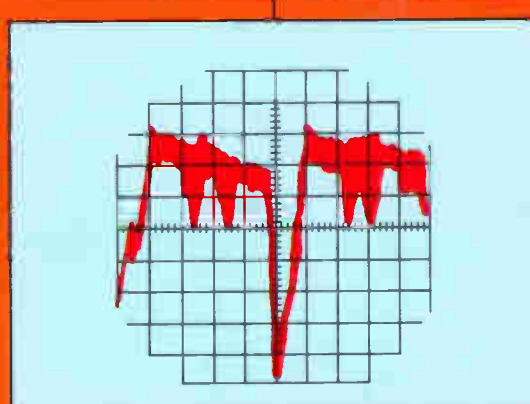
COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers

2 degree spacing
Page 20



Technical handbook
Page 50

October 1984

The case for Cablecon® for CATV Trunks, Drops and Feeders.

If you're making underground CATV installations, Integral's Cablecon offers you unique, cost-effective benefits.

Versatility: Cablecon can handle any communications cable, including current fiberoptic/waveguide cables, and provides an easy path for future modification.

Low installed cost: Field installation comparisons show Integral's Cablecon to be easier and faster to install than PVC duct systems.

Proven technology: Cablecon is Integral's tradename for a pre-assembled cable-in-duct system that is being used in utility underground distribution; airport, street, parking lot and highway lighting; irrigation power and control cable; traffic signal loop and CATV applications.

Integral pioneered the cable-in-duct concept and continues to improve it. Over 2,000 miles of Coax-Cablecon have already been installed.

Easy installation: Cables are preinstalled at the factory. Then, Cablecon is delivered to your job site, on reels ready to plow or lay in an open trench. After manufacture, the cable is never touched until it is spliced. Cablecon protects your cable during shipping, and protects against rocks, rodents and chemicals in the ground.

Technical help: Integral's engineering staff can provide cable-tension, pull length and friction coefficient data to help you achieve a very smooth easy and cost-effective installation.

National Sales Representative:
Channell Commercial Corporation
Call Toll Free 1-800-423-1863
In California (213)-963-1694

Integral Corporation
P.O. Box 11269
Dallas, Texas 75223
(214)-826-0590

Integral Corporation
"Our 24th year"

DX.
Rely on us for quality and performance.

New standards of quality and performance in satellite reception systems are being established. Standards maintained through every phase of design, production, and testing.

They're the result of DX's commitment to quality.

Our dedication to excellence is your assurance of high-performance products that deliver the clearest, sharpest pictures possible. The kind of reception available with receivers like the DSA 643A, one of our family of commercial-quality satellite receivers.

As a subsidiary of C. Itoh & Co., a $50-billion multinational company, we are uniquely qualified to provide the finest quality state-of-the-art technology the world has to offer. Plus a total commitment to service, right here in the U.S., that assures customer satisfaction today...and tomorrow.

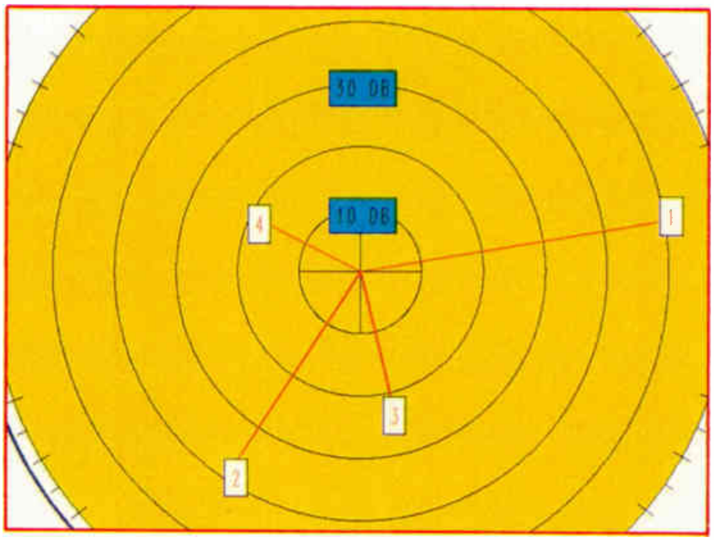
Quality and performance—the most important components in every piece of DX equipment. Definitely our competitive edge. Why not make it yours?

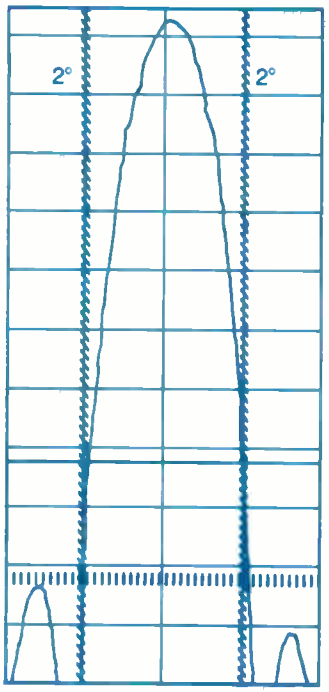
DX ANTENNA

DX COMMUNICATIONS, INC.
A Subsidiary of C. Itoh & Co. (America) Inc.
116 Midland Ave., Port Chester, NY 10573 • (914) 939-8880
Manufactured by DX Antenna Co., Kobe, Japan.

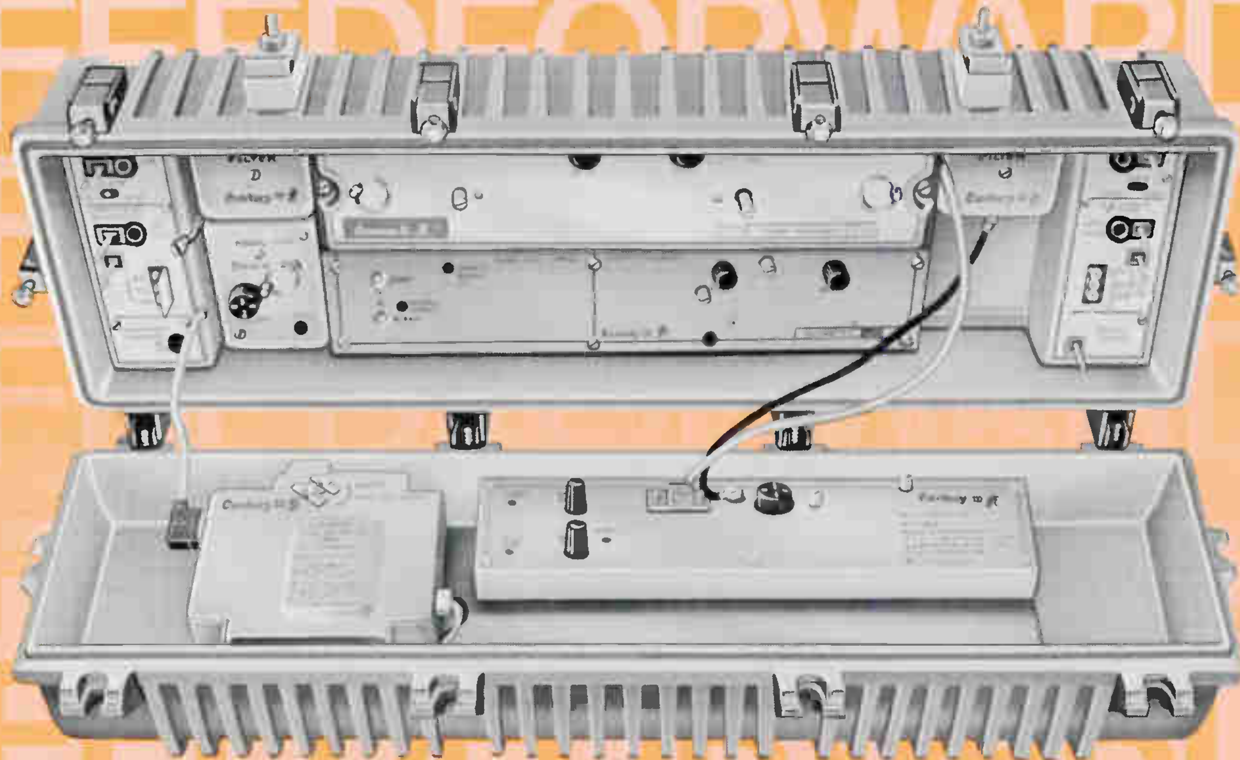
CONTENTS

Departments





Features



A matter of degree

Two degree satellite spacing: Why it's here, what it means and how to cope with it today are the concerns illuminated in this month's special features.

Because of the impact of a multitude of technical problems 2 degree spacing will cause to cable operators and earth station users alike, many of the answers will not be known until the scheme is fully implemented. Fortunately for the cable operator, most TV programming comes from satellites located in that portion of the orbital arc to be filled lastly with 2 degree spaced satellites. Thus, "we still have some breathing room," says Compucon's Scott Goldman, but not enough to procrastinate.

The story really began in 1972, when the FCC decreed a new policy known as the "open skies policy," which dramatically changed the role of the domestic satellite communications industry. In the pursuing years, as the number of satellite users increased, so too did the demand for additional satellites. Colleen McGuire of Jerrold points out in her article that "in 1970, the United States had 10 satellites in geostationary orbit. By 1984, this number increased to 19 and by 1990 there are expected to be 40 satellites in the orbital arc."

With the apparent need for more satellites to accommodate more users, the FCC has deemed it necessary to reduce the spacing between satellites to more effectively use the limited resources of the geostationary orbital arc.

Fred Fourcher and Dan Bathker, of Miralite Corp., point out that now, the correct concern for the majority of receive-only operators should be, "Will my present or planned terminal be vulnerable to adjacent satellite co-channel interference?"

One of the criteria that goes into answering that question is a satellite antenna's sidelobe response. Microdyne's Jim Grabenstein states that the real problem with the FCC's approach to 2 degree spacing is its reliance on reduced sidelobes. He suggests that "an even greater attenuation of adjacent satellite signals could be achieved if we controlled the polarization, power and frequency of each satellite. In fact," Grabenstein says, "20-30 dB isolation could be achieved by using cross-polarization and controlled frequency assignments."

Obviously, all the questions and answers concerning 2 degree spacing will not be known for sometime. What *is* known, is the fact that 2 degree spacing will happen. In the meantime, what should be done? My advice:

be prepared. Take the time now to investigate how 2 degree spaced satellites will affect your particular situation; it's never too soon to start planning.

Rocky Mountain meeting

On Wednesday, Oct. 17, the SCTE's Rocky Mountain Meeting Group will feature its second one-day technical seminar at the University of Denver.

Technical highlights will include the relationship of carrier-to-noise and noise figure with explanations of both; how distribution products are formed (cross-mod, second and third order beats and composite triple beat); how system design affects system performance; the effects of padding and equalization on system performance; and the evolution and design considerations of amplifiers.

Speakers for the seminar will be Richard Covell, C-COR Electronics, and Bill Williams, from the ATC Training Center.

Immediately following the training seminar will be a local chapter organization meeting. The main focus of the meeting will be on filling chapter offices and special committees. If this is your chapter, the time is now to prove it. Support your local chapter—it supports you.

Toni I. Barnett

An old line company... in a new line of business!

Poleline Corporation is the newest member of the RMS Electronics family. RMS Electronics, Inc. has been in operation for over 35 years.

PRODUCTS MANUFACTURED for various divisions of RMS Electronics, Inc. and available to the Cable Television Industry through **Poleline Corporation** include:

Poleline Hardware

■ Thimble eye bolts ■ Machine bolts ■ Suspension clamps ■ Support strand ■ Lashing wire ■ Tap and amplifier brackets ■ Lashing clamps ■ Crossover clamps ■ Guy-grip Dead-ends ■ False Dead-ends ■ and more.

Cable TV Products

■ Moulding Duct ■ Non-Power Passing "Raceway" Splitters and Directional Couplers ■ Apartment Amplifiers ■ Antenna/Cable TV Switches ■ Feed-thru Bushings ■ Ancillary Hardware ■ and more.

