost completely wipe out the gain of a 4.5 meter antenna. Even with a 10 meter antenna, the signal delivered to the receiver is still 10 dB below minimum acceptable C/N in the highest EIRP areas. An LNA is indispensable.

Now that the basic ingredients which make up G/T have been defined, we can examine components which are available that contribute to G/T and evaluate them from a cost and performance point of view for any EIRP. Table I lists a group of antennas and LNA's along with their basic performance and cost. The cost and performance of these items will change with time and vary up or down a little depending on manufacturer, but if we take things as they are today, Table I is a good round approximation. The results below can be fine tuned if desired with exact cost figures at any time for a specific case.

The curve shows, not surprisingly, that the higher G/T costs more money. The analysis is more revealing if we convert from G/T to available EIRP as the variable parameter. The conversion is done simply by substituting G/T into the link equation and setting C/N = 14.68 dB. This result is shown in Figure 6 on the following page.

The earth station buyer can now use the data presented in Figure 6 and select the antenna and LNA which, for minimum cost, meets the chosen standard C/N. He may in some cases have the option of selecting a slightly higher quality LNA in order to "buy" a little more margin.

Several conclusions can be drawn from analysis of this figure.

1. Not surprisingly it is costly to capture lower EIRP and convert to quality C/N. Those systems in the midwest which enjoy the big signal have an inherent cost advantage.
2. There are ranges of EIRP which are best served by specific antenna sizes.
3. Step up from 4.5 meter to 6 meter at about 34.8 dBW. A 4.5 meter antenna can be used below this EIRP level, however, the required LNA results in a higher initial total cost than a 6 meter set-up at the same EIRP.
4. If an 8 meter antenna is introduced in the future, move up from 6 meter to 8 meter at about 31.5 dBW. In the meantime, it appears best to use the 6 meter antenna down to about 30.5 dBW and then go up to 10 meter.
5. If the buyer is considering the addition of a spare LNA, this initial cost plus the intangible LNA maintenance must be taken into account and added to each cost curve. The impact is greatest at the low EIRP end of each antenna size and would tend to cause an earlier move up to the next largest antenna size. For example, at an EIRP of 31.5 dBW, a 6 meter antenna with a 100° LNA and spare is $31,000, whereas an 8 meter antenna with 170° LNA and spare is also $31,000. When the long run cost of maintenance is included, a step up to 8 meter is logical at this EIRP.
6. The horn is a special case which has its place in the mixture of op-

TABLE I
G/T COMPONENTS

Antenna Size		Gain	Cost
10 Meter Dish		51 dB	$45,000
8 Meter Dish*		48.5dB	$25,000
6 Meter Dish		46.5dB	$16,000
4.5 Meter Dish		44 dB	$12,000
4.3 Meter Horn		43.5dB	$17,500
Low Noise Amplifier			
75°K	$12,500		
100°K		$7,500	
125°K		$3,500	
170°K		$3,000	
260°K		$2,000	

*An 8 meter dish is not available at this time as a production item.

If we take the various antenna and LNA combinations, calculate their G/T and cost, we generate a family of curves each of which takes on the characteristic of that shown in Figure 5.

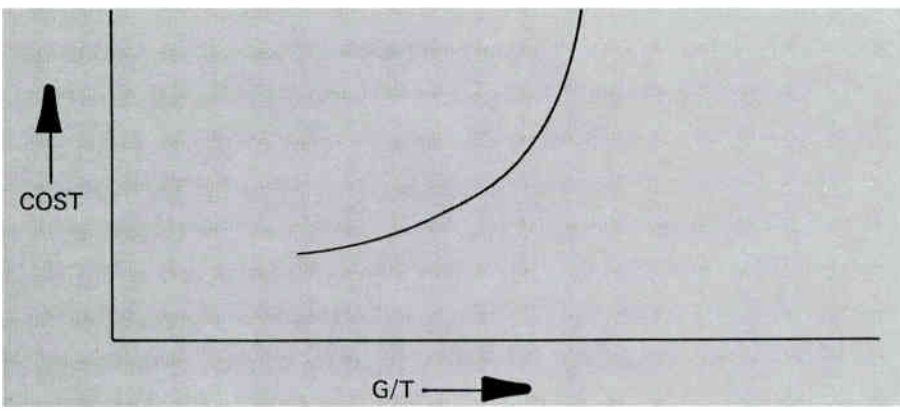


Figure 5 Cost Trend as a Function of G/T

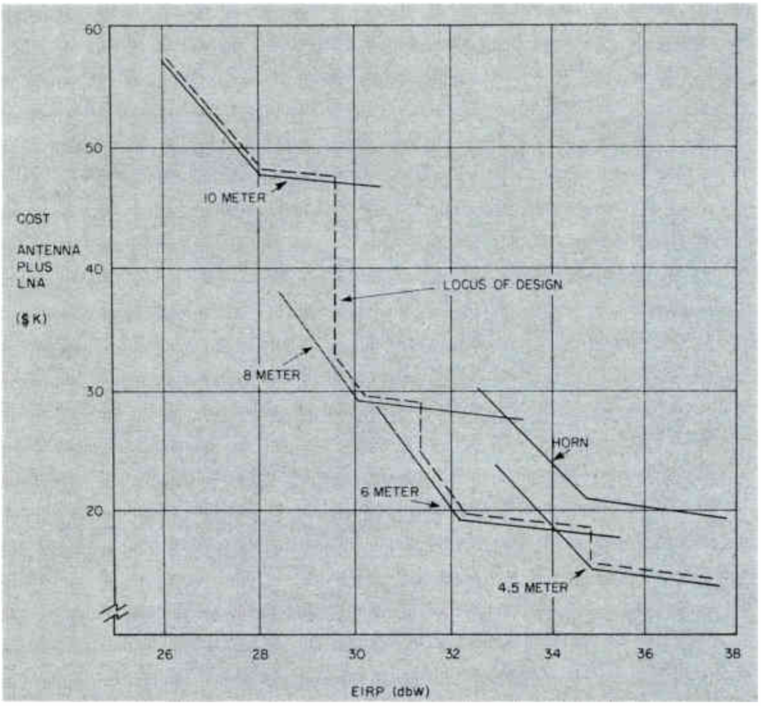


Figure 6 Cost as a Function of Available EIRP Based on C/N = 14.68 dB Minimum

tions. The horn should be used in those cases where interference levels are so high that frequency coordination cannot be achieved with a parabola without moving the earth terminal to another location and relaying the signal in via microwave. In this case, the extra cost of the horn is easily offset by not having to buy the microwave relay. It should also be noted in defense of the horn that these special cases may also warrant the use of a video threshold extension receiver to accommodate a couple of dB lower EIRP. One must be aware that video and audio S/N will be lowered and that audio S/N is usually approaching threshold.

Video Receiver Selection

In the previous section, we were able to reduce a variety of factors into a relatively scientific analysis which yielded guidelines for the choice of antenna and LNA. In this section, we will analyze the receiver requirement and see that the choice is much more subjective and is, within wide limits, a buyer's choice based on his own analysis of needs.

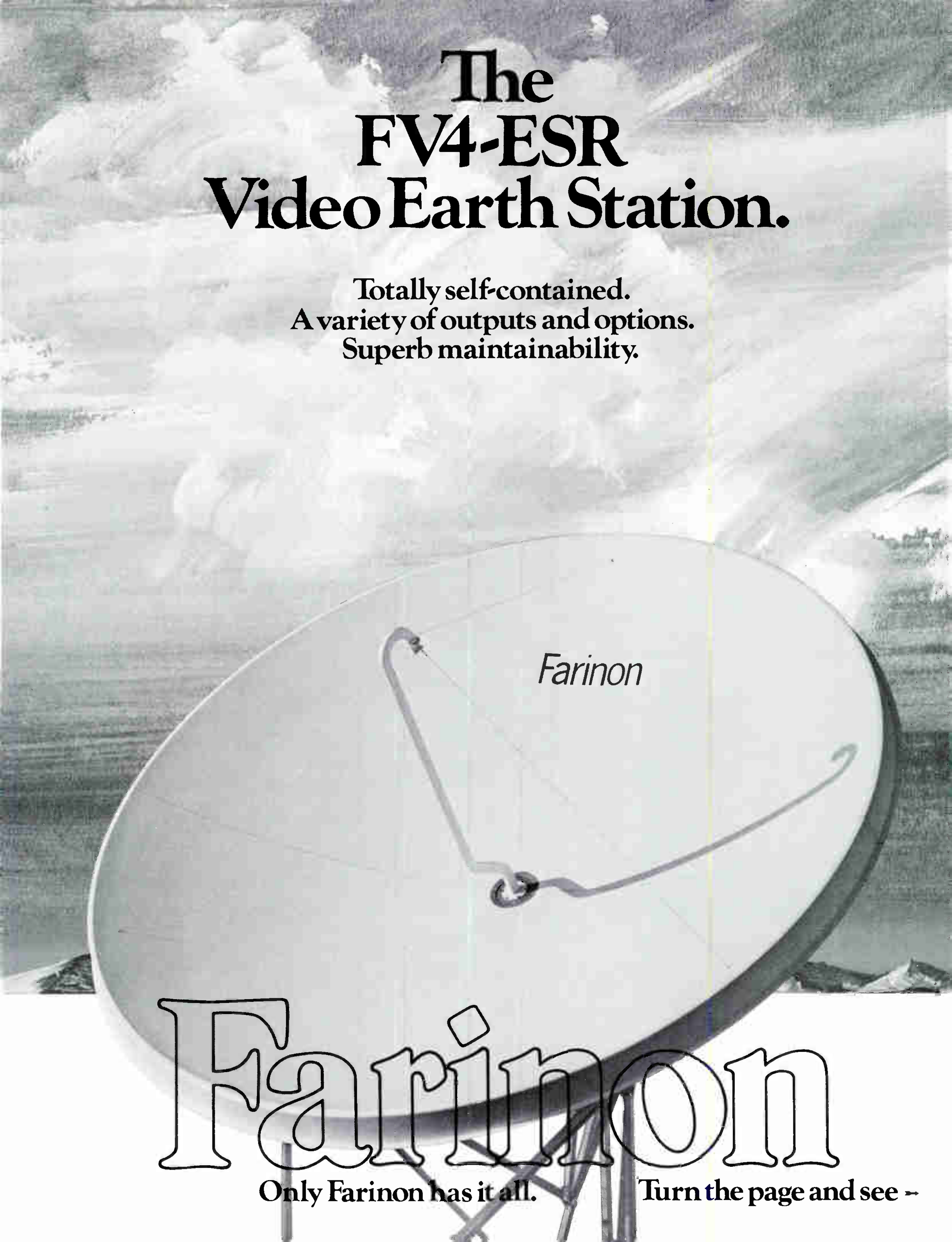
Questions relating to the buyer's operational needs which he must answer will now be reviewed. In many cases, an exact answer is not available and a judgment call is required. However, review of the following factors is essential so that some early decisions can be made.

1. *How many satellite transponders are to be received initially? How many are likely to be added in the future as satellite broadcasters proliferate?* The relevance of these questions is readily apparent. A conventional receiver tunes one frequency at a time. Therefore, the simultaneous reception of n programs requires n receivers plus n power dividers. That is true unless you start with a multi-channel frequency expandable receiver. So long as the expandable receiver provides all of the necessary operational features desired, it is a logical and economical choice for 2 or more channels. The more channels required, the more attractive it becomes. Cost savings at the 4 channel level for example, is over $10,000!
2. *Is remote frequency tuning a necessity?* Most CATV R/O's are located at the headend where people are available to perform frequency changes if any should be required. Advance notice of a change to be made is a reasonable expectation. The above leads to the generalization that remote tuning is not a necessity but may be handy to have on one channel.
3. *Would a fixed frequency receiver be acceptable in some cases or on some transponder frequencies?* If it's the only receiver in the station it should certainly not be locked to one frequency. If it is part of a multi-channel expandable receiver that has tunable back-up, it makes a lot of sense. This is especially true if it is economical and can at least be "work bench" shifted to other frequencies should the need arise.
4. *To what degree is redundancy required?* The earth station should have back-up hardware available to insure continuity of reception for commercial programming. With conventional receivers, this means a complete receiver in stand-by, or carrying programming which can be terminated without causing the vigilante committee to pay a visit at the earth station. The alternative is to utilize a tunable converter demodulator as a standby in the expandable receiver. In order to complete the redundancy, the expandable receiver should have a first converter and power supply.
5. *How important is the supplier's reputation for quality, service and dedication to the business?* The question answers itself and is given here only to insure that the buyer places it high on his list of priorities.
6. *What is the relative importance of the various technical specifications of the receiver?* Rather than making a point by point comparison of the various manufacturers' specifications, the discussion that follows will be an attempt to furnish some guidelines, while separating what is important from specs-man-ship. Unfortunately, we will always be plagued to some degree with enthusiastic specs.

Let's look first at what is not so important, then at what can be misleading, and last, take a fresh look at the usual "boiler plate" parameters.

Specifications which are of secondary importance:

a. *Receiver Noise Figure*—We showed earlier how the LNA essentially establishes the system noise temperature performance. A variation of 5 dB in receiver noise figure will change C/N by only a few thousandths of a dB in a typical set up. Receiver noise figures around 15 dB are certainly not a problem.
b. *Receiver Dynamic Range*—The signal level input to a satellite


The FV4-ESR Video Earth Station.
Totally self-contained.
A variety of outputs and options.
Superb maintainability.
Farinon
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Only Farinon has it all.
Turn the page and see →

The Farinon Video Earth Station.

The only complete video earth station has more options, too.

Now there's a *complete* video receive-only earth station that can give you the outputs you need, without the need for peripheral equipment and secondary suppliers. Farinon's FV4-ESR package gives you much more than just audio and video drops. You can feed a microwave radio link or a CATV system—or use it as a stand-alone source for audio and video signals. The system is fully compatible with NTSC, PAL, PAL-M, and SECAM standards.

Baseband interface options: separate audio and video outputs for use in CATV distribution systems or composite video with 4.5 MHz intercarrier for CARS-band microwave.

IF interface options: a 70 MHz output to drive a heterodyne back-haul radio system.

And some versatile plug-in options: AM and FM program transmission channels, orderwire channels, clampers, remote control and monitoring equipment, FM cueing, and 4.5/5.5 MHz aural carrier generators.