Poleline Corporation also distributes products such as:

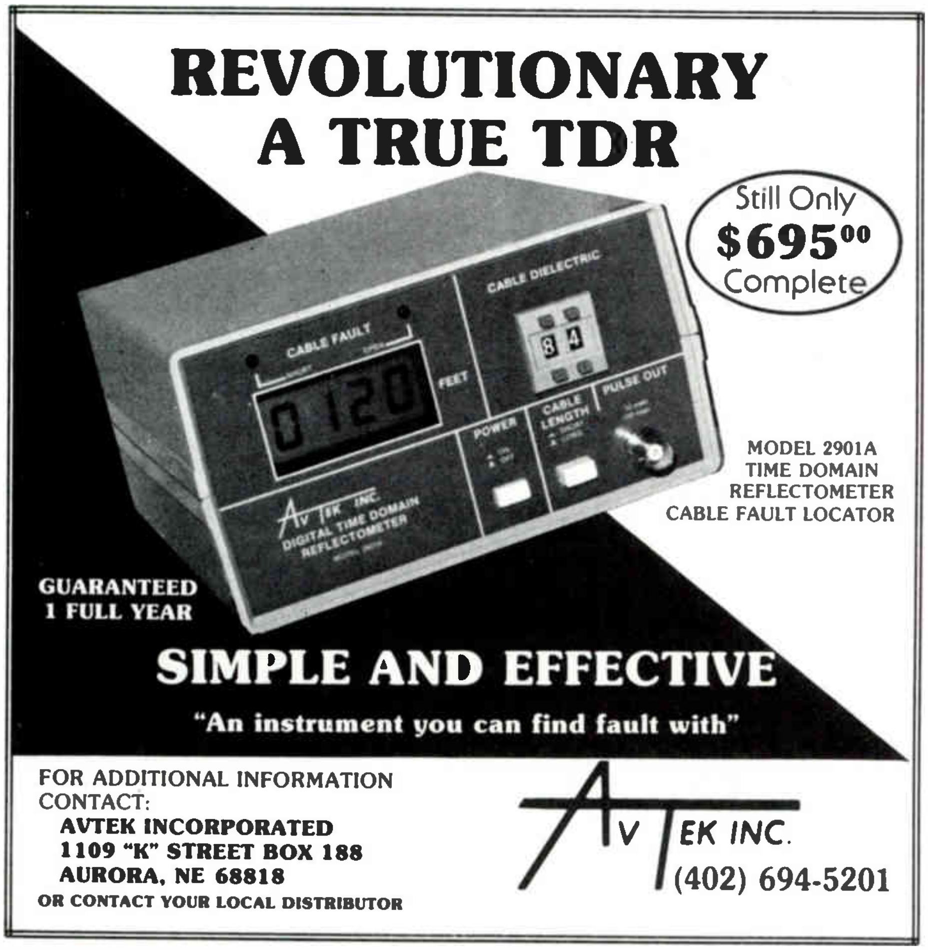
■ Heat Shrink Tubing ■ Moulding Duct ■ Prewire Apartment House Boxes ■ Cable ■ Lashing Machines ■ Pedestals ■ Test and Measuring Equipment ■ Ground Rods ■ Marker Tags ■ Tools ■ Silicone Grease ■ Ladders ■ Safety Equipment ■ Ancillary Hardware ■ and more.

Poleline Corp.

Subsidiary of RMS Electronics, Inc.

EASTERN OPERATIONS
20 Antin Place, Bronx, N.Y. 10462
TOLL FREE (800) 221-8857
(Continental U.S.A., Puerto Rico, U.S. Virgin Is.)
Call Collect (212) 829-1070 (N.Y. State Only)

WESTERN OPERATIONS
2901 W. Garry Ave., Santa Ana, California 92704
Telephone (714) 662-1041
TOLL FREE (800) 624-2511 (Continental U.S.A., Puerto Rico, U.S. Virgin Is., Alaska and Hawaii)
In California (800) 247-8435



COMMUNICATIONS TECHNOLOGY

Official trade journal of the Society of Cable Television Engineers

Paul R. Levine
Publisher

James G. Trevathan
Comptroller

Sherwood S. Sumner
Vice President-Sales (New York)

Toni I. Barnett
Vice President-Editorial

Wayne H. Lasley
Managing Editor

Rob Stuehrk
Account Executive

William Eager
Associate Editor

Sharon F. Lasley
Art Director

Pam K. Macy
Production Coordinator

Maria Sullivan
Artist

Sherri R. Wakehouse
Office Manager

Denver: Communications Technology Publications Corp., 7600 E. Arapahoe Road, Suite 305, Englewood, Colo. 80112-9989 —or— P.O. Box 3208, Englewood, Colo. 80155 (303) 779-9717. **New York:** 1641 3rd Avenue, Suite 2K East, New York, N.Y. 10128 (212) 599-0209

atlantic cable show set to deliver

ATLANTIC CITY, N.J.—Organizers of the Atlantic Cable Show, scheduled to be held here Oct. 30-Nov. 1, expect an increase in the number of exhibitors, exhibition space and people attending this year's show.

Three of the cable industry's top executives will share the dais for the show's keynote program on Tuesday, Oct. 30. Trygve Myhren, chairman and CEO of American Television and Communications, will serve as host of a panel that will explore the topic, "A Showcase for the Future." Joining Myhren will be John Saeman, vice chairman and CEO of Daniels & Associates, and Frank Hickey, the chairman and CEO of General Instrument. The three-day, mid-week show also will feature 20 separate panels, including a whole series of technical sessions.

Stanley Singer, executive director of the Pennsylvania Cable TV Associaton and a show organizer, said more effort has been put into this show than any previous show. "We're excited about this year's exhibition," he said. "I think this year's show will really establish the Atlantic Show as a 'must attend' for exhibitors and operators."

Final Mini-Hub II test site selected

WALLINGFORD, Conn.—Times Fiber Communications Inc. announced that its Mini-Hub II™ star-switched network equipment will be installed by Storer Cable Communications in its Houston system. The installation, which is the final test of TFC's latest generation of off-premises cable television program distribution systems, is scheduled to be completed in the fourth quarter of this year.

The Houston franchise was chosen because Storer had installed one of the first Mini-Hub systems in the Miami area and has had almost two years experience with star-switched networks. Times Fiber Communications will supply all the switching equipment and necessary coaxial cable for the test site. Storer personnel, with techical support from TFC, will install the system.

The Mini-Hub systems are made up of a computer-driven network of switches that distribute only programs which the subscriber is authorized to receive or for which he is to be billed. The Mini-Hub's software includes complete diagnostic capability and provides the cable operator with a total management system and direct interface to the billing system.

C-COR reorganizes engineering department

STATE COLLEGE, Pa.—C-COR Electronics Inc. announced a reorganization in its Engineering Department headed by Joseph Preschutti, vice president-engineering. The changes, effective immediately, have been implemented to facilitate growth through sales of products and services to the data transmission and entertainment cable television market.

John Englert has been promoted to director of engineering from senior staff engineer. In his new position, he will be responsible for managing research and product development activities for all distribution products (amplifiers) and for status monitoring systems. Prashant Jhaveri, who had been a senior staff engineer, has been promoted to engineering manager-special products group. He will have responsibility for directing R&D activity in the area of distribution products for the data and European marketplaces, including C-COR's local area network amplifiers. John Pavlic, engineering manager-distribution products, will continue to manage the traditional cable television distribution equipment product line as well as being given the increased responsibility for passives and line extenders. Robert Klotz, product engineer-special products, will be responsible for directing R&D activity for status monitoring.

Satellite-delivered SCTE seminar date set

WEST CHESTER, Pa.—The Society of Cable Television Engineers' first satellite-delivered seminar is scheduled for Oct. 24, from 6:15-9:15 p.m. It will be delivered courtesy of Home Box Office on Transponder 22 of Satcom III-R.

The seminar, videotaped during the first meeting of the SCTE Rocky Mountain Meeting Group, features a presentation on data transmission by Cliff Schrock, president of C-COR Labs Inc.

ITW Linx signs product rep deals

DES PLAINES, Ill.—ITW Linx Installer Products, a business of Illinois Tool Works Inc., announced that Cable Service Co. Inc. (Williamsport, Pa.) has become a stocking distributor and that Heath Communications (Macon, Ga.) has become a manufacturer's rep of its cable products line.

Cable Services Co. will represent the ITW Linx product line nationwide, while Heath Communications will be responsible for sales in the southeastern states of Florida, Georgia, North Carolina, South Carolina, Tennessee and Mississippi.

CWY to carry Electrohome products

LAFAYETTE, Ind.—CWY Electronics has been appointed exclusive stocking distributor of Electrohome Electronics products in Indiana, Illinois, Iowa, Wisconsin, Kentucky, Tennessee and Michigan.

CWY now stocks for immediate shipment Electrohome's products including the new SR-24 satellite receiver, the M-36 modulator and the SRM-36 satellite receiver/modulator, all designed exclusively for the cable systems market.

Dish discounts available for Galaxy reception

NEW YORK—Showtime/The Movie Channel Inc. has established a special discount program for its affiliates requiring additional earth station equipment for the reception of Galaxy I signals.

Special arrangements have been made by Showtime/TMC with Scientific-Atlanta and M/A-COM, allowing affiliates of both services to purchase the equipment directly from the manufacturers at significantly reduced costs. A mailing is currently being sent to all affiliates advising them of the types of satellite antenna equipment available, including specifications and discount prices.

SSS wins copyright suit

TULSA, Okla.—Southern Satellite Systems, a wholly owned subsidiary of Satellite Syndicated Systems Inc., has obtained a favorable judgment in the United States District Court of Minnesota that its transmission of television station WTBS to cable television systems across the country is in full compliance with federal copyright law.

Hubbard Broadcasting Inc., owner of several broadcast television stations, had filed suit alleging that Southern's method of operations violated the federal Copyright Act with regard to 12 programs that Hubbard had obtained licenses to broadcast locally. The programs were contained in the WTBS signal that Southern transmitted to cable systems in the plaintiff's television markets. The plaintiff had also joined Turner Broadcasting Systems Inc., licensee of WTBS, as a defendant in the suit.

Southern has always contended that it is exempt from copyright liability under the carrier exemption contained in the Copyright Act and the court upheld this contention. The court also held that the WTBS practice of inserting substituted commercial messages in the signal transmitted via direct interconnection from the WTBS studio to Southern's transmission facilities did not impose copyright liability on either company. In addition, the court held that Southern's use of the vertical blanking interval within the WTBS signal for its Keyfax and CableText services also is permissible under the Copyright Act.

The case was decided under a summary judgment procedure whereby all parties to the litigation had agreed that there were no issues of fact in dispute and that the question was purely a matter of law. Therefore plaintiff and defendants each submitted motions for summary judgment to the court, which granted defendants' motion and dismissed plaintiff's complaint.

Diefes forms consulting firm

PORT CHESTER, N.Y.—Gunther Diefes, formerly vice president of engineering for RMS Electronics Inc., has formed his own consulting firm. The firm will specialize in product design, product improvement and systems work for the CATV industry.

Diefes has over 15 years experience in the cable TV field, having worked for Jerrold and American Electronic Laboratories, in addition to RMS.

The office is located at 10 Charles Lane, Port Chester, N.Y. 10573; (914) 937-0207.

Anixter opens new regional headquarters

SKOKIE, Ill.—Anixter Communications has opened a new regional headquarters facility in the Dallas area to service the telephone and cable television industries in Texas, Oklahoma, Arkansas and Louisiana. The new headquarters becomes part of Anixter's North American network of supply and service centers, which are linked together by a proprietary on-line, real time business information system.

Key personnel include Tony Barclay, CATV regional vice president; Ed Hays, district manager-telephone products; Liz Vasquez-Cook, CATV district manager; and Carl Johnson, operations manager. The facility is located at 1250 Champion Circle, Carrollton, Texas 75006.

RTK increases credit line

EAST ORANGE, N.J.—RT/Katek Communications Group has consolidated the lines of credit of its five divisions into a single corporate line, and significantly increased the amount of credit available.

RTK Vice Chairman Roy Tartaglia said the consolidation and additional funds will ease RTK's further expansion in other areas of telecommunications, including discount telephone service. Morris County Bank is acting as the lead bank, with United Jersey Bank participating.

Technical note: VCR chroma beats

WASHINGTON—Several cases have been reported recently in which cable television systems have been involved in an unusual type of interference to video cassette recorders. Although the cable systems are not technically at fault, operators should be aware of the symptoms, cause and cure for this problem.

The symptom is a visable chroma beat during playback of tapes when the VCR/TV combination is connected to a cable system. The beat disappears when watching TV, regardless of whether the VCR or TV tuner is used; it also disappears on playback if the cable system is disconnected or replaced by an antenna. Finally, the beat occurs even if the cable is terminated and just the shield is touching the VCR's chassis! Finally, switching the VCR output RF channel has no effect on the appearance of the beat. The magnitude of the beat can vary from the threshold of visibility to extreme severity.

The cause of this interference is rooted in the format used to record video on magnetic tape. The chroma signal, rather than being recorded at the 3.58 MHz frequency used in NTSC format, is heterodyned to 688 kHz, thus reducing the bandwidth requirements of the recording and playback heads. Unfortunately, this places the low-level playback signal squarely in the AM broadcast band. Initial analysis indicates that the sheath of the cable system, house wiring and grounding systems apparently form an AM antenna system such that signals from a local radio station flow through the VCR chassis in sufficient magnitude to be picked up by the playback circuitry and cause the visual beats.

The beat may be eliminated by breaking the sheath current at low frequencies. One solution that has been used successfully is a series combination of 75/300 ohm transformer, TVI-type high-pass filter and 300/75 ohm transformer (see accompanying photograph). A coaxial high-pass filter will not work since it is an unbalanced circuit and will not block common-mode currents. The filter must be balanced (series capacitors in both legs) to work. This solution also has been successfully applied to similar situations in which baseband converters have picked up strong local AM stations causing luminance beats.

Network used experimentally to successfully eliminate interference to VCRs from cable systems.

The National Cable Television Association's Engineering Committee has reported the VCR situation to the joint EIA/NCTA committee that deals with issues of cable/TV compatibility for their review. It would greatly help that effort if operators would report observations of this type of interference to the NCTA with as many relevant details as possible (VCR make and model, strong local AM stations, beat level, unusual grounding situations, etc.) so that the cable industry may zero in on a better solution and possibly persuade manufacturers of VCRs to reduce the susceptability of their products. Address reports to the NCTA as follows: Wendell Bailey, NCTA Engineering Committee, 1724 Massachusetts Ave. N.W., Washington, D.C. 20036.

(Editor's note: Special thanks go to Dave Large, Gillcable's vice president of engineering, for bringing this matter to the attention of our readers.)

Wegener signs pact for U.K. distribution

NORCROSS, Ga.—Wegener Communications has signed an agreement with Megasat Ltd. of London for exclusive distribution throughout the United Kingdom. Megasat Ltd., a distributor of a full line of satellite communications equipment, will be adding the Wegener audio and data transmission equipment to its line.

Megasat will be supplying British systems with headend stereo processing equipment for the Thorn EMI music video service Music Box. Megasat will hold stock on this equipment in order to provide systems in the U.K. immediate delivery for stereo processing equipment. Additionally, it will maintain an inventory of this equipment to supply all of Europe until a more extensive distribution network is established by Wegener for this area.

In addition to the Music Box equipment, Megasat will assist in establishing new markets for the Wegener Panda II noise reduction system, as well as data transmission, network control and SCPC systems.

This distribution deal marks the entry of the Wegener product line into the British and European markets. The Wegener systems have been approved by British Telecom International for use on Intelsat.

Tele-Wire to distribute new Berko modulator

EAST FARMINGDALE, N.Y.—Tele-Wire Supply Corp. has agreed with Berko Technology Corp. to distribute the Berko UVM-4320 tunable standby modulator/processor.

The newly developed UVM-4320 is an economical standby unit, according to the company, with advanced features such as 105-channel input and 36-channel output capabilities, baseband audio/video and RF inputs.

Now when you install CATV converters, you can install Panasonic® reliability.

When you install the new Panasonic CATV converters for your cable customers, they'll be getting far more than just the reliability they've come to expect from Panasonic.

Take our TZ-PC110 with full-function infra-red remote control. It includes subscriber-oriented features such as 15-channel memory to make tuning easier, two-speed up/down scan tuning for quick search and a built-in holding bay for the remote when not in use. Even an optional parental guidance key so your customers can control the channels children watch.

When remote control isn't yet a customer priority, there's the "remote ready" TZ-PC100. And it accepts our optional remote control unit at any time, since no field retrofit is needed.

So now there is no reason to give your customers just any CATV converter. Give them the performance and reliability of Panasonic.

For information on how to supply your cable system with Panasonic CATV converters, call (201) 392-4109.

Panasonic
Industrial Company

Zen and the art of cable system maintenance

By Raleigh B. Stelle III
Vice President of Marketing Texscan Corp

Robert Pirsig's novel, *Zen and the Art of Motorcycle Maintenance*, provides the basis for these thoughts on CATV system maintenance. System maintenance requires a unique frame of mind; or in modern terminology, "mind set." This mind set must exist at all levels in the system heirarchy, from newest installer or clerk to the general manager or corporate officer. Everyone must understand and be committed to a system maintenance program. If this mentality fails to exist at any of these levels, the maintenance program will falter and eventually fail.

Modern automobiles will go 100,000 miles, if properly maintained. If this is true, why are used car lots full of 2- to 3-year-old machines with 40,000-50,000 miles? Because the warning signs at 10,000-20,000 miles were ignored . . . problems occurred that made it more attractive to trade cars than to fix them. Why don't most people follow maintenance programs? Poor mind set. Too much time. Too much money. Can you afford to "trade-in" your CATV system the first time it begins to show its mileage? Equipment vendors would love it, but that's a little unrealistic, isn't it? The alternative to this scenario is simple, but requires the dedication of every person in the system.

System longevity: How you can help

The easiest systems to maintain are *new* ones. There is no catch up to do, no major overhauls. Firstly, see that the system is mechanically sound from day one. Monitor construction crews closely and demand rework for items not meeting good engineering practice. Secondly, construct and maintain a log of system performance at all key locations. This logbook should be initiated during the proof and should contain as a minimum:

1) At each trunk location—the date—the temperature

a) Input levels
b) Output levels
c) Swept response pictures
d) AC input voltage
e) DC regulated voltage
f) Transformer tap
g) Pad value
h) Equalizer value
i) Interstage equalizer values
j) Special notes
k) Station configurations
l) Reverse input levels
m) Reverse output levels
n) Reverse swept response
o) Reverse pads values
p) Reverse equalizer values
q) Special reverse notes
r) Pilot carrier levels
s) Calculated VS actual for
- C/N
- CTB
- Xmod
- Hum

2) At each line extender—the date—the temperature

a) Input levels
b) Output
c) Swept response pictures
d) AC input voltage
e) DC regulated voltage
f) Transformer tap
g) Pad value
h) Equalizer value
i) Interstage equalizer values
j) Special notes
k) Station configurations
l) Reverse input levels
m) Reverse output levels
n) Reverse swept response
o) Reverse pads values
p) Reverse equalizer values
q) Special reverse notes
r) Pilot carrier levels
s) Calculated VS actual for
- C/N
- CTB
- Xmod
- Hum

3) Record system performance from the headend to the end of cascade for *each* trunk, and the distribution off the last trunk in each trunk leg.

These records are mandatory because the initial symptoms of degradation will most likely be small departures from the way the system worked when new. The usual approach is to just "tweak an amp, or change a pad," almost anything except diagnosis of the problem and systematic repair.

Who knows when system performance degrades? In a car, the driver or passengers know; in a CATV system, the installers and technicians know. And if the problem is bad enough the subscribers know!

Your first alert system is the installer or technician. Signal levels at the drop should be reported and the visual picture quality checked. If either of these checks fall outside acceptable limits, first diagnose the cause and fix it *now*!

Systems should follow the familiar bathtub curve of failures. Early failures are a result of infant mortality of products and construction flaws. At the end of 12-15 years, the system is at useful life end and requires major component replacement. It's during the inbetween that degradation must be kept low.

PM strategies (seven steps to Nirvana?)

1) Good PM starts with the system design . . . a system that is "squeezed" for the last tenth of a dB on spacing; cable losses at nominal, instead of maximum; amplifier gains at maximum; these are harbingers of future problems. In this situation, there is no reserve in the design and trouble will eventually come.
2) The second PM strategy is sound construction to documented and proven engineering practices.
3) There must be a preventive maintenance plan. This document must spell out system tolerances, schedules for monitoring performance and procedures for troubleshooting and repair.
4) The system log is essential. Without knowledge of the beginning we have no method to measure today's performance.
5) Trained and motivated personnel are essential. They must *want* to make it work properly and keep working properly. No system can afford a lackadaisical attitude on the part of any employee.
6) A reporting system that makes management aware of system performance also is mandatory. These systems may be as simple as a monthly meeting, or a complicated field report analysis with lots of paperwork. The type of system is not so important as the fact of its existence.
7) Do not overlook the RF leakage monitor as a source of data in system performance. Each truck and each installer/technician needs one of these devices. RF leakage is symptomatic of any of the following problems.
   - Cracked cable (trunk or distribution)
   - Bad drop cable or poor drop ground
   - Loose connectors
   - Loose covers on amplifiers, taps, passives, etc.

   If RF can get out, it can also get in, which leads to co-channel interference from local stations, possible AGC instability and ultimately water. Water means corrosion, hum, increased RF attenuation and AC and DC resistance. Eventually this means replacement of components and cable. This scenario can be called a "death spiral."

The foregoing may sound Utopian, but the penalty for ignoring this vital aspect is enormous. The customer dissatisfaction alone makes strong men weep; not to mention that the cost to rebuild is staggering! The real world is: "Pay me now; or you'll *really* pay me later."

TELSTA® VAN OR UTILITY MOUNTED LIFTS

We made a great value better than ever

Telsta A28C's are the most wanted lifts in the CATV industry. Now, we've made them easier than ever to own.

First, we're offering them at a price far lower than you would expect. Not just stripped down models, but fully equipped lifts like the ones above. Complete, down to the tool hangers. You simply can't buy a better lift at a better price.

Secondly, delivery has never been faster. Telsta maintains a chassis pool at our plants, so there is never a long wait for delivery.

And finally, you can get a Telsta A28C with our new APU (Aerial Lift Power Unit). This is an outboard mounted, heavy-duty industrial grade engine/generator which powers the three-way boom movement and provides 2250 watts of 110V AC power for your tools. Unlike other lifts, the boom can be operated with the truck engine off, thus eliminating overheating, conserving fuel and reducing battery drain.

Take advantage of Telsta's low prices, quality features, and fast delivery now.

General Cable COMPANY
APPARATUS DIVISION
MOPECO PUREGAS TELSTA

A Unit of The Penn Central Corporation

P.O. Box [illegible] West 88th Ave
Westminster, Colorado [illegible]
Phone [illegible]
[illegible] GA

Dishing for success

By Bob Schumacher
Telecommunications Engineer
American Television and Communications Corp

Almost exactly nine years ago, the first receive-only satellite earth stations were put into operation. During that nine years the cable TV business has been rejuvinated and revolutionized and in the process, a few grown men have been made to cry.

The first shock came when the Federal Communications Commission ruled that a receive-only station had to be licensed. Never before had a license been required to receive RF signals—transmit, yes, but not to receive. And then, the smallest "dish" that could be licensed was the 10-meter size. To put a 10-meter station in operation at that time cost approximately $105,000.

Fortunately, later, the small aperture antenna was approved and the satellite business boomed. Frequency coordination and licensing were still required but the cost of an earth station with necessary electronics decreased significantly. If there were no problems with frequency coordination, a 5-meter antenna with electronics could be installed for $25,000-$30,000. In isolated situations the only antenna that would coordinate was the conical horn, which cost approximately four times that of the 5-meter antenna. Even so, compared to the 10-meter installation, it was a bargain and made many sites useable that otherwise could not have been considered.