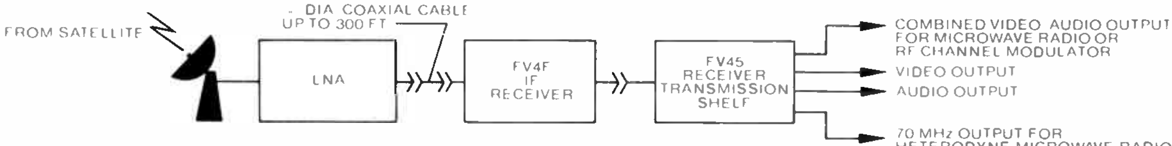
A single extender board to care for all modules.

And we give you an easy way out in case of power failures.

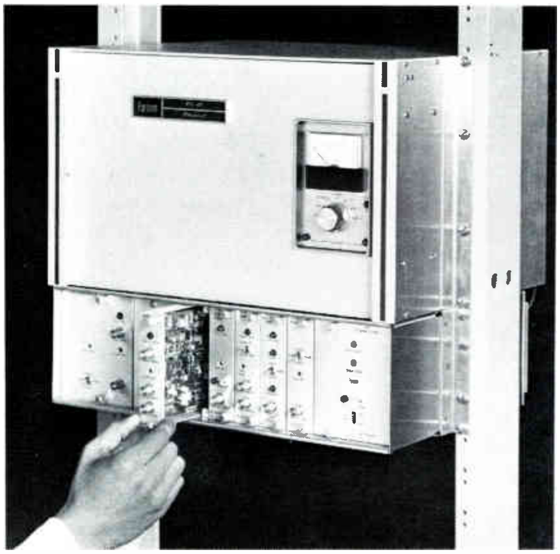
You can switch from 110 VAC to 24-48 VDC just by plugging in a new power supply. You don't have to buy an inverter. It's a simple, inexpensive step to take when you have to go into protected modes.

But we're not just selling equipment.

We're selling Farinon. Which is complete factory support—system engineering, field service engineering, and repair service. Experienced telecommunications engineers. Twenty-four-hour customer service. A single responsible supplier for all parts of the system including antenna and low-noise amplifier. Factory-pretested equipment, quick and easy to set up.



Simplified Block Diagram FV4SR Terminal



FV4SR Terminal. System shown includes FV4F Receiver and FV45 Baseband Shelf.

We've made it easy to maintain.

It's the right size and shape. We coordinated size, shape and mechanical design to put everything within easy reach. That's why the receiver is more spacious than other makes. It's also the reason you won't find any 4GHz push-on fittings. Not only that, but you need only remove a single panel—the front panel—and you can get at everything.

And *Pin-Out* on every module is identical, so that you need only a single extender board to care for all modules.

So go to the most versatile, maintainable earth station you can buy. And to the company with the outstanding service, worldwide. Farinon.

Call us collect. Ask for the Video Sales Group. And watch us respond. We'll give you the engineering help you need.

Remember only Farinon has it all.

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Phone (415) 592-4120.
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Only Farinon has it all.

receiver is very steady. A variation of 1 dB would be a surprise. However, in making system carrier to noise tests, it is necessary to convert input levels from noise to typical signal levels. Therefore, a range of 20 dB is desired and 30 dB would be more than enough. Since 30 or 40 dB is fairly easy to achieve, it usually comes with the box.

Now those specifications which can be misleading:

a. *Demodulator Threshold Performance*. The only method which realistically and reliably pins down a threshold value is based upon a plot of video S/N versus C/N as shown in Figure 2. Threshold should be accepted as that point at which S/N drops 1 dB below an extrapolation of the linear portion above threshold. As discussed earlier, this will occur at a C/N of about 11 dB in a standard FM demodulator, regardless of who designs or builds it. An exception is the video threshold extension circuits reviewed earlier.
b. *Video and Audio S/N*. These parameters are probably the ones which are most often misused or not understood. A good receiver, under laboratory test conditions with ample rf signal input (high C/N), will yield audio and video S/N in excess of 70 dB. These values are based on certain standards of deviation, weighting, etc., which must be specified by the manufacturer and not taken as assumed standards. We recommend reading an article in NCTA 1974, pp. 58-63 by T.M. Straus, titled "The Relationship Between the NCTA, EIA and CCIR Definitions of S/N Ratio." This high level or "clean carrier" S/N performance represents the ultimate receiver performance. It is important only because it insures good performance at the lower C/N that will be experienced in actual practice. It is much more meaningful to specify S/N at a point near threshold, or in the case of a complete earth station to specify S/N based on a certain (anticipated minimum) EIRP from the satellite.
c. *Receiver IF Bandwidth*. Calculations in the first section of this paper were based upon a receiver bandwidth of 30 MHz. Full transponder bandwidth is 36 MHz, however, very little energy is transmitted beyond 30 MHz. Opening the receiver width out to 36 would, in theory, improve picture quality if there were no other changes. However, the wider IF also passes through more noise which lowers C/N and reduces S/N. The net change in S/N is zero. The width may be reduced below 30 in order to improve a marginal C/N (C/N is proportional to negative 10 log BWHZ) but now we are getting into potential picture quality degradation by not passing the high deviation through the IF to the demodulator. In most cases, 30 is a good compromise. In any case, be aware that IF width should be an option to be selected, and that the selection will have an impact on C/N. For widths of about 30 to 36 MHz, it will have no practical effect on S/N, only on margin above threshold.

Standard Specifications:

a. *RF Return Loss*. If input VSWR to the receiver or if any interface VSWR within the receiver including IF is poor, picture distortion can result due to the standing waves which are set up. A minimum acceptable value for any return loss is 20 dB (VSWR = 1.22:1). Only input VSWR can be specified and verified directly. Others will be measured indirectly by confirmation that picture quality meets certain standards.
b. *Gain Flatness—Phase Linearity—Demodulator Linearity*. These simple words take into account a host of receiver parameters which basically relate to its ability to faithfully process an rf signal into high quality video and audio. Most manufacturers who seriously address the business will do an acceptable job. A summary of typical values is given below. The real test is how well the receiver performs when it processes the standard test patterns which are designed to display any such deficiency. If you have any doubts, look at the waveforms. For reference, Tektronix has issued an excellent series of brochures and booklets on the subject of distortion measurements of television signals.

Parameter	Typical Value
Differential Phase	±1% 10%-90% APL
Differential Gain	±0.5 dB 10%-90% APL
Line Time Distortion	1%
Field Time Distortion	1%
Short Time Distortion	4%
Chroma Delay	40 n sec
Chroma Gain	±0.5 dB

c. *Video and Audio Frequency response*. The usual minimums are:

Video — 10 Hz to 4.2 MHz	±0.5 dB
Audio — 50 Hz to 13 kHz	±0.75 dB

Engineers can do better, but the difference is detectable only in the laboratory.
d. *Audio Output*. Harmonic distortion of about 1% into 600 ohm with test tone level of about 18 dbM is normal.
e. *Clamping*. More accurately should be referred to as energy dispersal waveform removal. At least 40 dB is needed and 50 is worth the effort.

SUMMARY

A method has been established for the selection of an antenna size and LNA quality which yields a good margin of performance at minimum cost. Video receiver parameters have been reviewed and some simple guidelines discussed.

We hope that potential earth station buyers and designers will find this material to be useful and thought provoking. We welcome your comments and suggestions.

Please contact your regional Microwave Associates sales office of Duke Brown, Satellite Earth Station Manager, Burlington, MA for additional information. C-ED

Owensboro Cablevision To Operate Two Earth Stations

OWENSBORO, KY—Owensboro Cablevision is the first individual cable television system in the nation to be granted permission by the FCC to operate two earth receive stations (ERS), according to Robert H. Steele, president of Owensboro on the Air, Inc.

The second ERS will utilize a 4½ meter dish and will initially be positioned to receive programming from Western Union's Wester 2 satellite. The added station will provide cable customers with greater flexibility in enabling Owensboro Cablevision to furnish increased programming from satellites.

C-COR Receives Contract From IBM

STATE COLLEGE, PA—C-COR Electronics announced receipt of a contract from International Business Machines Corporation for the design, installation and testing of a two-way coaxial network. The coaxial network will interconnect computers and computer terminals at IBM's development facilities in Research Triangle Park, North Carolina.

The new system will provide multiple data channels in each of two directions throughout five buildings in the Research Triangle Park facility. A similar network will be installed in one of IBM's engineering buildings in Raleigh. Interconnection between the two sites will be via common carrier.

The system was jointly designed by IBM and John Hastings of C-COR, with construction scheduled for completion this fall.

New Software Firm Offers 'Rational Approach' To Mini/Micro System Development

COLLINGSWOOD, NJ—A new computer services firm that provides "at last, a rational approach to software system development," has been formed in Collingswood, New Jersey.

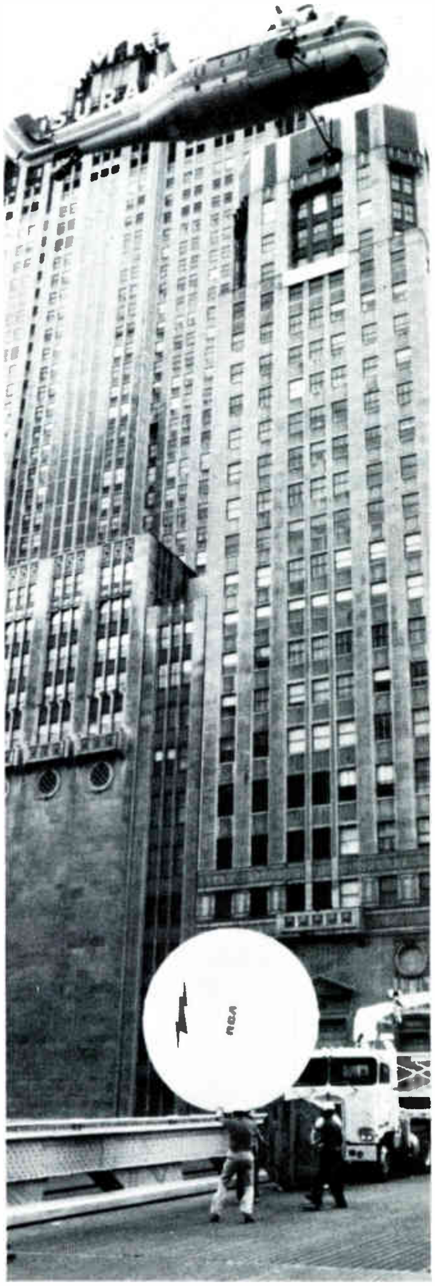
The new firm, Rational™ Systems, Inc. will focus on software system development, design and implementation, primarily for mini and microcomputer-based real-time applications. Their services will be available to mini/micro manufacturers and their customers for system development, OEM firms for mini/micro product vitalization and system houses for overall hardware/software integraton.

Kentucky 'KEWS' Contract Awarded to Prodelin

HIGHTSTOWN, NJ—The "Kentucky Emergency Warning System" (KEWS) microwave antenna contract has been awarded to Prodelin Inc., Hightstown, New Jersey. The contract for antennas, waveguide and installation services will cover 139 sites. Prodelin will have responsibility for the installation of antennas, waveguide, alignment and checkout of the system.

KEWS was initiated due to considerable loss of life in April 1974 when tornadoes destroyed power and other sources of communications for the state-wide system. This system will be a completely independent network designed to warn the population of any impending disaster.

KEWS will consolidate into one network all communications encompassing state police, video broadcasting, educational, voice communications, data, forestry, etc., resulting in an annual savings of 6 million dollars.



Helicopter Air-Lifts RCA Antenna

CHICAGO, IL—A 10-foot in diameter microwave antenna is lifted by helicopter from Chicago's Madison Avenue Bridge to a roof installation at RCA American Communications central office in Chicago. Two such antennas have been installed on a 50-foot tower (also air-lifted by helicopter) to provide space diversity protection.

The installation is part of RCA Americom's new dedicated microwave system linking its earth station at Lake Geneva, Wisconsin with the central office at 2 North Riverside Plaza. Satellite voice, data, facsimile and television services will be switched over to the new transmission facilities in September. Television services will also be provided via Midwestern Relay Company's microwave system and operations center.

C-COR To Present CATV Technical Seminar

STATE COLLEGE, PA—On September 22-23, C-COR Electronics, Inc. will conduct a CATV technical seminar at their plant facility in State College, Pennsylvania. A broad range of technical discussions and hands-on demonstrations will include: distribution system design; calculation and measurements; lightning and surge protection demonstrations; reliability; level control and other relevant material.

For additional information, contact John Yack at (814) 238-2461.

IEEE Continuing Call For Papers on CATV Transactions

PHOENIX, AZ—The Broadcast, Cable and Consumer Electronics Society of the Institute of Electrical and Electronics Engineers is actively seeking papers for publication in the quarterly IEEE **Transactions on Cable Television**. Into its third issue, this new IEEE **Transaction** has received a great deal of acceptance in the CATV industry and draws a continued interest in the field of broadband communications throughout libraries, schools and industry personnel.

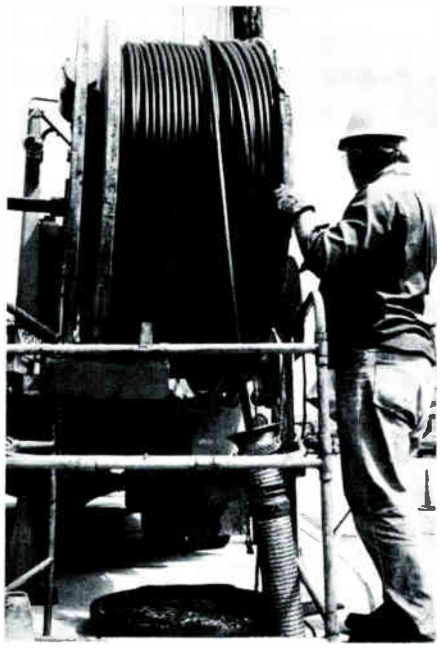
Abstracts of about 200 words should be sent to James Herman at Motorola Semiconductor, Mail station Z-201, 5005 East McDowell Road, Phoenix, Arizona, 85008.

Comm/Scope Offers Cable Manual Free To SCTE Memebers

WASHINGTON, D C —Nearly 1,000 CATV industry engineers and technicians, member of the Society of Cable Television Engineers, may order the **CATV Construction Manual** free of charge. This manual is an 86-page illustrated publication being offered to SCTE members by Comm/Scope, a Sustaining Member of SCTE and a leading coaxial cable supplier to CATV operators.

The manual, in its second printing, covers cable packaging and handling, unpackaging and test procedures, handling tools, installation procedures for lashed cable and handling and installation procedures for IM cable. Detailed test procedures as well as detailed diagrams are included to aid cable operators.