Engineers being what they are, have their own definite ideas as to minimum specifications, etc. We happen to believe a minimum video signal-to-noise ratio for use in our cable systems should be 50 dB for 4 degree satellite spacing and 52 dB for 2 degree spacing. As a result, each earth station is individually engineered for its specific geographic location, dictating antenna gain (size), low-noise amplifier (LNA) temperature, etc.

Since the original "cable satellite" (Satcom II) was parked at 119 degrees longitude, the station performance was calculated using the parameters for that geostationary position.

New satellites, new problems

Just as we began to relax we received another shock: Satellite service for cable was moved to Satcom I at 135 degrees longitude. Great news for Hawaii and the western two-thirds of the United States but not so great for all the operators in the eastern third of the nation. The stations that were so carefully engineered to meet specs on Satcom II were suddenly only marginal performers due to the lower "look angles" and different "footprint" of Satcom I. Some operators received a severe jolt (emotionally and financially) when they discovered that their antenna could not "see" the satellite because the path was blocked by a hill, building or trees. Some even discovered that the foundation and base of the antenna had not been properly orientated with the geostationary arc when originally constructed.


William Eager

In instances of extreme interference, a conical horn can solve the problem.

Due to the demand for transponders by programmers, other satellites were launched into orbit. Next problem: Some of the program services decided to move off of Satcom I. Many cable operators were obligated by contract or franchise commitments to carry the new programs or the ones that moved. The result was the beginning of the "antenna farms" you can now find virtually everywhere. Also, there were other minor irritations such as different methods of numbering transponders and different polarities for corresponding transponders on different satellites. Other services such as slo-scan news used additional sub-carriers requiring special equipment.

Eventually the FCC dropped all licensing requirements for receive-only dishes. Now the boom really took off. Competition among vendors became intense and prices dropped. New manufacturers appeared and some of the older ones decided to forego the earth station business. On the second try, RCA got Satcom III in orbit and everyone had the problem of realigning their antennas again. Some learned the hard way that even though they moved the antenna only a few degrees, the polarity adjustment of the antenna is critical as no two satellites can be positioned exactly the same.

The latest problem is Galaxy I spaced 3 degrees from Satcom III-R and more program moves. In addition, there is the 2 degree spacing rule. At the present time no one seems to know when the 2 degree spacing of C-band satellites will become a reality. Three degree spacing is here and that in itself poses some interesting questions. When is 3 degrees not 3 degrees? It depends upon where you are located. Certainly Galaxy I is positioned at 134 degrees and Satcom III-R is at 131 degrees and that is 3 degrees of separation in the geostationary arc. Calculating the azimuth angles for an earth station antenna located in different parts of the country tells us that the angle of separation changes drastically. For example, in San Diego the azimuth to Galaxy I is 209.13 degrees and to III-R is 204.4 degrees or a separation angle of 4.73 degrees. In Denver the azimuth to Galaxy I is 221.2 and to III-R it's 217.6 for a separation angle of 3.6 degrees. As you move further south and east, things get rough! In Orlando, Fla., the azimuths are 249.94 and 247.9—a difference of only 2.04 degrees. In some locations, Cassegrain antennas have a bit of a problem with the 3 degree spacing due to their sidelobe characteristics.

New designs provide opportunities

In 1981, Norm Weinhouse of Hughes Communications Inc. demonstrated the multiple-feed concept for parabolic reflector antennas. Today there are at least five different manufacturers offering a multiple-feed system. Also, larger multiple-feed spherical or torus shaped reflector antennas may be purchased as a "one antenna" alternative to multiple antennas or to antennas retrofitted with multiple feeds. As always, there are good and bad points to any approach. The name of the game is to get the "most bang for the buck."

If the multiple-feed concept is used, you may want to consider multiplexing the signals from a LNA (3.7-4.2 GHz) and the signals from a downconverter system (760-1,260 MHz or similar) on one feed line. This does require IF receivers but certainly saves on expensive feed lines. If the initial installation called for extremely long feed lines or the existing conduit cannot handle more cables, this approach can be a real life saver.

Will a multiple feed (MF) work for you? To make a logical decision requires a little research. If you now have any terrestrial microwave interference, chances are a MF will not be useable, although in some cases you can play games with the MF and actually decrease the interference. Also, you can do some wonderful things with IF traps if the undesired carriers are not of greater amplitude than the desired carriers. If you do trap, be careful not to overdo it. Do not trap the offending carrier below the noise floor of the received signal. Trapping too deeply can create more problems than it solves. Also, remember that terrestrial FM signals vary in amplitude and width due to channel loading. During peak hours, telephone carriers decrease in amplitude but increase in width, so trap for worst case conditions.

Multiple feeds are being used successfully in many cable systems today with the Satcom III-R/Galaxy I combination being the most popular. We recommend peaking the existing antenna on Satcom III-R and then installing the multiple feed. New 85 degree LNAs are installed on the III-R coupler and bore sighted. The original 120 degree LNAs are then used on the Galaxy feed, and it is peaked. Both feeds are adjusted for maximum gain with focal length adjustments and the polarity is adjusted for maximum rejection of undesired signals. Realign the antenna and repeat the peaking process until maximum performance is attained on both satellites. There are many variables to be considered, but with care, excellent results can be obtained.

Since company policy at American Television and Communications requires that all earth station antennas be licensed full arc, we are somewhat restricted as to the antennas to be purchased. Depending upon location, they vary from the 4.2-meter conical horn to the 7-meter prime focus antenna. No 10-meter antennas have been purchased since 1976.

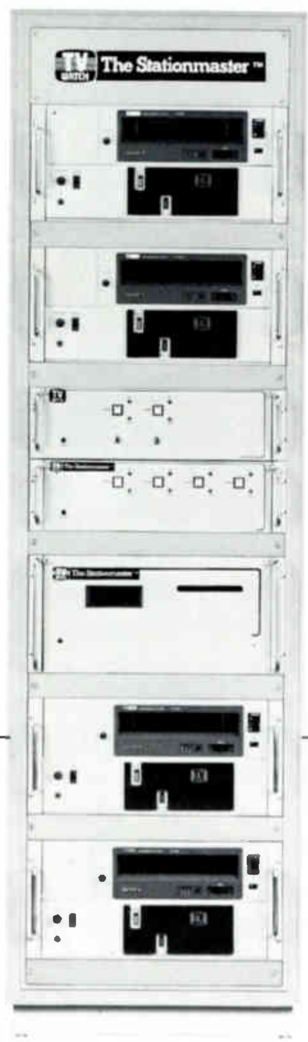
Now that 2 degree spacing is a distinct possibility, the new offset-feed rectangular antennas are creating considerable interest. It appears that they may be the answer to many of our problems when 2 degree spacing is implemented. If the FCC were so inclined, it could alleviate that problem easily by spacing satellites 2 degrees apart but alternating C-band and Ku-band, effectively making the spacing for either band 4 degrees. Since the FCC has already addressed the polarity problem, the alternate placement would be an ideal solution for the C-band users. (It would also save all of us a bunch of bucks.)

Great selection, right prices

The selection of equipment for use by the cable operator has never been greater and the prices are right. New concepts are being presented constantly, and the choices are practically unlimited. LNA prices are approximately 10 percent of what they were nine years ago. The receivers available today are much better than then and cost only about 16 percent as much. The low-noise converter (LNC) system is ideal for long feed line runs or for multiplexing on existing feeds. I would suggest considering converted frequencies carefully as there are several available. They range from 270-770 MHz to 940-1,440 MHz. Because of the possibility of interference being created by your cable system electronics or business radio system, the higher frequencies may be more desireable. Most converter systems are designed to use 75 ohm cable for feed lines, allowing the use of available P-1 or P-2 types as used in the cable system.

For the antennas that can be licensed, prices vary from approximately $3,500 for a 4.2-meter parabolic to about $21,000 for the conical horn. These prices do not include shipping or the installation. Sizes and shapes are available to fit any need. Shop around for the best value on all components. You will be pleasantly surprised at the cost of a good receive-only station today.

Stationmaster stands alone.



Level I
Linear System

Level II
Random Sequence

Level III
Random Access

Stationmaster.

The completely automatic system for inserting and verifying commercials on cable television.

Stationmaster is the *only* equipment you need to insert commercials as well as verify for the client that his advertising ran when he directed. And when we say Stationmaster stands alone, we mean it.

HANDS OFF! Stationmaster operates by itself 24 hours a day, year after year. **DON'T CALL US, WE'LL CALL YOU.** TV Watch calls its Stationmaster accounts once a month just to "check in." Otherwise, we might never hear from them.

HI-TECH. Stationmaster's secrets are in the software. It comes with a built-in verifier. Secret: CMOS chip technology. Every Stationmaster is custom-programmed for the individual cable system. Secret: EPROM (Electronically Programmable Read Only Memory) circuitry.

All operating components are on Printed Circuit boards. Stationmaster is totally software-based.

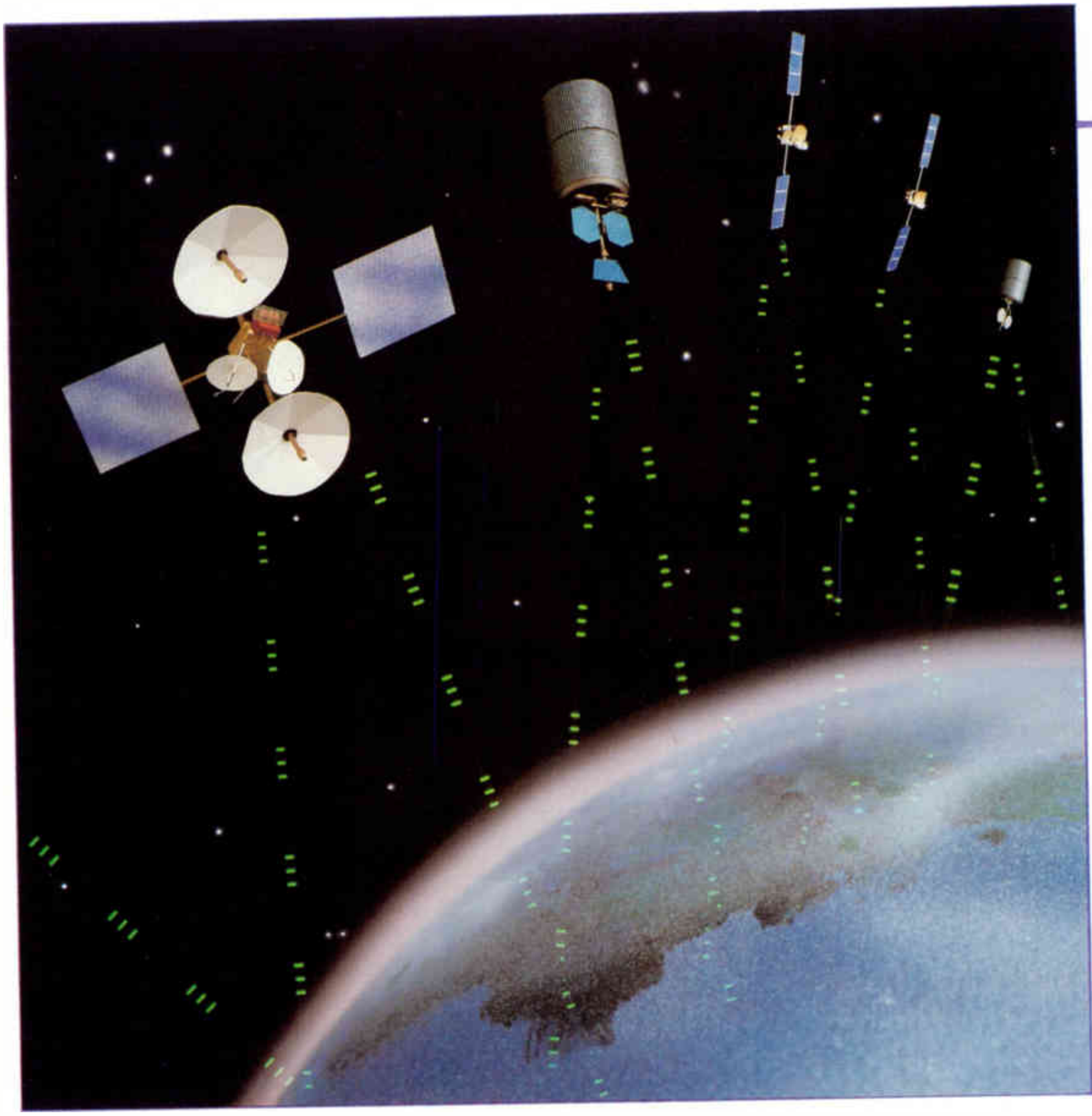
When Stationmaster arrives, we will be there to hook you up and we won't leave until we have trained your technical personnel.

Get more information today. Call or write: TV Watch, 1819 Peachtree Road, N.E., Atlanta, GA 30309. (800) 554-1155. In Georgia, (404) 355-0100.

TV WATCH

INSERTION EQUIPMENT
LOCAL ADVERTISING SALES

An affiliate of United Media Enterprises, a Scripps-Howard Company



©1984 Ted Kappler Photography

Two degree spacing: A mixed blessing

This article will examine the effect of 2 degree spacing on single-feed earth station antennas, namely the interference that may be produced by adjacent satellites in receive-only systems. It also looks at some of the basic concepts of antenna design and the approach by various manufacturers to mitigate potentially adverse effects that may result from the recent Federal Communications Commission decision.

By Colleen McGuire
Product Manager, Jerrold Division/General Instrument

In 1972, the Federal Communications Commission handed down a decision known as the "open skies policy" effectively changing the domestic satellite communications industry. By opening up the industry to commercial competition, satellites as a means of communications moved from being enigmatic vehicles for international and remote-location communications links to a more highly visible position as an effective and profitable means of domestic telecommunications.

Improvements in satellite technologies combined with significant economies of scale helped to spur an increase in demand for domestic satellite communications services. In addition, increased efficiency in the skies also lead to changes on the ground with concurrent advances in earth station electronics technology.

Commercial users of satellite communications have benefitted greatly from both the technological advances and corresponding reductions in cost for receive-only earth stations—especially in CATV, SMATV and backyard video entertainment applications.

Satellites continue to offer a more cost effective means of communications than land lines, and the demand for such services is expected to increase for some time to come. In 1970 the United States had approximately 10 satellites in geostationary orbit. By 1984, this number increased to 19 and by 1990 there are expected to be 40 satellites in operation in the orbital arc.

The finite limit to the amount of space within the geostationary arc and the mushrooming growth in demand for transponder space prompted the FCC in 1981 to propose a reduction in the space between each satellite in order to accommodate their increasing number. While the recent ruling in favor of 2 degree spacing has been welcomed by many in the satellite industry, concern is being expressed over the potential adverse effects of interference introduced by closer satellites on receive-only earth stations. Before examining the specifics of this interference, and its effect on earth station antennas, we will briefly look at the basics of antenna design.

Basic antenna design

The two primary characteristics of an earth

'In 1970 the United States had approximately 10 satellites in geostationary orbit. . . by 1990 there are expected to be 40'

station antenna are its gain and pattern of radiation. Antenna gain is primarily a function of the surface area of the reflector. The characteristic radiation pattern, however, can vary from one antenna to another. This is based upon several factors including reflector and feed design and manufacturing tolerances in the reflecting surface.

When considering the ability of an antenna to discriminate one signal from another, this pattern of radiation is critical. One such pattern is given in Figure 1 for the Jerrold 4.5-meter receive-only antenna.

The two primary parts of the radiation pattern are the main lobe or beam—the area where a majority of the antenna's radiation is focused—and a number of sidelobes of radiation surrounding the main lobe.

The main lobe

When considering the characteristics of the main lobe, the actual width of the lobe commonly referred to as the antenna's beamwidth or "angle of view," is of primary importance. In designing an antenna, it is most desirable to have as narrow a beam as possible so that a majority of the antenna's gain is focused on the desired signal, rather than that of adjacent undesired signals.

Like antenna gain, the beamwidth of an antenna is a function of the diameter of the reflecting surface. Beamwidth, however, is inversely proportional to antenna size such that a larger antenna will have a more narrow beamwidth and a greater ability to discriminate between incoming signals. The recent trend is to downsize the receive-only earth stations for SMATV and home video markets, however.

A common method of measuring earth station beamwidth is to refer to its "half-power"

Figure 1: Radiation pattern for the Jerrold C4A 4.5-meter antenna

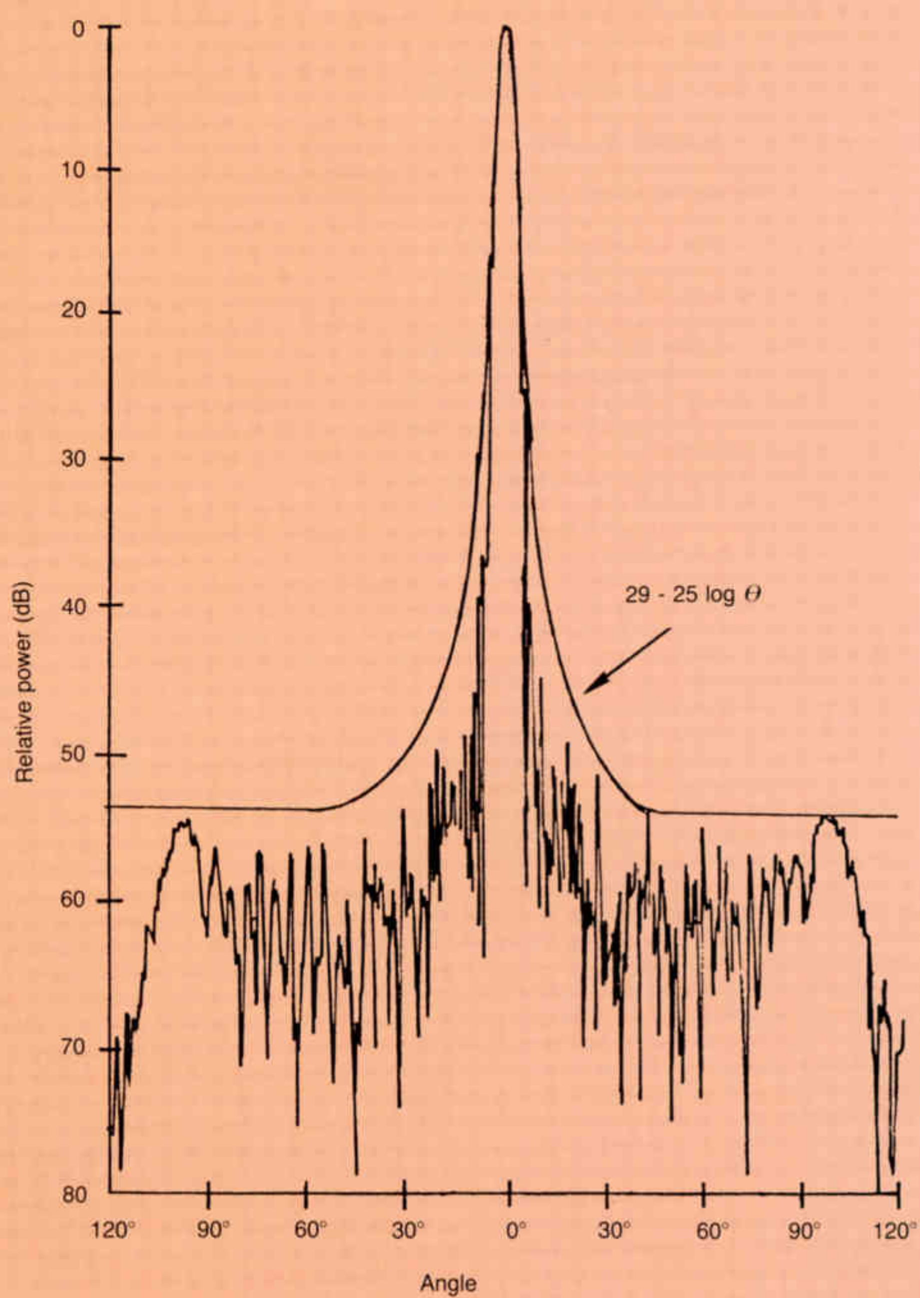
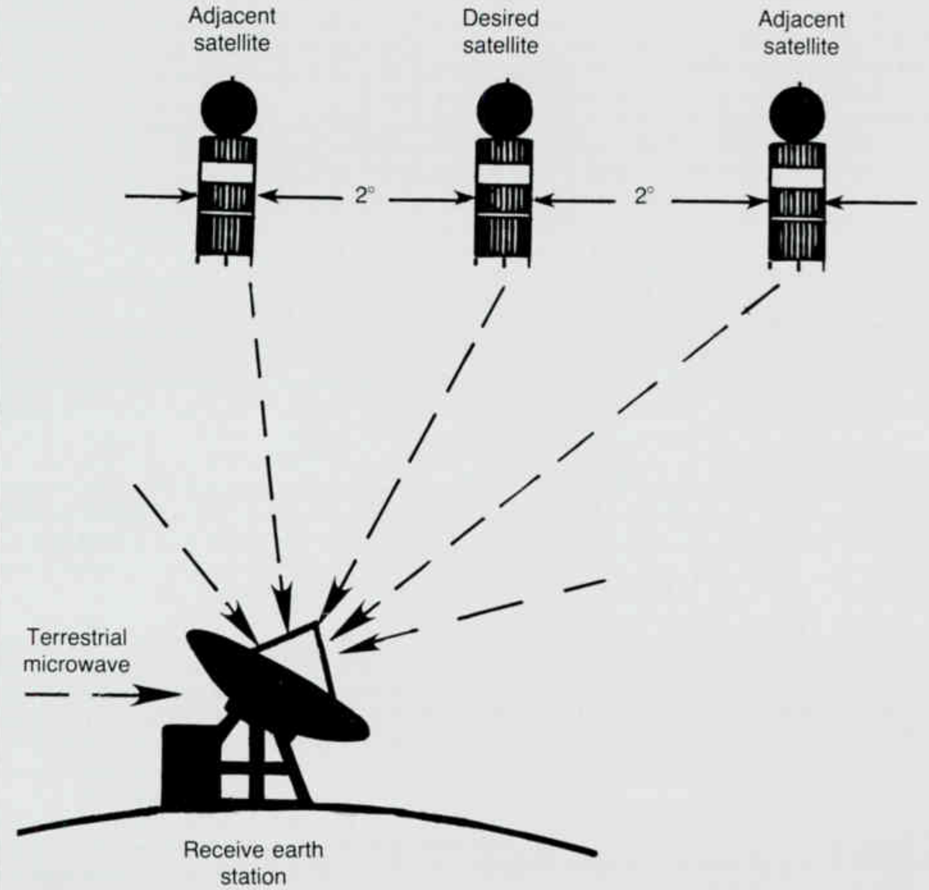


Figure 2: Adjacent satellite interference



or the width of the main lobe measured at power points 3 dB down from the axis of the main lobe. However, when considering the reception of video signals for CATV or SMATV applications, it is more useful to measure the beamwidth as the angle between points at least 18 dB down from the axis.

If the beamwidth calculated at the power points 18 to 23 dB down is greater than 4 degrees, an adjacent satellite signal at 2 degrees is likely to interfere. However, it should be pointed out that the 2 degree spacing refers not to the hard angle that an antenna sees between two satellites, but to a difference in longitude. The actual angle that an antenna sees between satellites may vary anywhere from 2 to 2.3 degrees depending on the location of the earth station.

For example, if the earth station were in Southern California pointed at theoretical satellites spaced at 122 degrees and 124 degrees longitude, the hard angle between them would be 2.35 degrees. If the earth station were in Maine, and looking at the same two satellites, the hard angle would now be 2.12 degrees. Therefore, the earth station in California may have a little more tolerance in beamwidth than that in Maine.

One proposal made to reduce this type of interference is to alternate polarizations between satellites. In such cases, channel one on satellite A may be vertical while on satellite B, the adjacent satellite, it would be horizontal. While this may certainly help an antenna's ability to discriminate signals, one would be ill-advised to depend on this type of isolation as it is extremely weather dependent. Both rainfall and snow buildup on the antenna can wipe out any benefits derived from this cross-polarization from adjacent satellites.