SCTE members must request the manual in writing to Comm/Scope Cable Construction Manual, c/o SCTE, 1523 O Street NW, Washington, D.C. 20005. Shipments will be made immediately after membership verification has been completed through SCTE's office.



Set For The Long Pull

SANTA MONICA, CA—The world's first "optical" communications system to provide regular telephone service was placed in operation in Santa Monica, announced General Telephone and Electronics Corporation.

Instead of carrying people's voices in the traditional electrical form, this radically new system converts customers' speech into streams of invisible light pulses that travel over hair-thin strands of pure glass encased in cable designed expressly for optical communications.

Conventional installation methods were employed to pull the new type of optical fiber cable through the underground ducts.

The new system, developed in Waltham, Massachusetts by GTE Laboratories connects the General Telephone Company of California long-distance switching center at Long Beach with the company's local exchange building 5.6 miles away in Artesia.

Rediffusion Designs Advanced TV System In Holland

ARNHEM, HOLLAND—Rediffusion Central Services Limited has announced the installation of a Dial-a-Program TV system in Arnhem, Holland. This installation is the first local wideband switched network to be installed on an operational basis for public use world-wide.

The first phase of this project, a joint development between Rediffusion and Deltakabel of the Hague, will initially serve 400 homes in Arnhem.

Constructed on the same principle as a telephone network the system will operate via two exchanges. Subscribers will be able to select any program on the main trunkline using remotely-controlled switches. Initial channel capacity will be 24 channels with a potential capacity of 72 channels.

Due to the successful fiber optic field-trial in the trunkline of Rediffusion's cable network in Hastings, one or two fiber optic subscriber connections will be incorporated in the Arnhem project.

If the Arnhem project is successful, the Dutch Postal authorities will probably approve large-scale application of the system in Holland.

NCTA Comments on WARC-79

WASHINGTON, D.C.—In response to an FCC inquiry into engineering consideratons for the 1979 World Administrative Radio Conference (WARC-79), the NCTA has proposed "flexibility in the international arena in the 470 MHz-890 MHz band," but noted this position "should not be regarded as advocating or even sympathizing with any near-term proceeding to reduce the size of the existing domestic UHF television broadcast spectrum allocations."

WARC-79 will determine international frequency allocations for the next 20 years, including cable TV and broadcasting, and focus on the growth of electronic communications.

While supporting UHF television allocation as the "major hope" for increased minority ownership, the NCTA stated that "based on the record, it is unclear whether or not all practical expansion could be accommodated within the existing allocation." It urged the commission to "amend its proposal in the 470 MHz-890 Mhz to reflect co-equal status internationally between broadcast and mobile services: 470-680 MHz Broadcasting/Mobile; 608-614 MHz Broadcasting/Mobile/Radio Astronomy; 614-890 MHz Broadcasting/Mobile."

On the microwave portion of the spectrum, NCTA encouraged "the continuation of positions that maintain future domestic ability to be responsive to the growing demand by the cable industry for additional private point-to-point and common carrier-provided terrestrial microwave circuits for program distribution purposes."

After calling on the commission to remain flexible in this area, NCTA stated it "strongly supports U.S. proposals in the microwave portion of the spectrum that maintain future domestic ability to adjust to future shifts in program distribution methods by a rapidly growing and innovative cable industry."

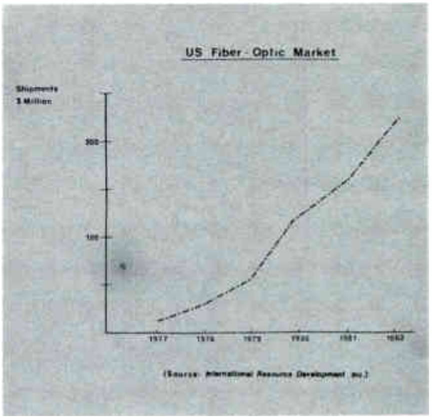
A final point raised by the cable trade association concerned CB interference and the FCC's interest in establishing a new mobile service in the 220 Mhz band. "To the extent that countries might be persuaded to make provisions for a similar service, we think the question of potential interference to the broadcast service is of sufficient international interest to warrant additional commission review before advancing the 220 Mhz mobile proposal further," NCTA said.

RCA Americom Files New Satellite TV Rate Structure

PISCATAWAY, NJ—RCA American Communications, Inc. has filed tariff revisions with the FCC for satellite communications services that will establish a new rate structure and expand the number of service options.

Several new categories of satellite transmission service, with corresponding rates, will be offered beginning November 10. For the first time rates will apply for off-peak usage. For both occasional and fixed term services, rates during off-peak times will be lower than during peak times.

Options are proposed that will allow the user to select protected, unprotected or preemptible service. The preemptible television rates are designed to attract users who do not require live or real time transmission, or whose programming can be shifted to a later period in the event of preemption.

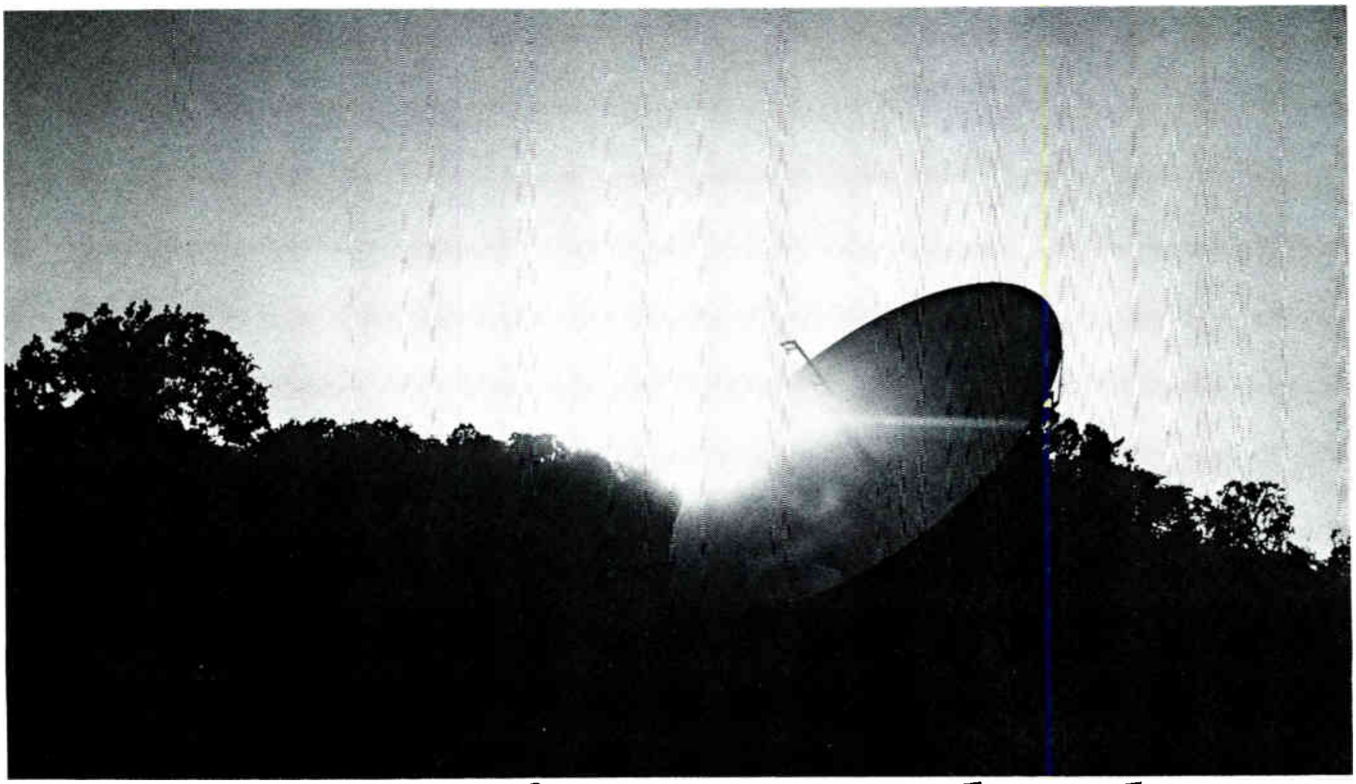


Fiber Optics Market To Top $1 Billion

NEW CANAAN, CT—Fiber Optics technology has now progressed to the point at which a market of at least $1 billion seems assured within the next ten years, according to a new 263-page report from International Resource Development Inc. (IRD), a New Canaan, Connecticut based market research firm. According to the IRD, the major portion of this market will come from the telephone industry, which will use fiber optics to replace heavier and bulkier copper cables.

When the fiber is in quantity production in the early 1980's, fiber optic systems are expected to be much cheaper than coaxial or twisted-pair cable; they are also immune to electromagnetic interference. The latter capability has already made fiber optics an attractive alternate for cable inside military aircraft and in electric power transmission applications.

Additional significant applications of fiber optics will be in the connections between computers and remote peripherals or terminals, secure battlefield military communications, and in the construction of such everyday items as gasoline station pumps.



Our earth station owners sleep better.

Anytime anyone buys an expensive piece of equipment, one of the first things he does is worry about how he'll get it fixed in case it goes on the fritz. But people who buy Scientific-Atlanta earth stations don't suffer from these nightmares.

We protect them with a nation wide network of 8 service centers that never sleeps. Emergency help by an experienced Scientific-Atlanta earth station engineer is available on a 24 hour a day basis.

What's more, we're the only people who make a complete earth station. The 10-meter dish plus all the special electronics which link it to the headend. So if a malfunction is only in an electronics module and we get a call for help, we won't have to call anyone else for help. We make it all. We fix it all.

That's why over 70% of the companies who've dreamed about cashing in on pay TV have come to us for a fully warranted and protected earth station. We're the only people who've made a commitment to the cable industry that's total in every respect. And we aim to keep it. Rest assured.

For more information, please call Jay Levergood at (404) 449-2000 or write us.

Scientific Atlanta

United States: 3845 Pleasantdale Road, Atlanta, Ga. 30340, Telephone 404-449-2000, TWX 810-766-4912, Telex 054-2898
Canada: 678 Belmont Avenue West, Suite 103, Kitchener, Ontario, Canada N2M-1N6, Telephone 519-745-9445, Telex 069-5239
Europe: 1-7 Sunbury Cross Centre, Staines Road West, Sunbury on Thames, Middlesex TW16 7BB, England,
Telephone Sunbury on Thames 89751, Telex 896015

How a Veteran CATV Manufacturer Presents a Technical Seminar

By Eileen Milton
Washington Correspondent

State College, PA—C-COR Electronics, a leader in CATV manufacturing almost since the birth of cable, has also been the host for technical seminars over the past ten years.

"In the past," noted C-COR president Jim Palmer, "the seminar was a useful method for showing cable operators how their equipment worked. Since C-COR's amplifiers are somewhat more complicated than other comparable models, this approach was not only good business policy, but was, in many cases, necessary."

With the evolution of more sophisticated CATV components, seminars today require more engineering expertise and the additional know-how to implement successfully the equipment in a cable system. C-COR's latest technical seminar, at the company's headquarters in State College, Pa., focused on both of these approaches: a demonstration on how to make troubleshooting more efficient; and technical sessions introducing more advanced electronic devices and calculation procedures for determining correct system levels at any point in the cable system.

The concept underlying C-COR's seminar was experimental. By testing the equipment, the participants could identify how the data sheets compared with the tests as well as evaluate how the equipment was used. Some of the attendees included two small cable operators (both run their own systems), a technician with Westinghouse's operation at Clearview Cable, and a head technician with a medium-sized cable system in Morristown, N.J. Each attendee had varying degrees of expertise and also different equipment needs for their systems. C-COR's technical seminar succeeded in appealing to these groups by providing both a technical review and highly specialized demonstrations of system testing.

After a tour of C-COR's plant facility and a brief technical review, the attendees proceeded to an environmental test chamber where Joe Preschutti, senior CATV engineer, conducted various cascade balancing tests in the 70°F chamber. Following the cascade testing, the chamber was pre-set for 20°F for the next day's tests. To determine the durability of the equipment under adverse conditions, chamber experiments for the following day were conducted at -20°F in the morning and at +120°F in the afternoon.

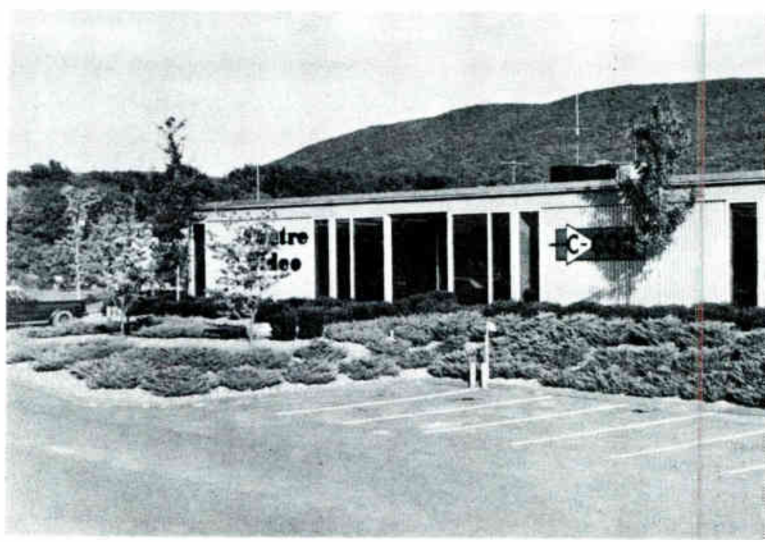
The next day, the students returned to the -20°F test chamber. After inspecting the frost on the cascade amplifiers, they returned to the lab for an oscilloscope check. Each channel was checked to determine carrier-to-noise measurement. Because video reception was "snowy" (below 40 dB), Joe Preschutti played with the equipment until he received a clear picture. Streaks appeared when stand-by power was used; but at 52 dB, the composite beat was barely preceptible. The test results showed 2 dB higher than normal levels at -20°F. This demonstration proved that the higher the dB level, the better the reception.

The last part of the seminar involved Transient and Surge Protection Devices. The instructors explained how three test devices (gas diode, SPM and MOV) apply in sequence to the test board.

The gas diode, sometimes referred to as a gas-filled surge suppressor, has a small volume and heats up quickly. Because it's a low capacity device, the gas diode can't dissipate much power. At 145 volts, the tolerance of breakdown voltage is 100 percent, using a test board with limiting resistors. One of the problems associated with the gas diode is that it cannot handle a lot of power.