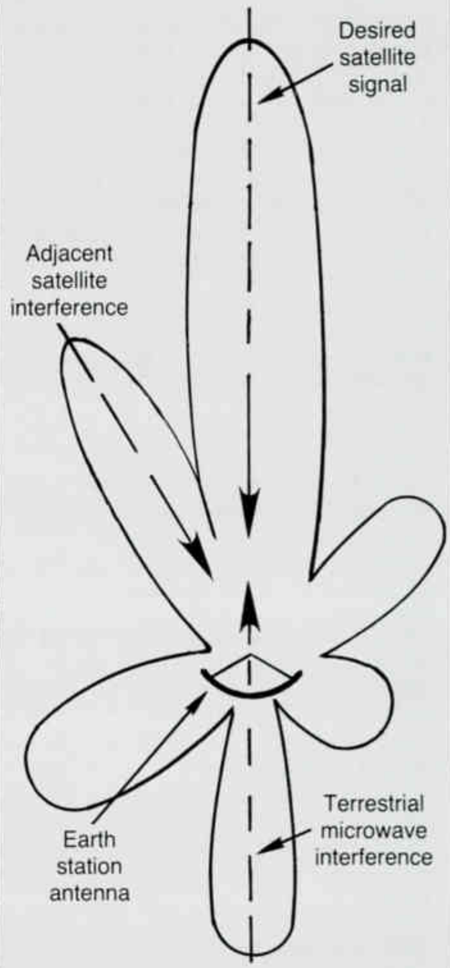
Antenna sidelobes

The second major consideration in an antenna's ability to discriminate between desired and interfering signals is its sidelobe radiation pattern. Figures 1 and 3 illustrate that, in addition to its main beam, an earth station antenna has several sidelobes of radiation directing 360 degrees around the focal point of the antenna.

Interfering signals from terrestrial microwave links or adjacent satellites may fall at the center of these sidelobes (Figure 2) and be subject to gain relative to the magnitude of the sidelobe. If the gain of these sidelobes is sufficiently small, few problems will exist. However, if the resulting carrier-to-interference (C/I) level, the ratio of the interference from all sources—adjacent satellites and terrestrial microwave—is less than 18 dB for CATV applications, interference will be perceptible.

In addition, the ratio of C/I from adjacent satellites is not only a function of where the signal is received within the antenna's radiation pattern, but is dependent on the relative power or EIRP (effective isotropic radiated

Figure 3: Antenna sidelobes



power) of each satellite. While the designed power level for adjacent satellites may be the same, one should take into consideration a potential power difference of approximately 3 dB due to such differences as age when determining the degree of interference between signals.

As mentioned earlier, the hard angle an antenna sees between satellites spaced 2 degrees apart varies depending on location. This point also should be kept in mind when analyzing antenna sidelobes. For example, it would be inaccurate to assume that, since there is a null in your antenna pattern at precisely 2 degrees, interference from adjacent satellites would be minimal.

The FCC—after extensive calculations to determine the interference of each current and proposed satellite with all of the other satellites—derived a new pattern envelope. It is defined as follows (where θ is the angle in degrees away from the axis of the mainbeam):

$29 - 25 \log \theta$ dBi	$1° \leq \theta \leq 7°$
$+ 8$ dBi	$7° < \theta \leq 9.2°$
$32 - 25 \log \theta$ dBi	$9.2° < \theta \leq 48°$
$- 10$ dBi	$48° < \theta \leq 180°$

Current regulation is such that the peak gain of any individual sidelobe may not exceed this envelope by more than 3 dB for angles between 1 and 7 degrees. For angles greater than 7, the envelope may be exceeded by 10 percent of the individual sidelobe peaks.

Although a number of antenna manufacturers have expressed concern over the difficulty to meet this radiation pattern, the FCC has not as yet received any alternative pattern recommendations. While receive-only earth stations are not required to be licensed by the FCC, the antenna's pattern envelope must conform to these standards in order to be licensed. In doing so, it will be protected from interference from new terrestrial microwave installations.

Meeting FCC specs

The following is a partial list of some of the approaches being taken by antenna manufacturers to meet FCC requirements:

1. Using prime focus feed designs. Cassegrain feeds, which employ a dual reflector surface, tend to contribute more to sidelobes as a result of spillover radiation from the second reflector.
2. Using corregated feed systems to reduce sidelobes to some extent and to achieve low cross-polarization isolation.
3. Improving tolerance in the design of the primary antenna reflecting surface. Some industry experts recommend a tolerance of at least .03 inches rms.
4. Using off-set feed antennas for significant improvements in sidelobe characteristics. This is achieved because of reduced blockage of the aperture by the feed.

It is clear that 2 degree spacing is a reality. The growth in demand for satellite telecommunication services will require reduced satellite spacing to accommodate the increasing number of devices. The implementation of this policy is not well defined at this point, however, it is possible that it will be several years before 2 degree spacing applies to entertainment video satellites. In addition, the impact of 2 degree spacing is not obvious for each installation. CATV, SMATV and other potential users of satellite receive-only earth station systems should take into consideration some of the points mentioned here when purchasing any new equipment.

THE NEW MC^2 COAXIAL CABLE SAVES YOU MORE MONEY

Because MC^2 components are bonded together for maximum flexibility and minimum signal loss, you save more money on installation, connections, labor and on the cable itself.

MORE RESISTANT

Because each cell is an hermetically sealed compartment, MC^2 is more resistant to moisture ingress and migration. No other cable can stand up to its environment better than the new MC^2.

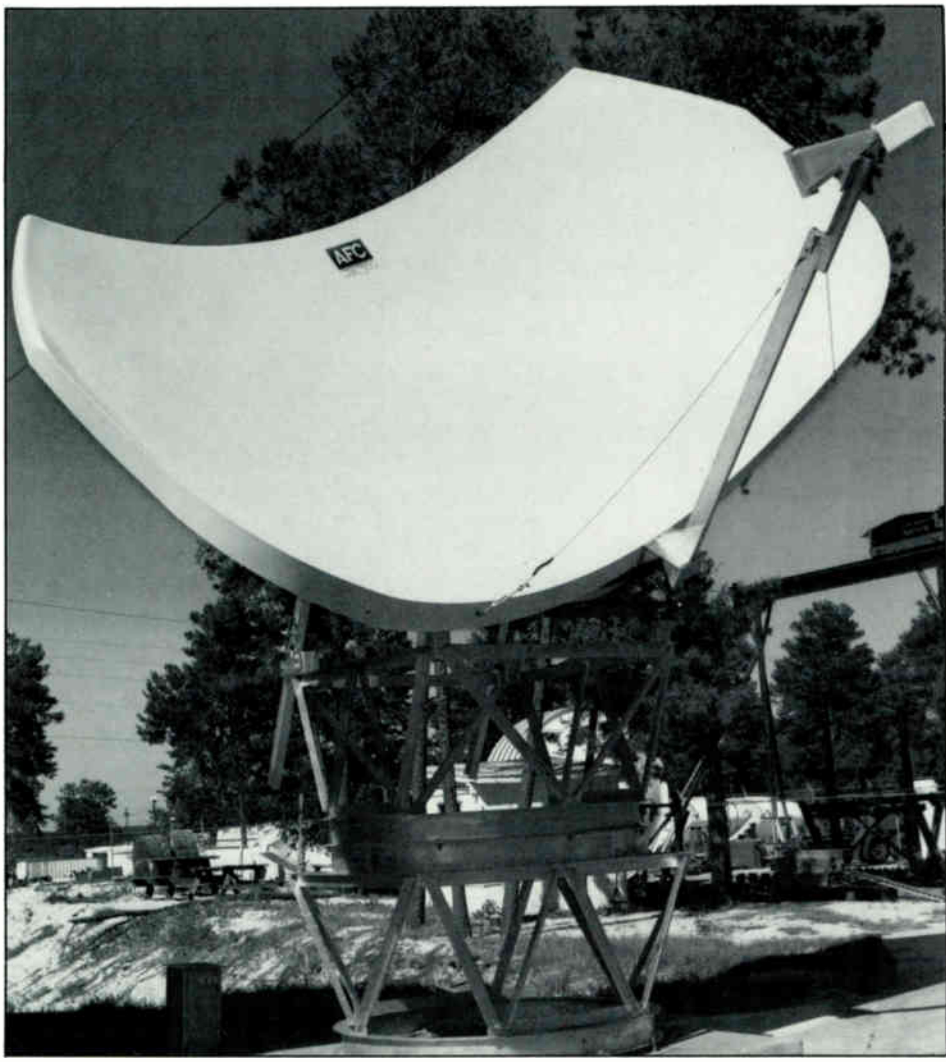
MORE SIGNAL STRENGTH

The new MC^2 Coaxial Cable's patented design of using air instead of foam means less attenuation and more signal strength. And that's with a signal load of 77 channels.

MORE economical. MORE reliable. MORE flexible. MC^2 outperformed the competition hands down and we'll be happy to show you the results anytime.

General Cable CATV

A Unit of The Penn Central Corporation



Antennas, such as Microdyne's AFC offset-feed design, provide reduced sidelobes and an improved carrier-to-noise ratio.

'The best thing you can do to protect your system from obsolescence is to install the largest and best-designed antenna you can afford'

Two degree spacing: Will it work?

By James B. Grabenstein
Senior Applications Engineer, Satellite Communications, Microdyne Corp

The question of whether or not current satellite systems will work at 2 degree spacing is being asked many times a day throughout our industry. As is often the case with questions relating to highly technical problems, an answer cannot be given without raising further questions: Are we talking about transmitted or received signals? What is the nature of the signal and how much power is required? What level of interference can be tolerated? Is the problem simply one of antenna radiation pattern, or is it the more complicated question of flux density?

Let's begin our inquiry with a review of antenna radiation patterns. The Federal Communications Commission, with its proposed report and order, requires that TV transmissions use an antenna that meets a 29 – 25 log θ sidelobe performance. Antennas with a 32 – 25 log θ pattern have been accepted for the transmission of low-power radio and data, providing an impact statement is prepared showing the effect on 2 degree spacing at the lower power level.

Now, since the antenna gain and the sidelobes are directly proportional (but inversely proportional with respect to each other) to the surface area, the larger the antenna, the lower the sidelobes become. For example, if the reflecting surface is doubled, the gain increases 3 dB and the sidelobes will decrease about 3 dB, if all tolerances are kept the same. To meet the 29 – 25 log θ radiation pattern envelope, a conventional parabolic antenna needs to be on the order of 7 meters across. And that is an expensive antenna, in terms of both unit and installation costs.

There is a less costly, smaller aperture antenna that will provide a radiation pattern envelope that meets the 29 – 25 log θ requirements. This type of antenna (see accompanying photograph) is similar to the air search antennas used at airports and uses an elongated section of a parabolic surface with controlled illumination to shape the sidelobe performance of the antenna. The feed is offset below the reflector so it does not shadow the parabolic surface. The elongated sides of the reflector are then aligned with the horizontal plane of the geostationary orbit, causing maximum attenuation to the adjacent satellites. This type of antenna gives the sidelobe performance of a larger aperture reflector, in the horizontal plane, at a much lower cost. The gain is equal to a circular reflector of about the same total illuminated area, providing the antenna reflecting surface is well designed and manufactured, and that the feed illuminates the surface to just inside the edges of the reflector.