The Surge Protection Module (SPM) automatically extinguishes and resets at the zero cross-over of each one-half cycle of a.c. voltage. It limits power dissipation by a voltage fold-back phenomenon to one volt, and resets automatically. While slightly nonsynthetic in firing, the firing voltage remains almost exactly the same with increased volts. Used in some isolation by RF, the Surge Protection Module is a high capacity device with 1,000 to 2,000 volts. The SPM heats to a non-conducting board, whereas the gas diode becomes too hot to touch. The students were advised that, in choosing an SPM, they should select one which will not fire under normal a.c. power conditions and will allow at least a 20 percent margin between the firing point and the peak normal voltage.

The other surge protection device is the MOV, also known as "clippers." These devices have a faster turn-on rate with a 60 Hz ferro-resonant supply. It fires at 82 volts, instantly resettles, and is



not limited by fallout time. Clipping devices can't be used across the RF panel, and have to dissipate at high voltage (500 volts).

In addition to demonstrations on Transient and Surge Protection Devices, the C-COR manual included a paper on power and lightning surges in coaxial distribution systems. According to the paper, written by C-COR president Jim Palmer, "Transmission and distribution system equipment is designed and rated to insure withstanding peak lightning voltages and ensuing fault currents." Palmer recommends "these surges be protected against using standard a.c. distribution practices, as well as the employment of a pellet lightning arrester. This device absorbs over-voltages four times above normal and reduces the magnitude of the voltage surge. Although it protects the a.c. supply, it does not protect electronic equipment." Palmer also suggests "the a.c. to a.c. power supply itself should have a primary insulation value of 1240 volts RMS for one minute per . . . for specialty transformers (1000 volts plus two times rated volts). Fusing is selected, not for load protection, but for fault protection to disconnect the circuit in case of transformer failure. Typically," Palmer interjects, "fuses applied at this location have a much greater interrupting capacity than circuit breakers. Their action is much faster."

Besides the many procedures covered in the seminar, the C-COR manual contained additional background information on equipment and measuring techniques. All in all, the seminar was an education for those who attended. By actually testing the equipment, the practical methods were beneficial to small cable operators who, on the whole, use less equipment. The seminar was just as profitable for those technicians who are more acquainted with highly sophisticated electronic components. C-ED

C-COR's plant facility in State College, Pennsylvania

SATELLITE VIDEO LINK

By Norm Weinhouse
Manager, Satellite Earth Terminals
Hughes Microwave Communications Products
Earth Station Seminar

Modulation Technique

Predetection carrier to noise ratio (C/N) pn is an important parameter in any satellite or terrestrial radio link. In this paper we shall consider one particular form of modulation currently used in domestic satellite systems for television transmission.

TV transmission is currently accomplished on satellite circuits by analog FM. The sound program is placed on an FM subcarrier above the video, producing a composite baseband as shown in figure 1.

Digital modulation shows promise for the future. It may be implemented soon for trunk distribution between large aperture earth stations, but for distribution to cable system FM is likely to be around for a long time.

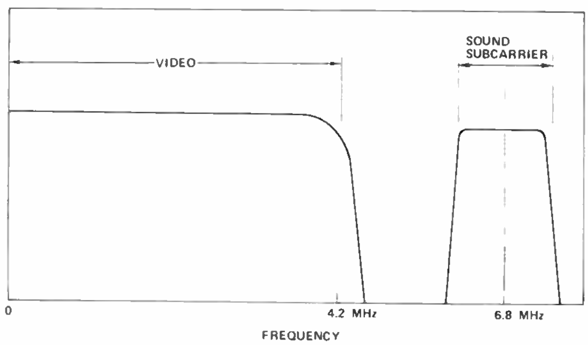


Figure 1 Composite TV Baseband

Figure 2 gives an equation for determination of video signal to noise ratio and the various parameters used in the SATCOM system. Other domestic satellite systems use similar values. The emphasis and weighting improvement utilizes CCIR standards (405-1 and 421-2).

In FM receivers (above threshold) with TV modulation, the signal to noise ratio of the video signal is given by:

$$(S/N)V = 6 \cdot \left(\frac{\Delta F}{f_m}\right)^2 \cdot \left(\frac{B_{PD}}{f_m}\right) \cdot \left(C/N\right)_{PD} \cdot \rho W$$

WHERE

$(S/N)_V$ = $\frac{\text{Peak Luminance Signal}}{\text{RMS Noise}}$

ΔF = Peak (one side) deviation of the carrier (including synch) = 11 MHz (TYP)

f_m = Highest Modulation Freq. = 4.2 MHz

ρW = Combined Emphasis and Weighting = 12.8 dB

B_{PD} = Predetection Bandwidth = 36 MHz = 75.6 dB - Hz

$(C/N)_{PD}$ = Predetection Carrier to Noise Ratio

SUBSTITUTING GIVES:

$$(S/N)V = 10 \log 6 + 20 \log \frac{11}{4.2} + 10 \log \frac{36}{4.2} + 12.8 + (C/N)_{PD} \text{ (dB)}$$

$$= 38.3 + (C/N)_{PD} \text{ (dB)}$$

Figure 2 S/N Performance Equation

Audio Performance

Figure 3 gives equation for determination of audio signal to noise ratio for the parameters of the SATCOM system. The de-emphasis improvement of 13 dB comes from the 75 micro-second broadcast standard.

$$\left(S/N\right)_A = 3/4 \cdot \left(C/N\right)_{PD} \cdot \left(\frac{\Delta F_C}{f_{sc}}\right)^2 \cdot \left(\frac{\Delta F_{SC}}{f_a}\right)^2 \cdot \frac{B_{PD}}{f_a} \cdot \rho$$

WHERE: $(C/N)_{PD}$ is predetection carrier to noise ratio

ΔF_C is deviation of the carrier by the subcarrier	= 2 MHz
f_{SC} is the subcarrier frequency	= 6.8 MHz
ΔF_{SC} is deviation of the subcarrier by audio	= 75 kHz
f_a is the highest audio frequency	= 15 kHz
B_{PD} is the predetection bandwidth	= 36 MHz
ρ is the de-emphasis improvement	= 13 dB

SUBSTITUTING GIVES:

$$\left(S/N\right)_A = 10 \log 3/4 + 20 \log \frac{2}{6.8} + 20 \log \frac{75}{15} + 10 \log \frac{36 \times 10^6}{15 \times 10^3} + 13 + \left(C/N\right)_{PD} \text{ (dB)}$$

$$= 49 + \left(C/N\right)_{PD}$$

Figure 3 Audio Performance

Example

Figure 4 shows an example of the performance to be expected from a system using a 4.5 meter antenna system with a 125°K low noise amplifier in New York City.

Let us look at that expression for downlink C/N again.

$(C/N)_D$ = $EIRP_D + (G/T)_E - (L_D + k + B)$ dB

Consider HBO signal in the vicinity of New York City (Channel 24)

A. EIRPD = 34.5 dBW
B. L_D = 196.7 dB
C. k = -228.6 dBW/°K/Hz
D. B = 36 MHz = 75.6 dB - Hz
E. $(G/T)_E$ = 22.3 dB

SUBSTITUTING GIVES:

$(C/N)_D$ = 13.1 dB

$(C/N)_{PD}$ = 13.1 $\boxplus$ 18.5 = 12.0 dB

AND

$(S/N)_V$ = 38.3 + 12 = 50.3 dB

$(S/N)_A$ = 49 + 12 = 61 dB

Figure 4 Example of Determination of (C/N)D and (C/N)PD and (S/N)

Measured Results Video S/N

Figure 5 shows the measured S/N vs C/N for the Hughes SVR461 Receiver. The measured result is approximately 0.1 dB from theoretical.

The subjective notes are the result of extensive subjective tests. It is interesting to note that even with the presence of inpulse noise, the picture quality was judged to be good. The perception of impulse noise comes about at a C/N = 7.4 dB.

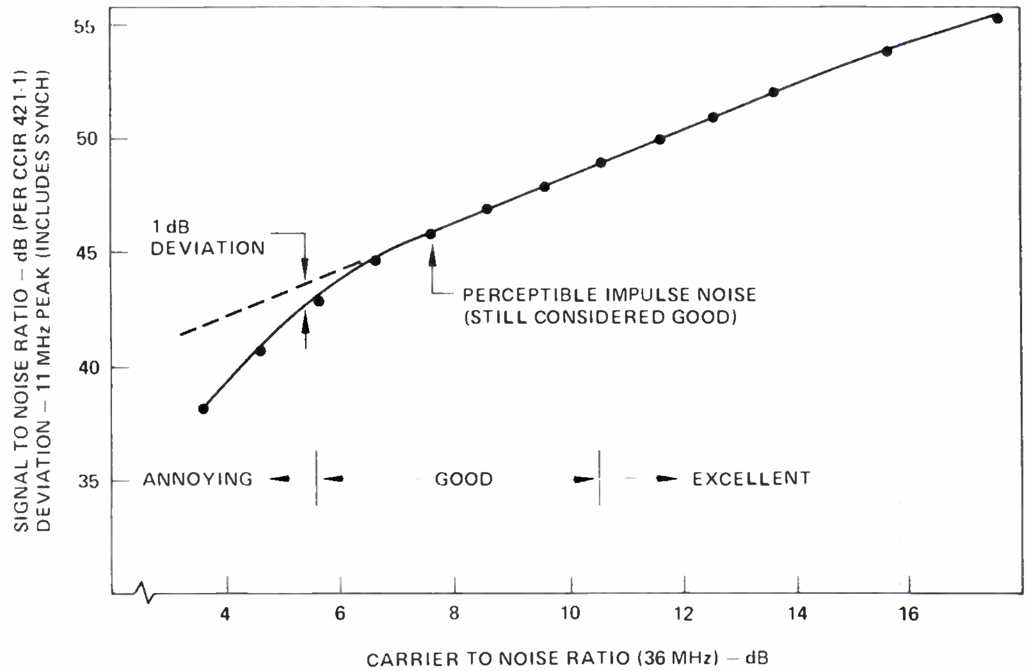


Figure 5 Quieting Characteristics
Hughes SVR-461 Satellite Video Receiver

Implementation of TV Uplink

Figure 6 shows the basic elements of a TV uplink. Video is emphasized and fed to a roofing filter. This filter cuts off spectral components that exceed 4.2 MHz, which if left unattenuated, would interfere with sound subcarrier and cause other anomalies. The audio is preemphasized and frequency modulated on a subcarrier. These two signals are summed and fed to an energy dispersal unit (EDU) to preclude high power flux density on the earth from the satellite.

This composite signal then modulates a carrier (usually 70 MHz, output), and the modulated signal is filtered to preclude splashing into adjacent transponders if an overmodulation should occur. An upconverter is used for conversion of the 70 MHz to the appropriate transponder frequency at 6 GHz. A 6 GHz high power amplifier is then used to obtain sufficiently high signal power for saturation of the satellite transponder.

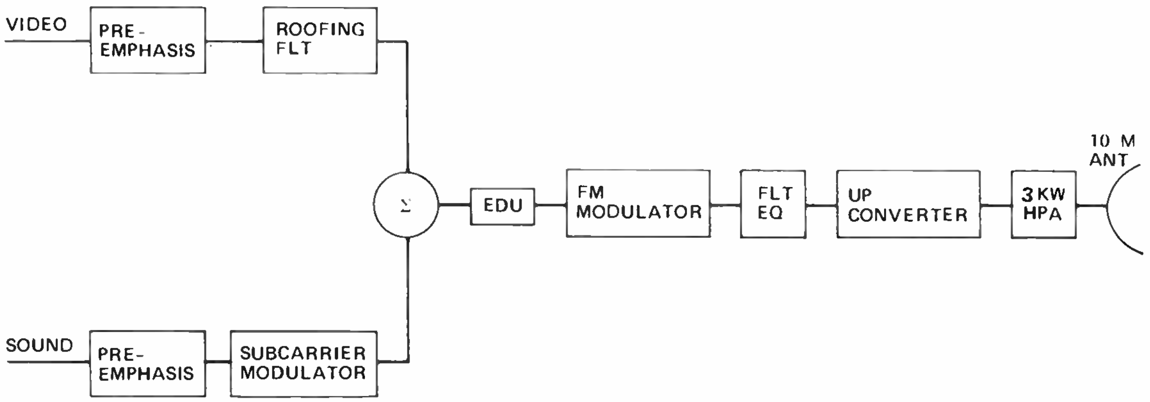


Figure 6 Elements of a TV Uplink Station

Implementation of TV Receiving Station

Figure 7 shows the basic elements of a receiving station. There are three important components (1) the Antenna, (2) the Low Noise Amplifier, and (3) Receiver. A single channel system and multiple channel system is shown. C-ED