Sidelobe performance

But controlling the sidelobes of the antenna is only a small part of the 2 degree spacing problem. If we look at the formula that generates the theoretical sidelobe curves, we can see that a 3 dB change in the dB constant will cause a corresponding 3 dB change in the sidelobe gain curve: L = G – (29 – [25 X log


SAFE! FAST! EFFICIENT!
ARROW
WIRE & CABLE
STAPLE GUN TACKERS
FIT RIGHT IN
for doing the CATV installation job RIGHT!
Rugged, reliable Arrow Wire & Cable Staple Gun Tackers are made of all-steel for lasting durability and engineered for safety, speed and efficiency with these built-in high performance features:
● GROOVED GUIDE positions wires and cables for proper staple envelopment and safe, secure fastening.
● DRIVING BLADE automatically stops at the right height to prevent staple from damaging or cutting into wire or cable.
● AUTOMATIC, SINGLE-STROKE COMPRESSION ACTION speeds up fastening, reduces installation time and minimizes hand fatigue.
● PATENTED PRECISION-LOCKED MECHANISM ensures smooth, uninterrupted trouble-free performance.
These outstanding features have made Arrow Wire & Cable Staple Gun Tackers the top choice in fastening tools of professional installation men in every field, including CATV, telephone, electrical, electronics, communications, alarm systems and many more.
4 Models Fit All Wires and Cables Ranging From 3/16" to 1/2" in Diameter.
MODEL T-18
Uses 3/16" round crown staples in 3/8" and 7/16" leg lengths - for diameters up to 3/16".
MODEL T-25
Uses 1/4" round crown staples in 9/32", 3/8", 7/16" and 9/16" leg lengths - for diameters up to 1/4".
MODEL T-37
Uses 5/16" round crown staples in 3/8", 1/2" and 9/16" leg lengths - for diameters up to 5/16".
MODEL T-75
Uses 1/2" flat crown staples in 9/16", 5/8" and 7/8" leg lengths - for diameters up to 1/2".
THE RIGHT ARROW TACKER AND STAPLE SIZE TO USE FOR THE RIGHT CATV INSTALLATION:
For fastening ground wire - use Model T-18 with 3/8" leg staple.
For fastening RG-59 - use Model T-25 with 9/16" leg staple.
For fastening RG-6 - use Model T-37 with 9/16" leg staple.
For fastening RG-11 - use Model T-75 with 5/8" and 7/8" leg staples.
Call your supplier or write for catalog & prices.
ARROW FASTENER COMPANY, INC.
271 Mayhill Street
Saddle Brook
New Jersey 07662

Table 1: Antenna performance characteristics

Typical C-band antenna performance at 4 GHz

Antenna size in meters	−10 dB gain point	1st sidelobe	1st hull point	−3 dB gain point	¼ dB gain point	55% efficiency gain in dB
1	10°	9°	7°	5.2°	1.6°	30
1.5	6.7°	6°	4.7°	3.5°	1.05°	32.25
2	5.1°	4.55°	3.55°	2.6°	.8°	35.8
3	3.35°	3.0°	2.35°	1.75°	.53°	39.4
4	2.5°	2.25°	1.75°	1.3°	.4°	41.8
5	2.0°	1.8°	1.4°	1.05°	.32°	43.75
7	1.45°	1.3°	1.0°	.75°	.225°	46.75
10	1.00°	.9°	.5°	.52°	.157°	49.8
Typical Ku-band antenna performance at 10 GHz						
1	4.1°	3.6°	2.8°	2.2°	.62°	37.75
1.5	2.7°	2.4°	1.9°	1.4°	.42°	41.4
2	2.0°	1.8°	1.4°	1.05°	.32°	43.8
3	1.35°	1.2°	.87°	.7°	.21°	47.4
4	1°	.9°	.7°	.52°	.156°	49.8
5	.8°	.72°	.56°	.42°	.125°	51.75

θ]); where L = gain loss from main beam, G = gain of main antenna beam, 29 = dB constant, and θ = angle in degrees from main beam.

This difference between the two sidelobe curves will affect uplinks more than downlinks, because most satellites have about the same input sensitivity, although their outputs vary by as much as 4-6 dB. Uplink antennas therefore require narrow beamwidths and as low a sidelobe performance as possible. The power and bandwidth of the uplink information will affect the flux density of adjacent satellites. The wider the beamwidth of the antenna, the more power required to override the normal noise of the system. So, in theory, the larger the antenna, the narrower the beamwidth and hence less interference to adjacent satellites.

For both uplink and downlink we have a much better chance of making the 2 degree spacing work at Ku-band frequencies than at C-band, because antennas have better performance at high frequencies and we can therefore use smaller antennas to achieve the same results. In fact, a 3-meter antenna at Ku-band frequencies has about the same performance as a 7-meter antenna at C-band frequencies (see Table 1). The total power received as interference will be the power addition of all interferences received from adjacent satellites, adjacent uplink transmissions, terrestrial microwave and all other combined noise. The smaller the antenna, the wider the beamwidth at the −10 dB and −3 dB gain points. As can be seen in Table 1, the gain of an antenna at 2 degrees is down −10 dB on a 5-meter antenna operating in the C-band. At Ku-band frequencies, the same point is reached on a 2-meter antenna. (Note: This information was taken from a "Perrygraf" satellite link calculator, not antenna range patterns, and could vary a few percent from actual readings.)

Polarization, power and frequency

The real problem with the FCC's approach to 2 degree spacing is its reliance on reduced sidelobes. But an even greater attenuation of adjacent satellite signals could be achieved if we controlled the polarization, power and frequency of each satellite. In fact, 20-30 dB isolation could be achieved by using cross-polarization and controlled frequency assignments.

This is not a new idea, but it makes a lot of sense. The telephone microwave and terrestrial common carriers have used it for years to get more traffic per path. Why don't we, as users, press for some commonsense plan of frequency and polarization use? The problem is that each of us sees the problem from our own narrow point of view. As customers and users we want inexpensive terminal equipment and would like to use as small an antenna as possible. As common carriers we would like to have as many services as we can cram into satellites in geostationary orbit, and we want to maintain our freedom to change power levels and frequency. As manufacturers we need standards in frequency and bandwidth formats to reduce the cost of manufacturing, yet we want to be able to change the products as market demands vary. None of these reduces the problems of closer satellite spacing. Overshadowing this whole picture is the responsibility of us all to protect the geostationary orbit as an international resource.

It is clear that we will need to make 2 degree spacing work. We need to develop standards of transmision that will not conflict with the development of the free market. Satellite services are competitive with every wired and RF service in use today and satellite radio networks have proven that the technique provides higher quality and reliability while being more cost-effective than point-to-point land lines. History has shown us that no part of the RF spectrum goes unused—despite the fact that there is a current surplus of satellite capacity.

More studying, more work to do

As to the question of whether or not the current system will work at 2 degree spacing, the answer can only be that we don't know. As engineers, we have a lot of studying and work to do. We must attack the problem of flux density, which is a measurement of the amount of energy dispersed over occupied bandwidth. In the mean time, the best thing you can do to protect your system from obsolescence is to install the largest and best-designed antenna you can afford.

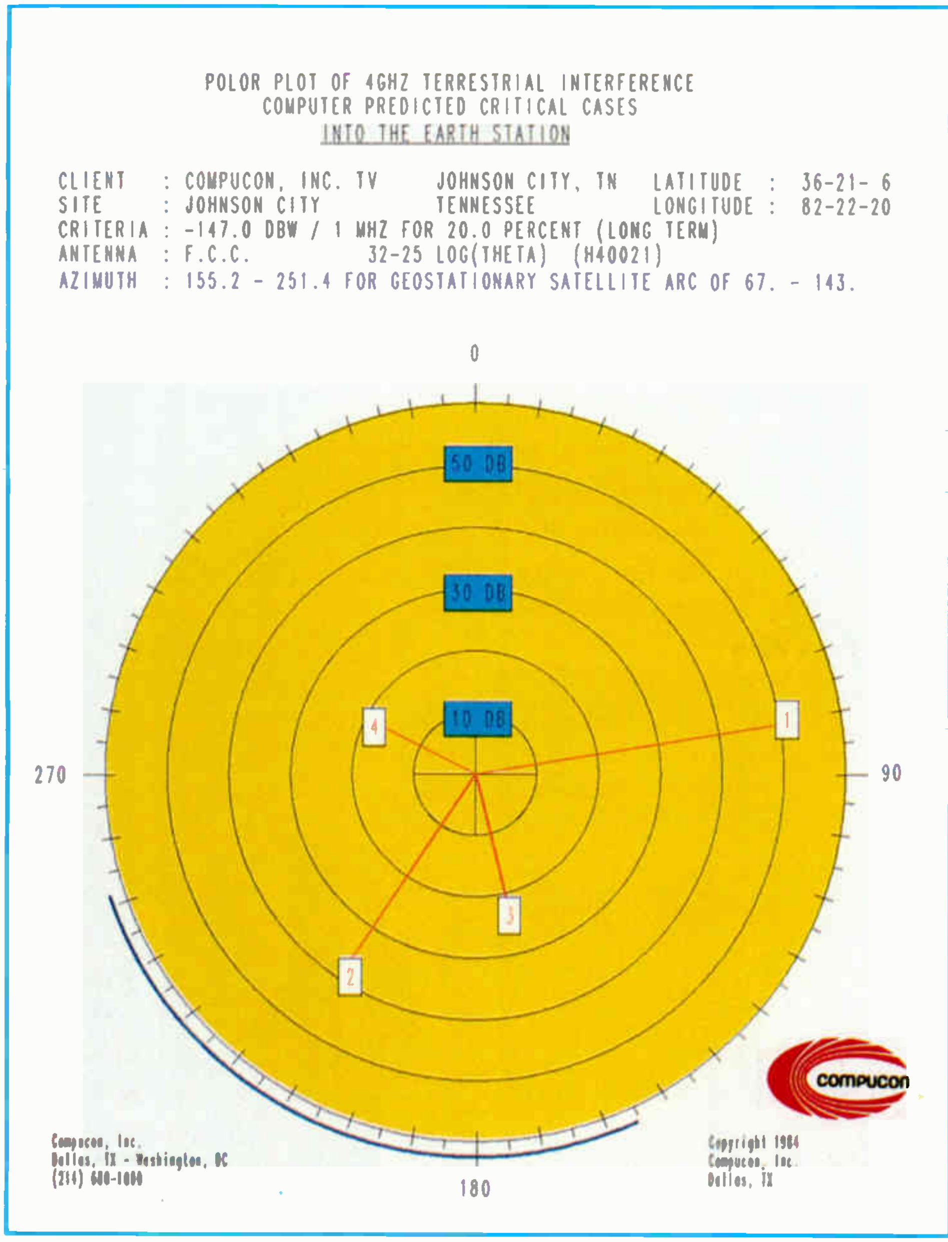


Figure 1: Computer-generated graphic illustrating interference sources

'There will be an impact on signals being downlinked from satellites spaced close to each other that may negatively impact . . . profitability'

Two degree spacing: A primer for operators

Improvements in technology generally simplify things. Especially in the communications business. As an example, improvements in computer modeling, propagation predictions and data base management have made the frequency coordination process considerably more simple than it once was. Improvements in satellite technology simplified sending voice, data or video across thousands of miles at incredible speeds. There are cases, however, where improvements can complicate already complex issues. The matter of 2 degree satellite spacing, an improvement of sorts, is one of those issues. Before understanding why this improvement can complicate things for a cable operator, it's important to understand the current satellite structure and how it was developed.

By Scott Goldman
Compucon Inc

All satellites that provide the cable television industry with sources of programming are in orbit above the Earth's equator, at a distance of approximately 22,300 miles. A satellite that stays in a fixed position relative to a point on Earth is referred to as being in geosynchronous orbit. Cable TV operators receive various programming sources from the satellites currently in geosynchronous orbit above the equator via their earth stations, or "dishes" aimed upwards toward the appropriate satellites. The program suppliers, such as HBO, Showtime, Cable News Network, etc., transmit their signals up to a satellite (called uplinking), the satellite receives that signal, amplifies it and transmits it back down to Earth on a lower frequency to be received by the cable operators on their earth stations (downlinks).

In order to avoid interference between signals transmitted to different satellites from Earth, the Federal Communications Commission (FCC) deemed that a space of 4 degrees be placed in between each of the orbiting satellites. This 4 degree spacing yields approximately an 1,800-mile distance between satellites in this orbital arc.

Now that 2 degree spacing is permitted, this "buffer zone" will be reduced to half of that, or about 900 miles. One would think that a distance of 900 miles would be sufficient to avoid having signals destined for one satellite to be inadvertently picked up by another, and it is, provided the transmitting antenna is of adequate size to produce a sufficiently narrow beamwidth. What is not understood by many in the industry is that there will be an impact on signals being downlinked from satellites spaced close to each other that may negatively impact the cable operators' profitability.