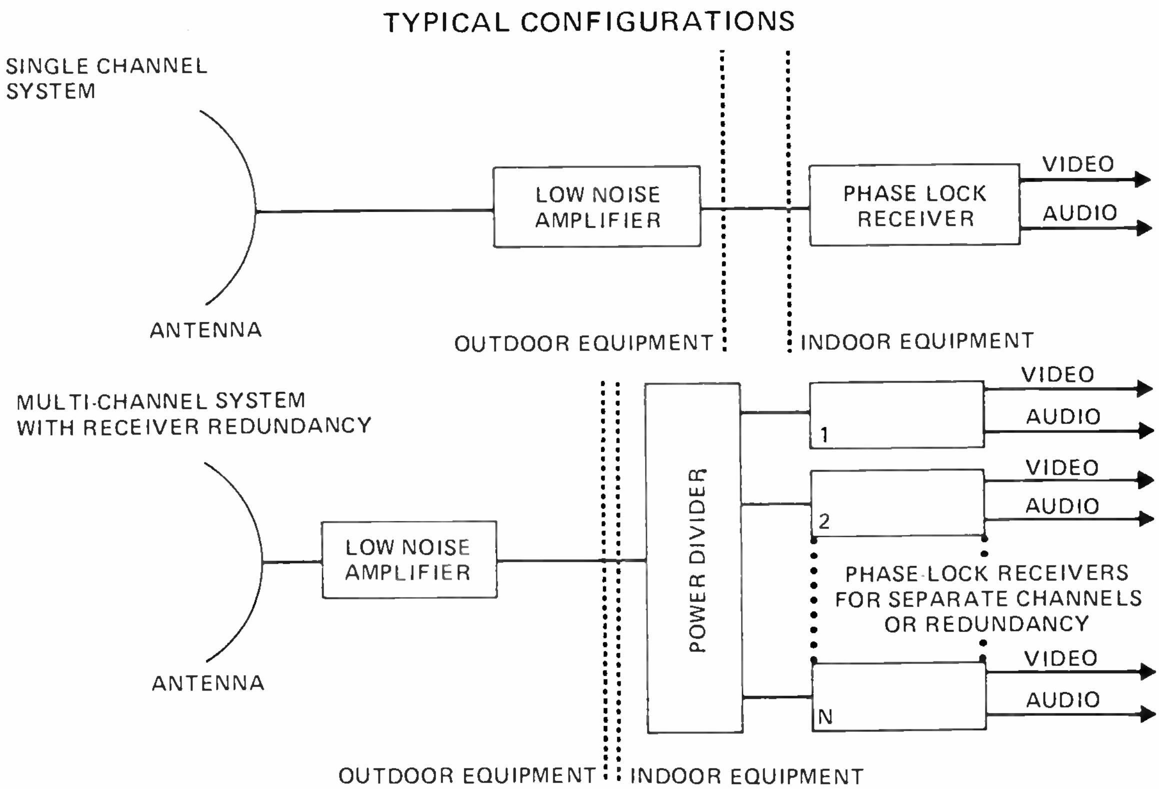
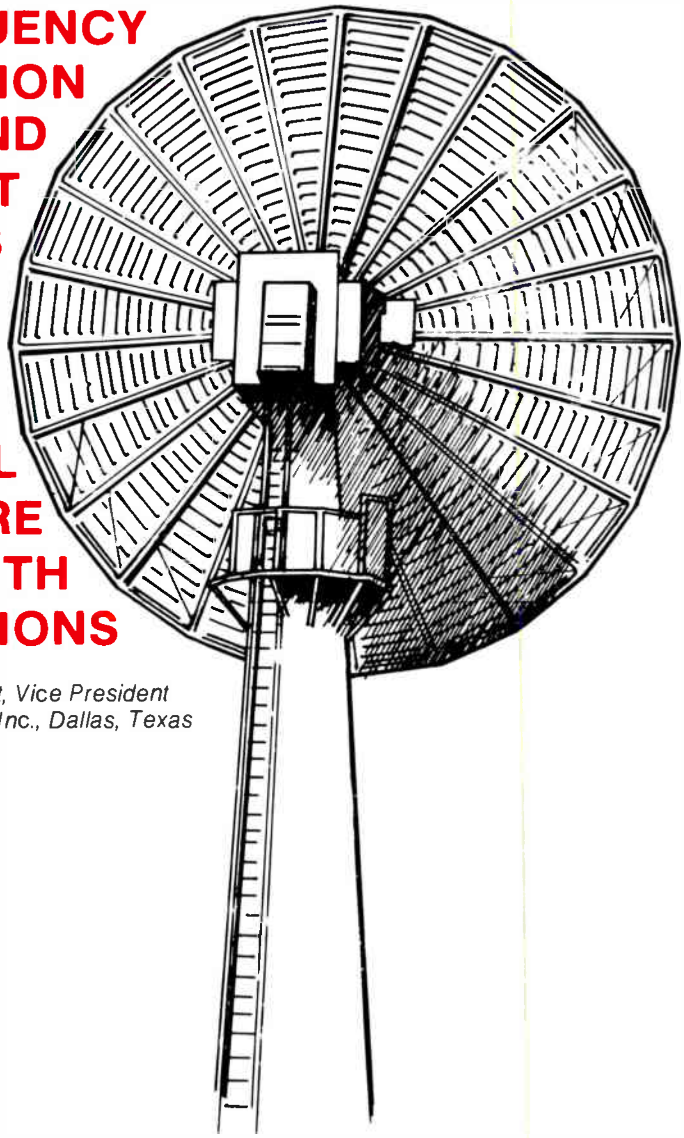


Figure 7 Satellite TV Receiving System

FREQUENCY COORDINATION AND PLACEMENT CONSIDERATIONS FOR 10 METER AND SMALL APERATURE EARTH STATIONS



By Dan Yost, Vice President
Compucon, Inc., Dallas, Texas

This paper was delivered at Scientific-Atlanta's Earth Station Symposium in Atlanta, Georgia.

Introduction

Since the dedication of the first 10-meter satellite earth station antenna at UA-Columbia's Fort Pierce, Florida location for video reception, the pressure and justifications for smaller aperature earth station antennas have been increasing. Both the suppliers of satellite programming services and the prospective users as well as a large group of equipment suppliers have supported the FCC to take action without requiring a formal rulemaking procedure. In a declaratory ruling issued in December, 1976, the FCC specifically allowed the use of earth station antenna sizes down to 4.5 meters in diameter after sifting the various arguments revolving around the previous 9-meter earth station antenna size guideline.

The impact of the FCC change in antenna size requirements has resulted in a rapid proliferation of small receive-only satellite earth station antennas, primarily for cable TV systems. The availability of satellite programming services is increasing as this network of large and small receive-only earth stations expands. Much of this proliferation is surprising considering that the receive-only earth stations must frequency coordinate with existing and proposed terrestrial microwave facilities. The existing networks of 4 GHz and 6 GHz terrestrial microwave routes are large, complex and cover vast areas of the country.

The key to the rapid expansion of satellite receive-only earth stations has been in the engineering technique for the analysis of prospective site locations for potential frequency interference. This paper reviews the reasons for frequency coordination, the types of frequency interference mechanisms and the interference environment for small earth station antennas. In addition, the process of the earth station site selection is examined and the role of on-site RFI field measurement reviewed. Finally, the FCC filing and licensing procedures are considered for planning and scheduling purposes.

Reasons for Frequency Coordination

The satellite earth station receives transmissions from the domestic satellite in the frequency band 3700 MHz to 4200 MHz and transmits to the satellite in the frequency band 5929 MHz to 6425 MHz. The satellite using frequency reuse techniques has 24 satellite transponders centered at 20 MHz spacing with half of the transponders using horizontal polarization and half using vertical polarization. The RCA Satcom I and II have this configuration.

These same frequency bands are also allocated for common-carrier terrestrial microwave users such as AT&T, MCI, SPCC, etc. The terrestrial microwave networks at 4 GHz and 6 GHz have developed over the last 20 years into vast, complex route networks spanning the entire nation. In many areas of heavy population density, the design of new terrestrial microwave routes is difficult, if not impossible. Hence, the satellite earth station must consider the frequency interference from these potential sources of interference at 4 GHz for establishing receive-only capability, and at 6 GHz for potential interference into the terrestrial microwave receivers when transmitting.

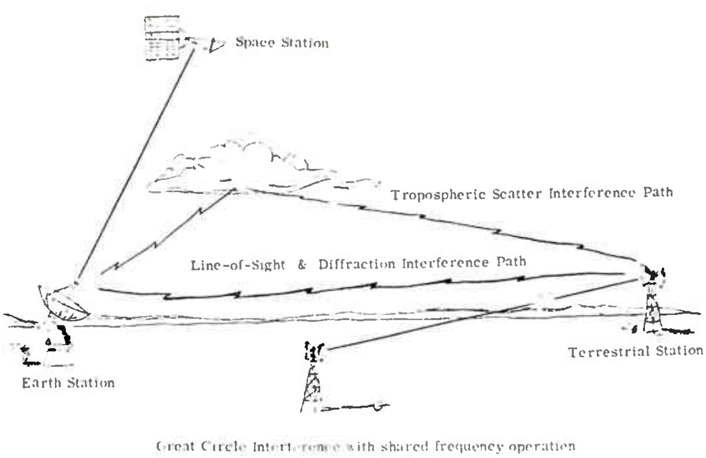


Figure 1A

The frequency interference analysis for a satellite earth station must consider proposed and planned microwave routes as well as existing microwaves. More than 20 percent of the microwave data bases are microwave routes which have been planned by the Bell system or other carriers and have not been built are filed with the FCC. Under Part 25.203 of the FCC Rules and Regulations the satellite earth station must frequency coordinate this application for 30 days with the surrounding common-carriers before filing an application with the FCC. Even for receive-only earth station applications, the common-carriers must be concerned with the potential blockage of planned routes and system expansion on existing routes. There is no potential frequency interference between two satellite earth stations. Hence, there is no coordination between them.

The primary reason for frequency coordination of an earth station site is that the potential for frequency interference with terrestrial microwave routes is very real and can disrupt or seriously degrade a received signal. The interference can occur via interference mechanisms which require investigation and analysis before coordinating a specific site location. If interference is encountered in the analysis, there are techniques for artificially shielding the earth station to achieve satisfactory performance.

Types of Frequency Interference Mechanisms

The satellite earth station designed for video reception must contend with the potential for frequency interference from 4 GHz microwave transmitters which may be located at considerable distances from the earth station. The design criteria based upon lab studies requires the interfering microwave signal to be at least 25 dB below the signal level received from the satellite. For a typical 10-meter earth station installation, the nominal received signal level from the satellite is -113 dBw which will vary with changes in satellite transponder and site location. In order to maintain acceptable margins above the interference thresholds, all interference signals should be below -138 dBw at 20 percent (in this case). For a small aperature antenna, this interference criteria for the same site location may be set at -145 dBw at 20 percent.

The first type of frequency interference mechanism of concern for the placement of the satellite earth station involves the great circle interference path. The direct path between the earth station site and the source of frequency interference may be line-of-sight and encounter only free-space attenuation losses. If terrain, building or other ground clutter blockage exists preventing a line-of-sight radio path, then additional diffraction propagation losses will be encountered reducing the level of the interfering signal. Propagation via the tropospheric scatter may result in a potential frequency interference path and the associated tropospheric scatter losses. Figure 1A shows the possible interference paths which may occur over the great circle path. This type of frequency interference mechanism can utilize artificial site shielding techniques for reducing interference levels.

The use of artificial site shielding or local ground clutter such as building structures and trees is common practice and can be an effective means of clearing a prospective site location which encounters problems. Passive interference reduction techniques would include using earth embankments, artificial pits, wire mesh fencing and dense trees as diffraction screens to reduce an interfering signal level. An alternate but more expensive approach would rely on active interference cancellers to receive the interfering signal, change its phase by 180° and mix it with the signal received at the earth station resulting in a cancellation of the interfering signal. Additional shielding can be obtained by adding shrouding to the earth station antenna to improve the antenna discrimination pattern, especially the front to back ratio. The smaller earth station antenna can be easier to shield due to its physical size and the dimensions required for shielding construction.

The second type of frequency interference mechanism, Figure 1B, involves the intersection of the satellite earth station beam and the terrestrial microwave beam. Within the common volume of this beam intersection, rain or other precipitation can cause scattering of the interfering signal from the 4 GHz microwave transmitter back into the earth station receiver. At 6 GHz, the reverse scatter impact can occur. Since the height of this common volume intersection can be at several kilometers, the use of local site shielding is ineffective. If a chosen site location encounters an interfering beam intersection, the only alternatives are to restrict the useable satellite orbital arc or relocate the earth station. Obviously, in clear ski conditions, this type of interference would not present a problem.

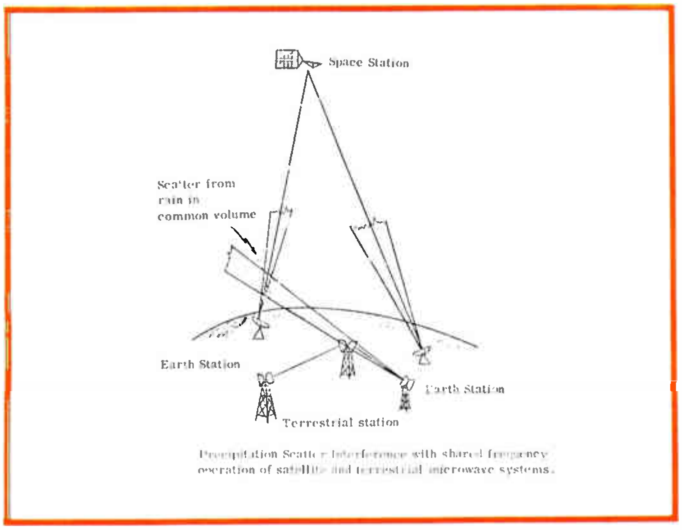


Figure 1B

Evaluation of Small Earth Station Antenna Impact on the Frequency Interference Environment

A comparison of the small earth station antenna with the 10-meter and 9-meter antenna is important in understanding the current proliferation of small earth station antennas. The small antenna has a lower main beam gain which requires potentially interfering signals to be below a lower interference level than a 10 meter. Hence, the small antenna is more susceptible and sensitive to frequency interference and may not coordinate at locations which will clear for a 10-meter antenna. A wider main beam makes the small antenna more susceptible to adjacent satellite interference and will cause the earth station to have more beam intersections. A small antenna's gain pattern performance may be as good or better than a ten meter due to the FCC requirement to meet or exceed the 32-25 log O curve. Shrouding on the small antenna further improves the antenna pattern performance for the side and back of the antenna.

Despite all of the above considerations, small antennas are proliferating. Why? The small antenna has a lower profile which can make a one story building look like an effective RF diffraction screen. Hence, the ease of shielding a small antenna with local building structures and artificial shielding can more than compensate for the loss in gain and the lower interference criteria. The small antenna does require careful design so that the carrier-to-noise margins above FM threshold are adequate over a number of satellite transponders and satellite orbital positions.

Satellite Earth Station Site Selection Process

The characteristics of a good earth station site include adequate local site shielding, visibility to the satellite orbital arc and no interfering signals from terrestrial microwave transmitters. The earth station requires access and adequate power. But, given these characteristics, how does the site selection process work if the primary site location can not be cleared of frequency interference? Figure 2 shows an outline of a site selection procedure which systematically evaluates prospective earth station sites for receive and transmit capability.

If a primary site location encounters severe frequency interference problems which cannot be resolved by interference cancelling techniques, the search for an alternate site location does require some guidance. The identification of alternate earth station site locations needs some data concerning the potential for frequency interference as a function of location. Selection of feasible earth station site locations for interference analysis involves a coordination between (1) terrain topography, (2) anticipated land availability and (3) the potential interference impact of the proposed earth station on the surrounding microwave environment. Knowledge of the microwave environment is required to identify areas of least potential interference. Land availability surveys can indicate potential site locations with suitable zoning and environmental clearances with these areas.

A computer technique using interference intensity map overlays is the most effective means of conducting site selection search. Map overlays graphically display the potential interference intensity of the microwave environment for locating an earth station with specific parameters at each prospective site location. A proposed site location which is in a low interference area at both 4 GHz and 6 GHz would have a good probability of clearing for transmit/receive capability.

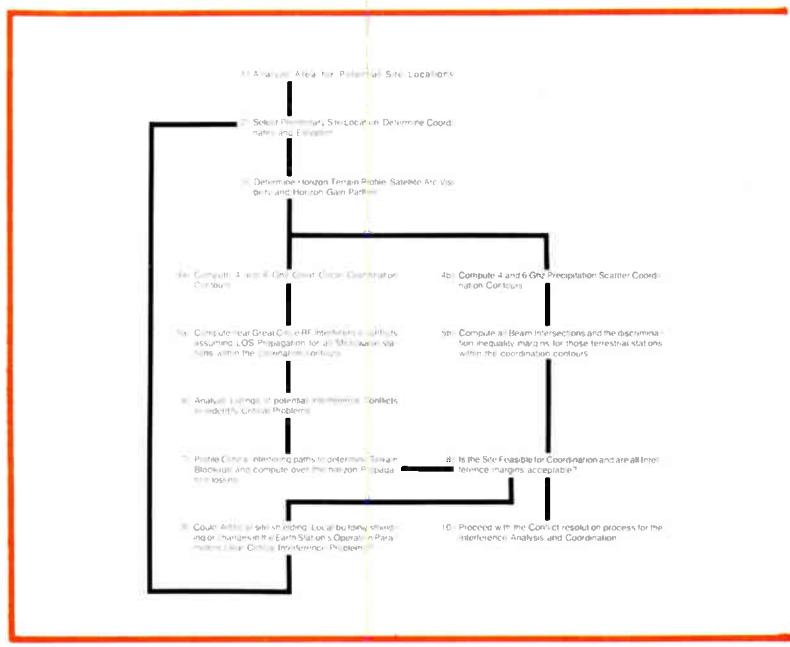


Figure 2

RFI Field Measurements

The on-site RFI field measurement of a prospective earth station site generally occurs if the frequency interference analysis indicates that the site has marginal clearance are the effectiveness of the local site shielding cannot be determined. The RFI measurement does encounter some difficulties since the interfering signals will vary with the time of day and the day of the year. Changes in local site shielding such as trees losing leaves may dramatically change the received signal level. In addition, the evaluation of planned or proposed routes is not practical since there are no on-the-air transmitters.

The field measurement is directed towards measuring interfering signals which occur via the great circle interference path. If a site location has encountered a serious beam intersection with a terrestrial microwave route, the RFI measurement cannot evaluate the interference impact. The on-site measurement does provide a means for detecting possible reflections of interference signals which could present a problem. In city locations, this reflection problem is of increasing concern and can only be analyzed on-site without extensive and time consuming calculations.

FCC Filing and Licensing Procedures

The sequence of events and time period required for frequency coordination, FCC filing, Public Notice and Licensing is variable but may conform to the following schedule:

Time and Event Schedule
For Obtaining FCC License

1) Frequency Interference Analysis	5-10 days
2) Part 25 Frequency Coordination	30 days plus mail time
3) FCC Application Preparation & Filing	10 days
4) FCC Public Notice	30 days
5) FCC Review and Grant of License	8-60 days

The earth station application does not require a specific FCC form and the contents of the application are specified in FCC Public Notices of August 8, 1975, and May 14, 1975. Applications for small receive-only earth station antennas also require an additional technical showing presenting the carrier-to-noise, carrier-to-interference and signal-to-noise calculations for the primary and back-up satellites for all desired satellite transponders.

The proliferation of 10-meter and small aperature earth station antennas will continue to occur as the applications of satellite technology expand. The success of the earth station placement effort is a contributing factor to the licensing of satellite earth stations within the vicinity of major population areas. The engineering techniques available allow a systematic approach for earth station site selection and frequency coordination. C-ED

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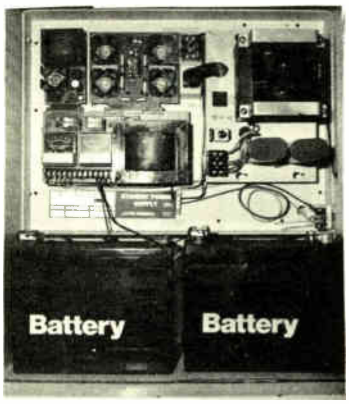

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H.G. Wells Would Be Proud or Rainbows Replace "Blue Skies" in Woodlands, Texas

By Toni Barnett, Managing Editor

Residents of Woodlands, Texas swear their town is one of America's safest—and according to statistics, they're probably right! This fast-growing suburb, 25 miles north of Houston, has a futuristic interactive two-way CATV system that has been developed and installed by Dallas-based TOCOM, Inc.

TOCOM, Inc. has combined cable television, home security systems and computer control into an economically feasible security program which is proving to be a powerful new sales tool.

The Woodlands' major attraction, in addition to cable and pay-TV, is the security/surveillance system provided by the TOCOM II system. Unlike most towns where conventional security systems offering 24-hour-a-day central-station monitoring are too expensive for typical residential applications, every house and some apartments in The Woodlands are wired for cable and security/surveillance.

"Normally, you would find this kind of protection only in a top-grade housing project, like an elite retirement community," states Donald T. Rozak, the system's general manager. "Never would I expect it in an entire town. It's just too expensive. However," Rozak adds, "the cost of the average home in The Woodlands is only about $54,000."

For a one-time cost of $300 for the home terminal unit (often supplied by the builder) and a $5 monthly service charge, residents can tie-in all these security devices directly to the central computer.

The security system demonstrates the practicality of two-way cable. Every six seconds, the central-station computer checks in with the terminal unit in a subscriber's home. If an alarm has been triggered since the last check (a six-second cycle), the computer's printer types out the name, address, telephone number and the particular information (kind of alarm, medical history, etc.)

Simultaneously, a teleprinter alerts The Woodlands Fire Department, which also operates the town's emergency medical service. The dispatcher can contact patrol cars immediately. He also verifies police, fire and medical alarms and recalls emergency units in case of false alarms.

By law, the builder must supply a minimum package before residents occupy the home: a smoke detector, two TV outlets, two medical/fire emergency alarm switches and two police alarm switches. The builder—or buyer—can add extra smoke or heat detectors, alarm switches and intrusion-detection devices.

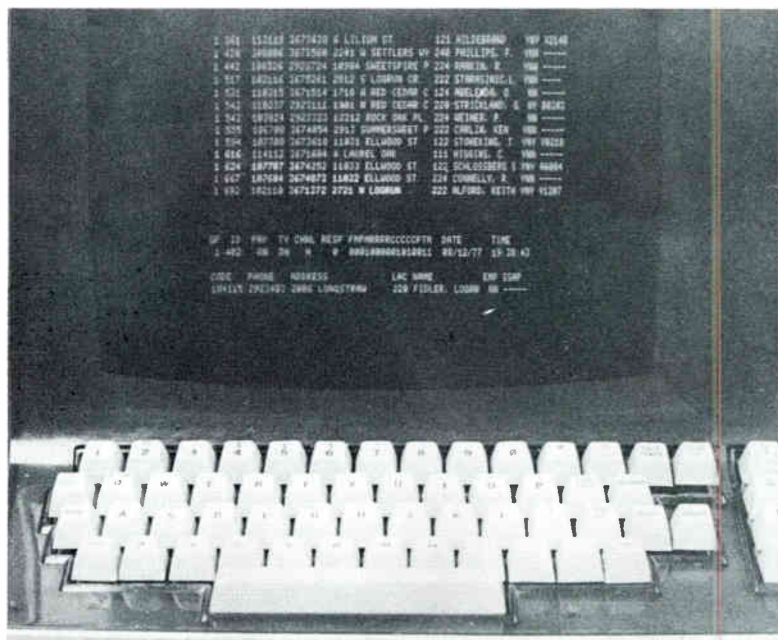
Household emergencies requiring outside assistance usually fall into the following categories: fire, police and medical. Generally, response time is critical. The typical time lag for the individual to reach the appropriate agency and that agency to respond can be anywhere from five minutes to one-half hour. With automatic detection, however, individual reaction time and possible communications delays are eliminated.

In case of a fire, medical or police emergency, there is no need for verbal communication. A forced-open lock will automatically bring police in about 90 seconds. A smoky attic will instantly alert the fire department; with response time about two minutes. If a medical emergency should arise, the fire department/medical emergency team will arrive two minutes after the medical emergency switch is activated.

The equipment which eliminates the "blue-sky" approach to interactive two-way CATV belongs to the TOCOM II system.

The unique TOCOM II system consists of three primary elements: varying numbers of Remote Units; a computer-controlled Central Data Terminal; and a bi-directional cable distribution system.

The Remote Unit is a combination of a 26-channel TV converter and a Digital Transmitter-Receiver, which is housed in one cabinet. Each Remote Unit has its own unique identification,

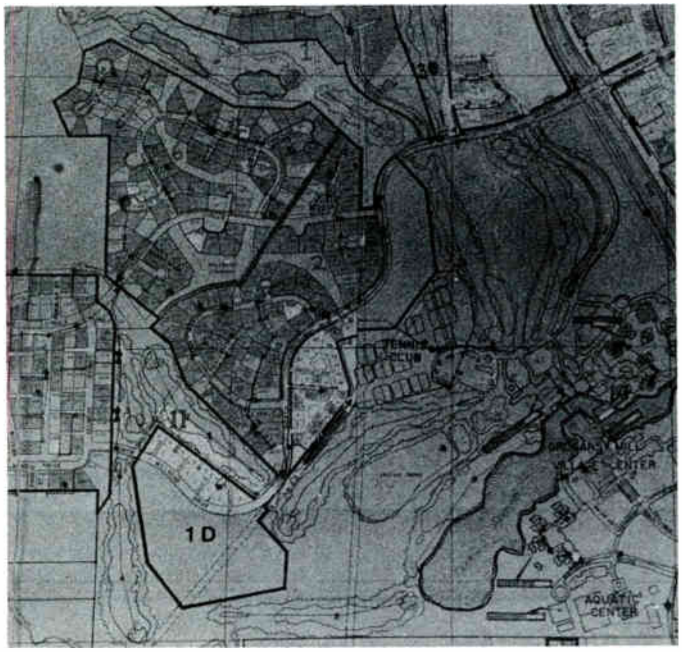


and it responds with a digitally-coded signal when interrogated by the Central Data Terminal. The Remote Unit automatically relays data pertaining to electronic inquiries from the Central Data Terminal (i.e. does an alarm condition exist?; what is your opinion?; etc.)

The Central Data Terminal (CDT) can interrogate, receive responses and act on the responses from 60,000 Remote Units

every six seconds. The CDT utilizes a mini-computer with bulk memory, a control and display panel, data receivers/transmitters and teleprinters.

The bi-directional cable distribution system uses dual trunk configurations incorporating uni-directional amplifiers with a 5-300 MHz response. The bi-directional cable plant exhibits a forward transmission bandwidth to allow for 26 channels of TV reception and also exhibits a reverse transmission bandwidth in the 5-25 MHz frequency range.



In addition to the security/surveillance system (which incorporates opinion polling), residents of The Woodlands have the option of receiving high quality TV reception, locally-originated TV programs and pay-TV.

For a $7 per month service charge, subscribers are provided with five channels of basic cable TV from Houston and an all-FM band. There is no additional cost for extra TV outlets. An additional $9 monthly fee enables the resident to receive pay-TV, via Telemation's MDS link to Houston.

By selecting TOCOM's entire package (security and subscriber response, cable and pay-TV), the resident can receive a 31-channel package that provides six Houston channels, a pay-TV channel and currently four of The Woodlands own 24-hour-a-day channels. These four local origination channels provide local/national weather conditions; continuous New York Stock Exchange readouts and general financial news from the Reuters News Agency; and local, state, regional and national news from the Associated Press.

WCATV also provides television studio and production facilities so that residents or organizations can produce and present non-commercial messages to residents of The Woodlands (the first five minutes of production are free.)

"Subscriber response" (part of the security package) is an efficient, easy method for residents of The Woodlands to *attend* local community meetings without leaving the comfort of their homes. By utilizing the response buttons on the hand-held Remote Unit, the subscriber may actively participate in televised public meetings, vote on issues with instant tabulations and results, ask a speaker to explain an issue further or ask the meeting to move on to another subject.

Votes cast at home by the viewer are counted and printed out via the computer. The results are instantly televised to the association and viewers.

A combination of the four buttons on the Remote Unit will allow up to 15 different responses. A "clear" button is provided in the event a subscriber wishes to change his response.

The Woodlands has a current penetration of over 1,000 subscribers. 96½ percent of the homes passed subscribe to some level of service; over 72 percent of the residents take advantage of the security option; and 38½ percent subscribe to pay-TV.

According to general manager Donald Rozak, "revenues per month for The Woodlands average about $15.55 versus national monthly subscriber revenues of $6.80."

Thanks to the nearly three-year-old TOCOM II CATV alarm system, residents of The Woodlands have chalked up the following record:

- Only one fire resulting in some structural damage. (The owner had tinkered with the wiring, causing a short circuit.)
- Only one successful burglary due to resident leaving his key in the control panel. (Forceful, successful entries in unprotected homes in The Woodlands is approximately 47 percent.)
- No violent acts at all, and amazingly few prowlers.

The effectiveness of the protection afforded by this Texas town's security/surveillance system provides an additional benefit to subscribers. So far, two insurance companies are providing security subscribers with a 25 percent discount.

"Two-way is alive and well," reports Rozak, "and we're anticipating additional futuristic applications." Rozak is trying to get utility companies to use the system for "reading" individual light, gas and water meters. "The entire town could be 'read' in six seconds."

Receivers

Hughes Offers New Receiver For Satellite Earth Stations

A new 24-channel video receiver for use in the distribution of satellite-transmitted television programming has been introduced by Hughes Aircraft Company's microwave communications products.

The new receiver, Model SVR-461, is a phase-locked unit featuring full-frequency agility via local or remote control. A special feature of the receiver is threshold extension designed to extend the FM threshold considerably lower than conventional receivers.

The receiver accepts a frequency modulated video signal, with audio program subcarriers, in the frequency range of 3700 to 4200 MHz. It includes down converter, phase lock demodulator, video processor, audio subcarrier demodulator, and associated power supplies and control circuitry. The frequency control circuitry uses COS/MOS logic, offering high noise immunity, with local and remote BCD control.

Other features of the new unit include a single RF conversion stage, internal LNA power supply, modular construction and built-in test and alignment circuitry. The use of fewer parts than conventional receivers provides for low power consumption, longer life and higher reliability.

Model SVR-461 is designed for use with an appropriate earth terminal antenna and low-noise amplifier in satellite video receiving terminals, and is aimed at the CATV systems market.

For further information, contact Hughes Microwave Communications Products, 3060 West Lomita Blvd., Torrance, Calif. 90509, (213) 534-2146

New Satellite Receiver Scores With Weather Forecasters

The Muirhead Inc. M-136 Electrostatic Facsimile Receiver is creating strong interest among weather forecasters. The dynamic range of 16-plus steps with high black-white contrast reproduces details previously available only on high-priced equipment.

The 8½" × 8" format of received GOES-SMS satellite pictures is also convenient for TV applications. Camera copy with overlays provide accurate reproductions of weather patterns.

Cable

CERROFLEX™ Cable Won't "Tiger Stripe"

Cerro Communications has developed a bonded shield/braid drop cable with a new type of aluminum shield over the dielectric that won't crack ("tiger stripe") when bent or pushed back when connectors are slipped on. This new cable has the same electrical properties as standard bonded foil cables.

CERROFLEX™ uses a special aluminum tape shielding, composed of aluminum laminated to both sides of a high tensile strength plastic film, rather than just foil. This higher degree of flexibility means that CERROFLEX™ will not give away at bending points—thus eliminating a source of radiation leakage and signal ingress.

Comm/Scope's Shield Drop Coax Eliminates Cracking

Comm/Scope Company now has a new series of laminated bonded shield drop cables. The BLPV (patent pending) series of cables incorporates an overlapped, laminated foil bonded to a polyethylene core. In addition to aiding proper connector installation and acting as a moisture barrier, the new shield is highly flexible and overcomes the radial cracking evident in conventional bonded shield constructions.

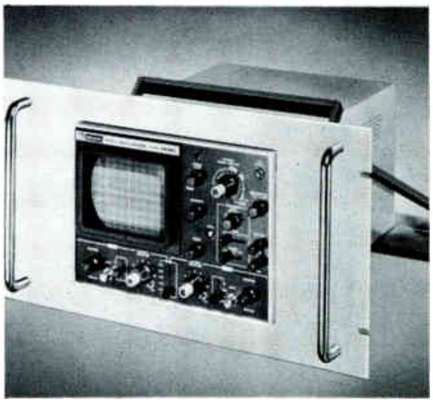
The series is available in standard ADF59BLPV AND ADF6BLPV as well as other configurations upon request. Standard drop is jacketed with flame retardant PVC. For specifics write Comm/Scope, Rt. 1, Box 199-A, Catawba, NC 28609.

Test Equipment

Oscilloscope Rack Mounting Kit By B&K-Precision

The "RM-14" oscilloscope rack mounting kit is designed to allow rack mounting of B&K-Precision oscilloscope models 1474, 1472C, 1471B or 1461.

The "RM-14" now permits operators an option to expensive scopes. When combined with the "RM-14," the B&K-Precision scopes are one of the most cost-effective rack-mounted scopes available.



Utility Products Introduces 12 Pair Terminal Block

Utility Products Company introduces a new design concept in fixed count termination, Series UP-2100 Fixed Count Terminal Blocks.

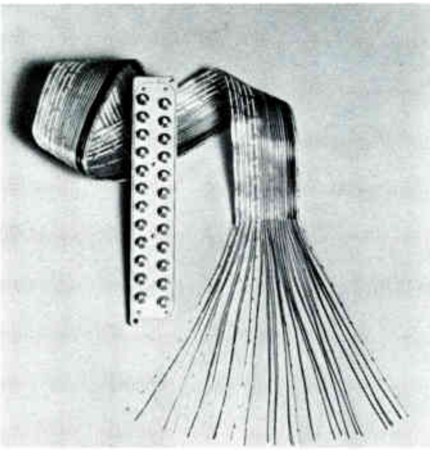
Model UP-2112, a 12 pair block, was developed using aero-space technology and materials to insure long-term performance. Its design and durability reduces initial installation and in-service maintenance costs.

Model UP-2112 features unique new flat ribbon cable and a translucent PVC jacket cover. This permits fast pair identification of the band marked color coded conductors. Stub length is a standard 36 inches. The first eight inches of the jacket are removed for fast conductor to conductor termination.

Model UP-2112 component parts include a glass-reinforced epoxy circuit board permanently mounted in a high-impact ABS plastic housing. The entire circuit assembly is encapsulated providing an effective seal against moisture in any environment.

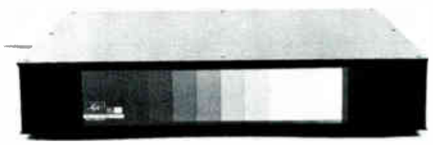
Model UP-2112, clearly marked Tip-up, Ring-right, is available back stubbed or bottom stubbed, factory installed in Utility Products CAD, GHC or FT Closures, or bulk packaged for field installation.

Utility Products Co. with established capabilities to meet future demands within the telecommunications industry is the world's largest manufacturer of buried cable closures.



Telecommunications Newest: PORTA-PATTERN™ Color Monitor

Telecommunications Industries Ltd. has announced the immediate availability of a PORTA-PATTERN instrument for precise adjustment of picture white and grey scale tracking. This new Color Monitor Grey Scale Reference Unit, packaged in a rugged 4" × 19" × 13" case for portability, contains a ten-step scale transparency manufactured on special film stock that matches the output of a standard ten-step signal generator. Its application is in control rooms and other technical areas to match color monitor luminance characteristics to standard independent of transmission system distortions.



Hewlett-Packard's New Generation Of Spectrum Analyzers

Hewlett-Packard has developed a new state-of-the-art spectrum analyzer, Model 8568A, capable of precision performance, power and easy use and automatic measurement capability.

The 100 Hz to 1500 MHz Model 8568A offers: unprecedented frequency tuning accuracy ($\leq$150 Hz); frequency stability (essentially 10^{-9}/day frequency reference); 10 Hz resolution (even at 1500 MHz); freedom from close-in noise (local oscillator noise sidebands are typically $\geq$80 dB down 100 Hz away at 10 Hz resolution); and spurious-free dynamic range ($\geq$85 dB).

The HP spectrum analyzer can measure low-level line-related sidebands on oscillators so clean they previously could be measured only by indirect means. The amplitude measurement range is -137 dBm to +30 dBm with AC or DC coupled inputs. The calibrated display range is 90 dB and overall amplitude accuracy is +2.5 dB.

30/60 Volt Transformer For CATV Systems From Scientific-Atlanta

Scientific-Atlanta's new versatile transformer enables cable system operators to extend their present 30 volt system or replace their outdated equipment on an on-going basis. This eliminates the need to order special 30 volt only equipment to extend existing 30 volt systems and then having to purchase additional equipment later when updating to 60 volt operation.

The new 30/60 volt transformer improves reliability and system performance. The switch over is done easily with a screwdriver inserted in a recessed switch and moved to either the 30 or 60 volt position. The recessed switch will not permit the technician to accidentally change the setting.

Electron Generator

Electrons Are Writing Tools of New Photoengraving Machine For Making Integrated Circuits

Varian Associates has introduced a machine for fabricating solid state electronic circuits that could reproduce an entire 20-volume encyclopedia on a standard playing card.

The machine, called the EBMG-20 electron beam pattern generator, is a system for making the photomasks used in fabricating integrated circuits. In making these circuits, silicon wafers specially treated to behave like photographic printing paper are "exposed" to light projected through photomasks. The wafers are then "developed" to prepare the silicon for the next layer of processing. Several such "exposures" under different masks are required to build up the layers that finally yield fnished circuits.

Each silicon wafer (the wafers are circular and vary in diameter from two to five inches and are only a few hundredths of an inch thick) can contain from a few hundred to a few thousand circuits. Fabrication costs are approximately the same for each wafer, independent of the number of circuits contained on it.

The new machine generates circuit elements, such as connecting lines or transistors, three times smaller than the conventional means of making photomasks. The reduction can take some circuits down to one-ninth their present size and increase the number of circuits on a wafer by as much as eight or nine times.

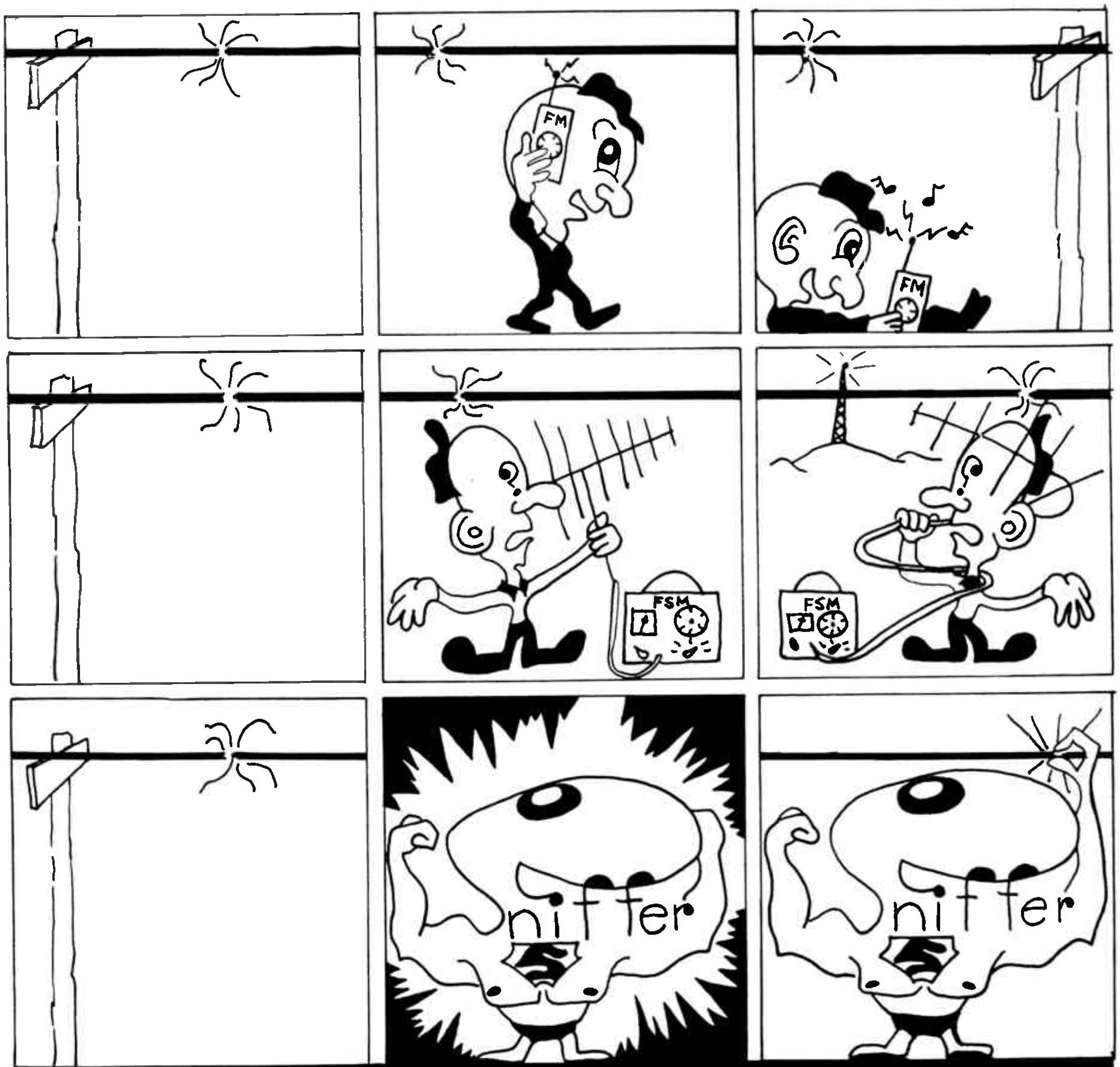
Passives

Allen Avionics' Video L-C Delay Lines

A complete line of passive L-C Delay Lines in 75 ohms, designed specifically for the video industry, has been announced by Allen Avionics. The units are manufactured with toggle and rotary switches, as well as terminals for strappable delay variations.

The series contains 10 variable delay units (the lowest delay is from 0 to 10.5 nanoseconds in .5 nanosecond steps). The longest delay available is from 0 to 2075 nanoseconds in 25 nanosecond steps.

All units feature exceptional amplitude flatness to 5.5 MHz, low insertion loss and low signal distortion.



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Hewlett-Packard's Library Solutions

Forty new books designed to provide owners of HP-67 and HP-97 programmable calculators with solutions to problems in such fields as personal finances, statistics and the natural sciences were introduced today by Hewlett-Packard. The books are priced at $10.00* each.

The **HP Users' Library Solutions** provides the user with programs, written by people knowledgeable in each discipline, in an easy-to-understand format. A summary of each program, a listing of program steps, and an explanation of how the results are displayed on the calculator allow even an operator with little or no experience to program the calculator, operate it and obtain the desired results.

Each book in the **HB Users' Library Solutions** contains between 10 and 15 programs specifically selected for their everyday usefulness from more than 1000 programs in the HP-67/97 Users' Group Library. These programs, when purchased separately from the Library, are $3.00* apiece.

The HP Users' Library Solutions consists of 40 new books designed to provide owners of HP-67 and HP-97 programmable calculators with solutions to problems in such fields as personal finances, statistics, medicine, engineering and aviation. Each book contains between 10 and 15 programs specifically selected for their everyday usefulness from the HP-67/97 Users' Group Library.

Free Brochure Gives A To Z of Custom LSI Microcircuits for OEMs

A 24-page illustrated brochure which describes the pros and cons and presents a step-by-step guide for OEMs to incorporate custom microcircuits is available free of charge from American Microsystems, Inc., (AMI), largest producer of custom integrated circuits. Fields of application include appliances, autos, communications, business machines, instruments, process controls, machine tools and others.

Subject matter of *Custom Microcircuits, Key to Today's Advanced Products* includes case histories, tradeoffs, costs and risks, computer aided design, comparison of circuit types, and details of design and production.

Inquiries for *Custom Microcircuits, Key to Today's Advanced Products* should be addressed to: Mr. Tom Edel, Manager, Marketing Services, American Microsystems, Inc., 3800 Homestead Road, Santa Clara, California 95051, (408) 246-0330.

Signature Analysis—What the Digital Product Designer Needs to Know

Signature analysis, a new concept recently developed by Hewlett-Packard for troubleshooting microprocessor-based products, gives the serviceman the ability to locate faults in complex digital circuits right down to the component level. This new Application Note 222 written for the circuit designer and service manager explains SA, how it can be designed into a product, and how it is used.

Because the greatest benefits of SA are realized in field troubleshooting microprocessor-based circuits, the 50-page booklet places most emphasis upon this area. However, discussion of other logic structures is included. Economic tradeoffs involved in applying SA are included in a section which lists key factors that the designer must consider.

Application Note 222 concludes with a typical case study showing how designing with SA results in reduced manufacturing and service costs.

Hewlett-Packard Application Note 222, 'A Designer's Guide to Signature Analysis' is available free of charge.

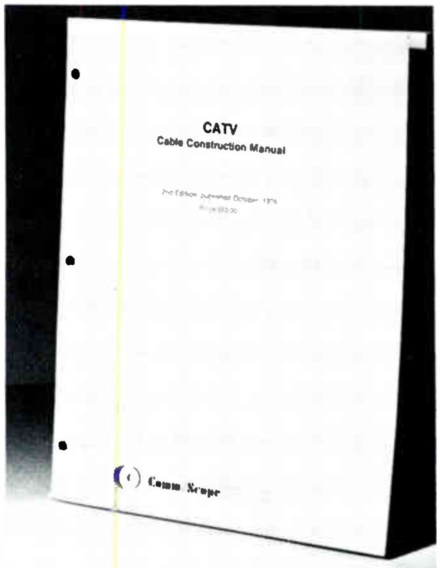
Comm/Scope's 2nd Edition Manual Now Ready

The second edition of Comm/Scope's 80-page "CATV Cable Construction Manual" is now available.

The manual may be obtained free of charge by writing to Comm/Scope, Route 1, Box 199-A, Catawba, NC 78609.

Intended as a helpful guide for the handling and installation of coaxial cable for CATV systems, the manual includes sections on loading and unloading procedures; testing cable for impedance uniformity and insertion loss; cable handling tools; safety equipment; cable handling and installation procedures for lashed and integral messenger cable.

Fully illustrated, the manual is the result of Comm/Scope's own experience plus suggestions from two of the top construction engineers in the country and some of Comm/Scope's CATV customers.



Cable and the Canadian Satellite

By Michael Hind-Smith,
President, Canadian Cable Television Association

Canadians are fond of thinking of themselves as the pioneers of the cable television industry. And observers on both sides of the border can agree that much has been achieved here. From its start in the early fifties, the Canadian cable television industry has grown rapidly to a predominant position in the Canadian communications system. Cable now passes more than 76 percent of Canadian homes. And 3.2 million families have chosen to subscribe. "The New Majority," as we called them at our 20th annual convention in May, comprise more than 50 percent of all cable television homes.

Microwave systems bring distant signals up to 900 miles from their point of origination to subscribers in Atlantic Canada and the western provinces. Urban cable systems are increasing their capacity with converter service which offers up to six and eight locally originated video or digital channels providing multi-lingual programs, dedicated children's channels, airport, weather, stock market, continuous news and comparison shopping services to their subscribers over and above a full dial of conventional television signals.

And yet the momentum of the past twenty years seems to be slackening as cable operators are locked into a monumental jurisdictional struggle over the future of the industry. Much of it is the familiar battle with the telephone companies that has been the common experience of cable operators in both the U.S. and Canada. But it has escalated to the sky—literally—in the struggle for access to our domestic communications satellite system.

Canada was the first country in the world to initiate its own domestic satellite system—the ideal solution to the communications needs of a nation stretching across our shared-widths and far-flung into the sparsely inhabited north.

Telesat Canada was created by an act of Parliament in 1969 as a mixed corporation, with shares to be held in equal part by the federal government, the common carriers and the general public. The public shares were never issued; so Telesat is, in effect, a partnership of the carriers and the government alone. The Anik (Eskimo word for friendship) series of satellites—launched in 1973—has been consistently under-utilized. In an effort to increase utilization and to provide funding for a generation of high-powered satellites operating in the 12/14 MHz band, Telesat sought membership in the common carrier consortium, Trans Canada Telephone System (TCTS), which operates the long distance communication services. The government endorsed the agreement subject to the approval of the Canadian Radio-Television and Telecommunications Commission (CRTC) under which two of the principal members of the TCTS—Tel-Canada and B.C. Tel—along with Telesat itself were regulated.

At the ensuing public hearing, Telesat and Bell encountered massive opposition, including that of four provincial governments, the other major common carrier, CMCT Telecommunications, the Canadian Association of Broadcasters and the Canadian Cable Television Association.

In its decision released August 24th, the CRTC rejected the agreement as not being in the public interest. The lengthy and complex decision (at 56 pages, it's the longest ever and described privately as its most important of the decade) the CRTC concluded the agreement would contain substantial likelihood of preference to TCTS; would erode the autonomy of Telesat; and would restrict competition in a long-haul data, video and other private line services.

In the wake of the decision considerable doubt is thrown on Telesat's continuing plans for its new generation satellite, for which supplier contracts were being developed, including reservations on the Nassau space shuttle "enterprise."

The cable industry intervention was based, in large part, on its continuing desire to utilize satellite interconnection, independent from the terrestrially based telephone companies, and omits opposition to Telesat's own restrictive policies, which preclude earth station ownership and which require "whole channel leasing." Canadian cable entrepreneurs have watched enviously the effect of the U.S. "open skies" policy, which has made possible the partnership of cable companies with access to satellite delivery for the rapid development of pay-television services. Robert Button of Trans Communications, Greenwich, Connecticut, appearing as an expert witness of TCTA at the hearing, enthralled TRTC commissioners with his testimony on the present and future of U.S. cable and satellite.

Meanwhile, pay-television itself remains in regulatory limbo.

Following its second major round of public hearings in two years last June, the CRTC is to recommend to the government whether it is prepared to reverse its previous decision of December 1975, that large scale development of pay-television in Canada would be "inappropriate."

It is little wonder then that pioneering Canadian cable TV entrepreneurs are seeing their capacity for innovation eroded. Increasingly, they look south of the border, where Maclean-Hunter Cable TV successfully expands in New Jersey, and enters an MDS pay distribution service system in Detroit, and Canadian cable systems compete successfully for the new franchise in Rochester, New York.

Dear CED,

Very pleased to have your letter of 8th August and the August issue of "Communications Engineering Digest". I welcome an exchange of information.

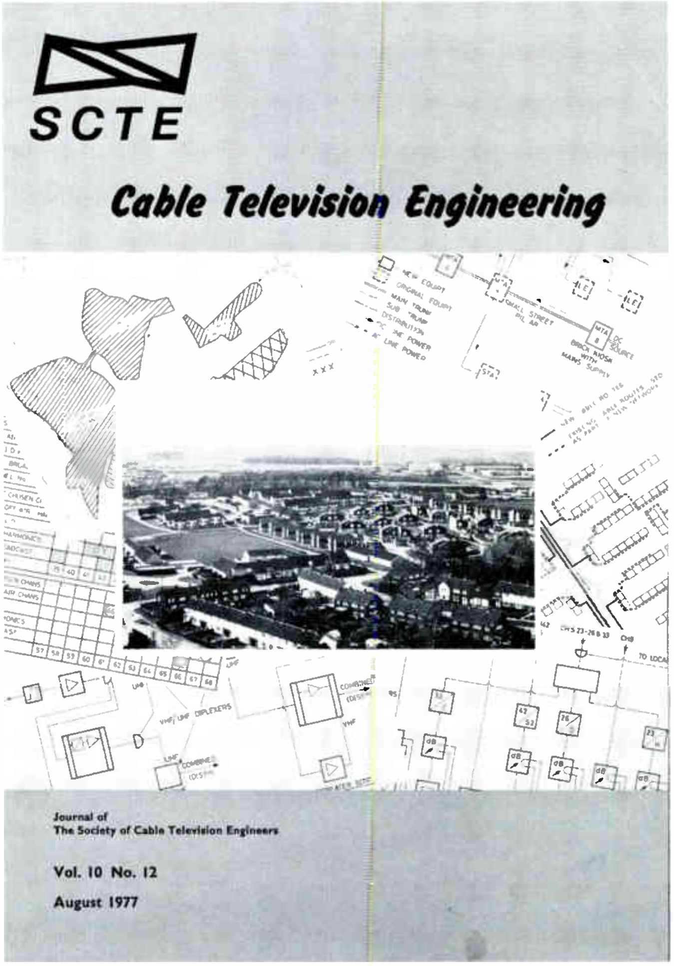
Our Journal "Cable Television Engineering" is currently published three times each year (April, August, December) but we plan to publish quarterly. I will see that you receive copies of all future issues and look forward to having copies of your Journal.

I'll be happy to contribute to your International column.

I'd welcome contributions from you for our Journal, ideally a chatty resume of developments in North America, either for inclusion in my 'Random Reflections' feature, or as a separate 'News from America' item.

Yours sincerely,

Tom Hall, Managing Editor, SCTE, West Midlands, England



British Cable TV Operators Are Facing Difficult Times

The proliferation of UHF transmitters bringing the two BBC programs and a commercial (IBA) program, in color, to almost the whole country limits the appeal of cable prevented by licensing restrictions from carrying programs other than those obtainable off-air in the locality, except for a few instances where controls have been relaxed to permit the addition of out-of-area IBA programs.

The report of the (Annan) committee on the Future of Broadcasting, presented to Parliament in March, was disappointing and discouraging. Although recognizing cable as the ultimate logical way of distributing all forms of fixed communication signals (leaving broadcasting for mobile use), the Committee saw private development over the next fifteen years only as a local community service under a proposed Local Broadcasting Authority, and visualized the Post Office as eventually providing a national network. Pay TV, which could be a life-saver for the cable industry, was not favored by the Committee, although experimental services were a possibility.

Local programming experiments by the five companies issued with limited licenses in 1973 (at Greenwich, Leeds, Bristol, Swindon and Wellingborough) have proved costly and have all been terminated with the exception of Swindon Viewpoint (a community service operated over Radio Rentals' network at Swindon) which faced closure this month (September) but may have a last minute reprieve as a result of the injection of funds and proposals for a lottery. Meanwhile, local programs under community control are now being relayed over a cable network being installed by the Post Office at the new town of Milton Keynes.

The CTA (Cable Television Association of Great Britain) has recently submitted comments on the Annan Report to the Home Office, urging freedom, subject to reasonable controls, to make the optimum use of existing cable systems and to develop new ones, insofar as subscribers wish to pay for such services.

Help Wanted

SYSTEM MANAGER

MSO seeking manager with electronic know-how for medium sized cable system in mid-west. Company offers generous benefit package. Salary commensurate with experience and ability. Send resume with salary history in complete confidence to Box CED-0801-1.

REGIONAL ENGINEER

Major MSO is seeking an experienced CATV field engineer to assume responsibility for regional technical operations. Successful candidate should have BSEE degree and minimum of three years progressive technical experience. FCC license helpful. Position requires heavy travel. Send resume and salary requirements to: Box CED-0829-1.

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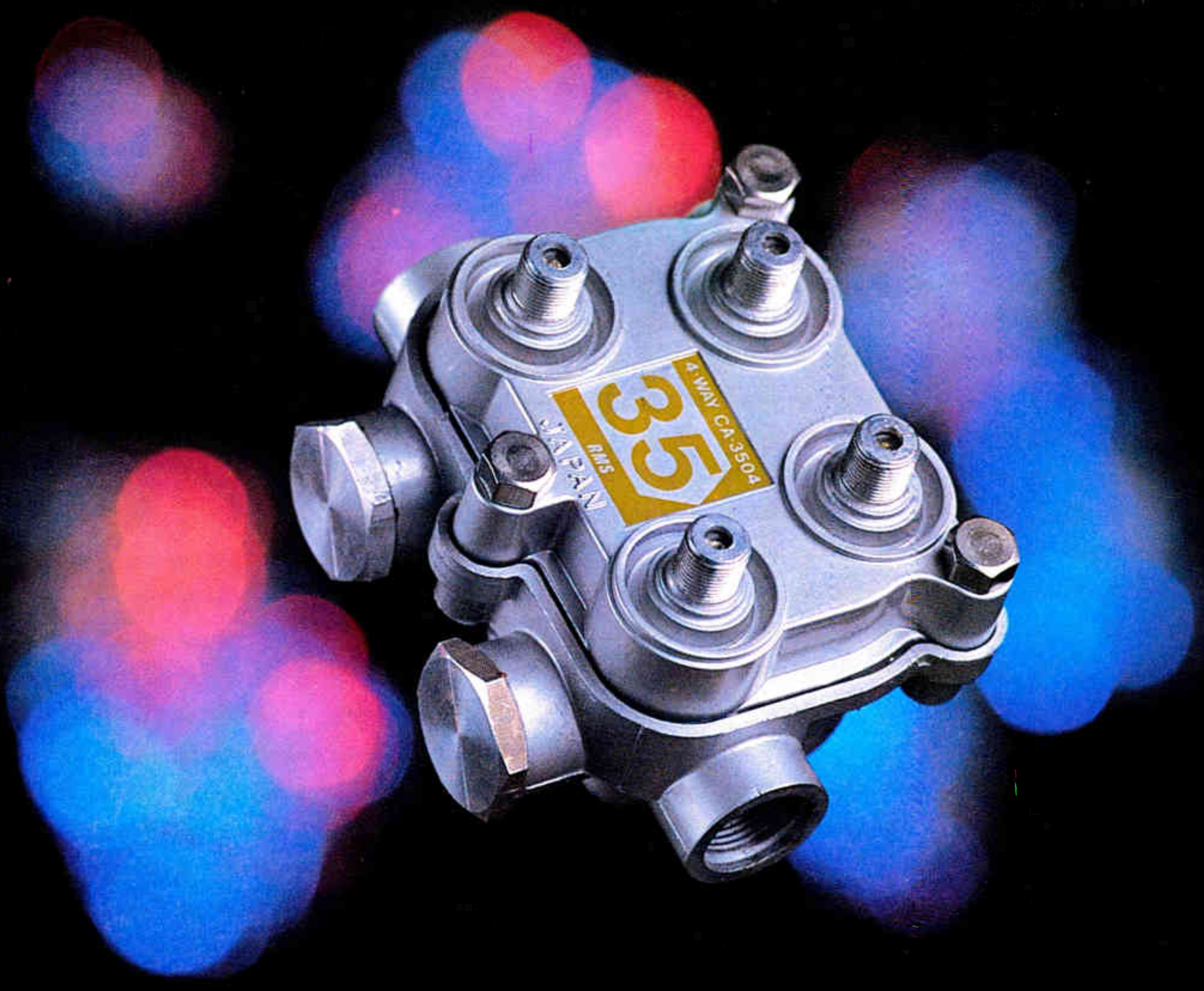

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