When considered in the early stages, planning to avoid interference and degradation of the signal can be done easily and inexpensively. Unfortunately, many cable operators are using dishes designed to comply with earlier, less stringent FCC specifications and are going to experience difficulties in one form or another.

The following will attempt to outline the potential problems, how they are caused and how to avoid them on the front end of planning a satellite receiving system. For the system already in operation, tips on how to minimize the impact of 2 degree spacing will be offered. Make no mistake, the issue here is to keep the subscribers happy with a high quality signal. If a cable system can't receive the satellite programming on a high quality basis its subscribers soon will become unhappy, service calls will increase and cancellations could proliferate.

This brings us back to the issue of improved technology complicating otherwise simple issues. (It should be pointed out here that the reason satellite spacing has become such an issue of importance is that the demand for satellite services is expected to be so large in the future that additional transponder capacities are required.) This improved transmitting technology, although causing some problems on the uplinking, is now causing increased difficulties on its reciprocal end, the receiving side.

The receiving side

The earth stations that many cable operators use have been designed, engineered, frequency coordinated and purchased with 4 degree spacing in mind. With the advent of 2 degree spacing, several issues come up for the cable operator to deal with:

- Will I still be able to receive a high enough quality picture to keep my subscribers happy?
- Will I have to change the pointing azimuth of my earth station to accommodate programming coming from satellites not currently in orbit?
- If I have to change the pointing azimuth of the earth station, don't I open myself up for interference problems from other terrestrial sources if my earth station was not cleared for the entire orbital arc during its coordination process?
- If I do change satellite feeds, when will sun outage be a problem?
- If I have a dual or multiple feed antenna, how will the signal quality be affected?
- What size earth station do I need to ensure that the 2 degree spacing rule will not put me out of business?
- Will other, more advanced technologies come to the rescue?

All of these issues deserve attention, and the sooner the better. The cable operator has an advantage over other satellite users in planning to accommodate this 2 degree ruling: Television programming generally comes from satellites in the western end of the orbital arc, and this will be the last portion of the arc to be filled with 2 degree-spaced satellites. So, there is some time to evaluate and respond to the issues, but not enough to procrastinate.

Size is important

Let us, then, take a look at some of these problems on an individual basis. It is generally assumed in the industry that all earth stations less than 6.1 meters will require special coordination and analysis procedures in order to avoid potential interference problems. This figure is chosen because, according to most equipment manufacturers specifications, anything less than 6.1 meters will not have enough discriminatory capability to avoid interference.

The existing cable operator's receive-only earth station, if it is less than 6.1 meters, is therefore likely to require replacement, even if it is a single-feed antenna. If satellites are placed half as far apart as they currently are, the antenna will essentially be "looking at" twice as many signals as they were prior to 2 degree spacing. Without the capability to discriminate, a cable system's signal is likely to be frought with interference generated by signals from satellites adjacent to the one its dish is looking at for programming. Consequently, antenna selection, installation and alignment all become more critical than ever before.

Other dishes that are likely to have problems due to their size are the kind commonly used for SMATV (private cable) systems. These small dishes (typically about 3 meters) are not large enough to provide the needed discrimination between satellite signals in the 2 degree environment. Furthermore, these dishes are usually not licensed. There is no problem regarding the lack of licensing from a legal aspect; receive-only dishes are not required to be licensed. However, because they are not licensed, they are not protected from potential sources of interference. If an SMATV installation provides interference-free reception now, it may not have the same clear signal reception if the dish is repositioned to look at a different satellite.

Another type of earth station antenna that may be affected by 2 degree spacing is the multi-feed type. This antenna can simultaneously look at several satellites in the orbital arc. Although most manufacturers state that their multi-feed dishes will tolerate the 2 degree spacing without suffering from extensive interference, it is recommended to keep a close watch on the quality of the received signal. As in any other technology, when more than one component is packed into an electronic item, the performance of that item is likely to decrease at least somewhat due to its concentration upon servicing several needs well instead of one need excellently.

Coordination and licensing

What happens if 2 degree spacing prompts cable programming suppliers to put new satellites in orbit to take advanage of the latest in technology? Well, one thing that is likely to occur is that the earth station that once received the programming source from the original satellite will have to be pointed in a different direction to receive the programming from the new source. The potential difficulty here stems from the original coordination process.

When an earth station is coordinated or licensed, the process considers the interference that comes from other communications facilities, primarily terrestrial microwave systems in 4 GHz that are sharing the frequency band with the programming being downlinked from the satellite. That works just fine until the orientation of the earth station is changed. Where there was once a clear signal with little or no interference, the cable operator may face a situation where pointing the earth station at a different satellite exposes the dish to sources of interference from another direction.

This situation can be avoided if the proper precautions are taken during the initial planning stages of the earth station installation. When an earth station is coordinated and licensed, the engineer should try to clear the station of interference for the entire geostationery arc that the dish sees. In doing so, you assure that the earth station will receive no intolerable interference from existing systems, but more importantly, new terrestrial microwave systems will have to demonstrate that they will not interfere with your earth station regardless of the direction that it is pointing.

The obvious issue here is interference; how much, from which direction, from what source, etc. Competent engineering firms will be able to give the answers to these questions. In addition to data in tabular format, which is not always the easiest to interpret, computer-generated color graphics that illustrate interference sources are now available (see Figure 1).

Not only are graphics like this important for the interpretation of interference data, they also are quite useful in the field. When an installer is on the roof of a building, or out in an open lot trying to do a proper installation of an earth station, a graphic can be immensely helpful in determining the best location for shielding, or using natural barriers to block sources of interference. Without a clear picture of which azimuth the interference is originating from, it is difficult to perform a quality installation within a reasonable time frame.

Another consideration when the dish is pointed at a different satellite is sun outage. Sophisticated computerization can calculate the times during the course of a year when the conflict between the sun, the satellite and a particular earth station will cause interference so extensive that it degrades the signal substantially enough to be noticed by viewers, or in the worst cases to be lost for up to a few minutes. When having an earth station coordinated, be sure to insist that the engineering firm provide calculations of when the sun outage will be a problem. Warning viewers in advance of the difficulty will save numerous unnecessary phone calls from them. Keep in mind that the outage time will vary depending on the satellite the dish is looking at. Be sure to have new calculations run if the dish is repositioned.

Two degree satellite spacing is likely to be of benefit to the cable operator as well as a problem for one simple reason: the more satellites in the sky, the more competitive pricing will become for transponder time. And when transponder time becomes inexpensive, other sources of programming, probably at reduced prices commensurate with the reduced transponder pricing, will appear. Additionally, opportunities such as long distance services, data transmission from cable system to cable system and others will become more realistic as transponder pricing drops. The scope of opportunities will expand as the number of satellites expands.

With all of the potential difficulties facing cable operators because of 2 degree satellite spacing, it becomes more important than ever before to license the earth stations, clear them from interference sources for as wide a portion of the orbital arc as possible, and to keep a close eye on the quality of the signal they receive as more satellites are launched. Be sure that the engineering firm that you deal with is reputable, and has the tools to ensure your continued profitability. Together, the operator and the engineer can make this potential difficulty easier to live with and perhaps even turn it into a money-making opportunity.

Scott Goldman is the director of business development for the Communications Services Division of Compucon Inc., located in Dallas and Washington. Compucon is a subsidiary of the A.C. Nielsen Co., most popularly known for the Nielsen TV ratings. Goldman is responsible for the development and sale of new services to the communication industry with a special emphasis on the land mobile, satellite/terrestrial microwave and broadcast areas. He has been actively involved in the communications services business since 1973, acting as director of operations and as sales manager for two radio common carriers in Texas. In addition, Goldman played an instrumental role in the development of several cellular-related research techniques for Compucon's Communications Marketing Research Group.

ARCOM Traps
Stack Up...
against the competition

- Superior long-term stability
- Superior moisture proofing
- Superior security-rolled case prevents subscriber tampering
- Superior RF radiation shielding

Traps Shown Actual Size

2 Pole Series

4 Pole Series

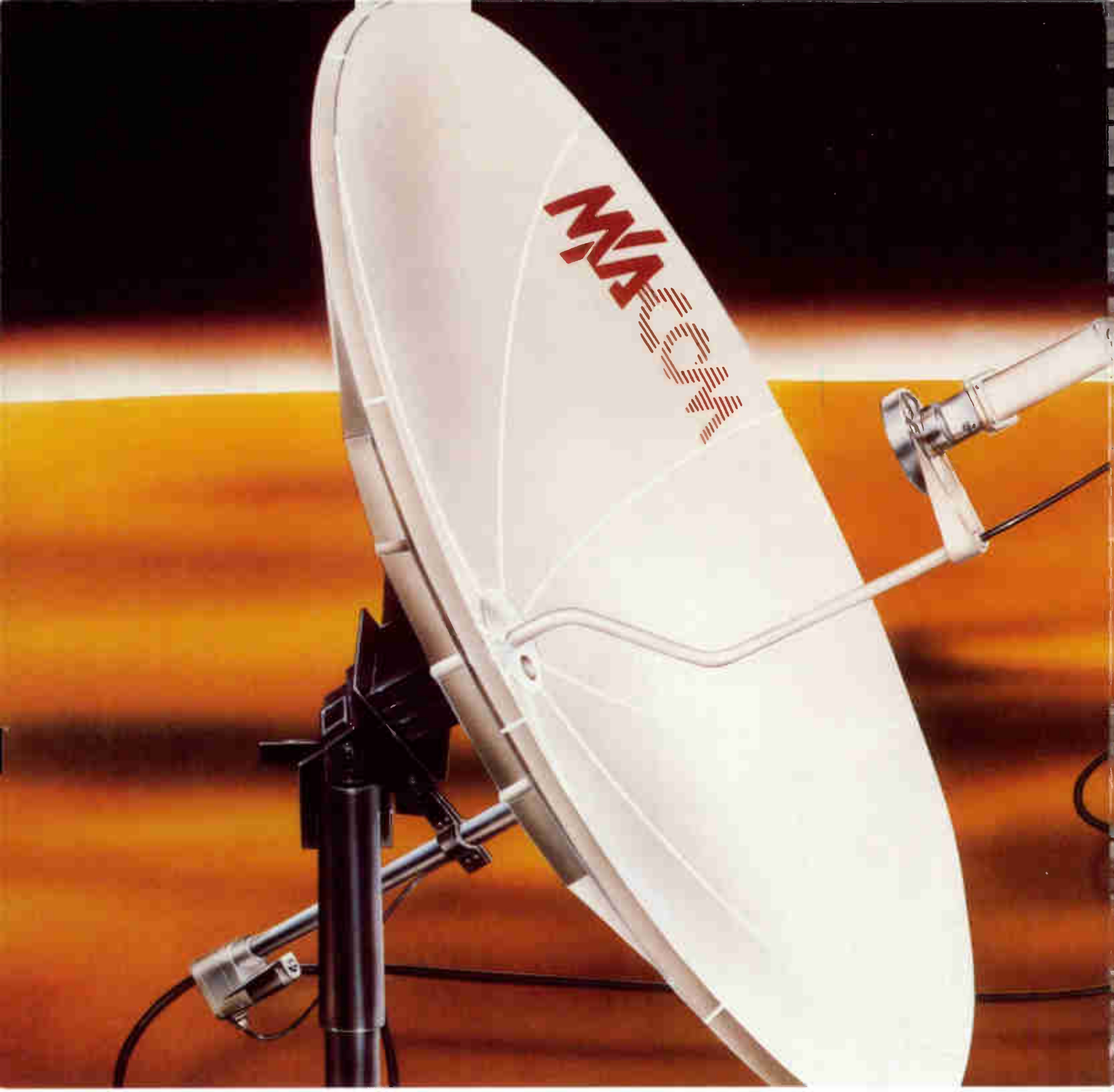
6 Pole Series

8 Pole Series

IN N.Y. STATE
CALL COLLECT
315-463-8433

(800)448-1655

Northern
catv sales, inc.



After a satellite signal travels 22,300 miles, it's the last few hundred feet that make the difference - because the system makes the picture... and M/A-COM makes the system.

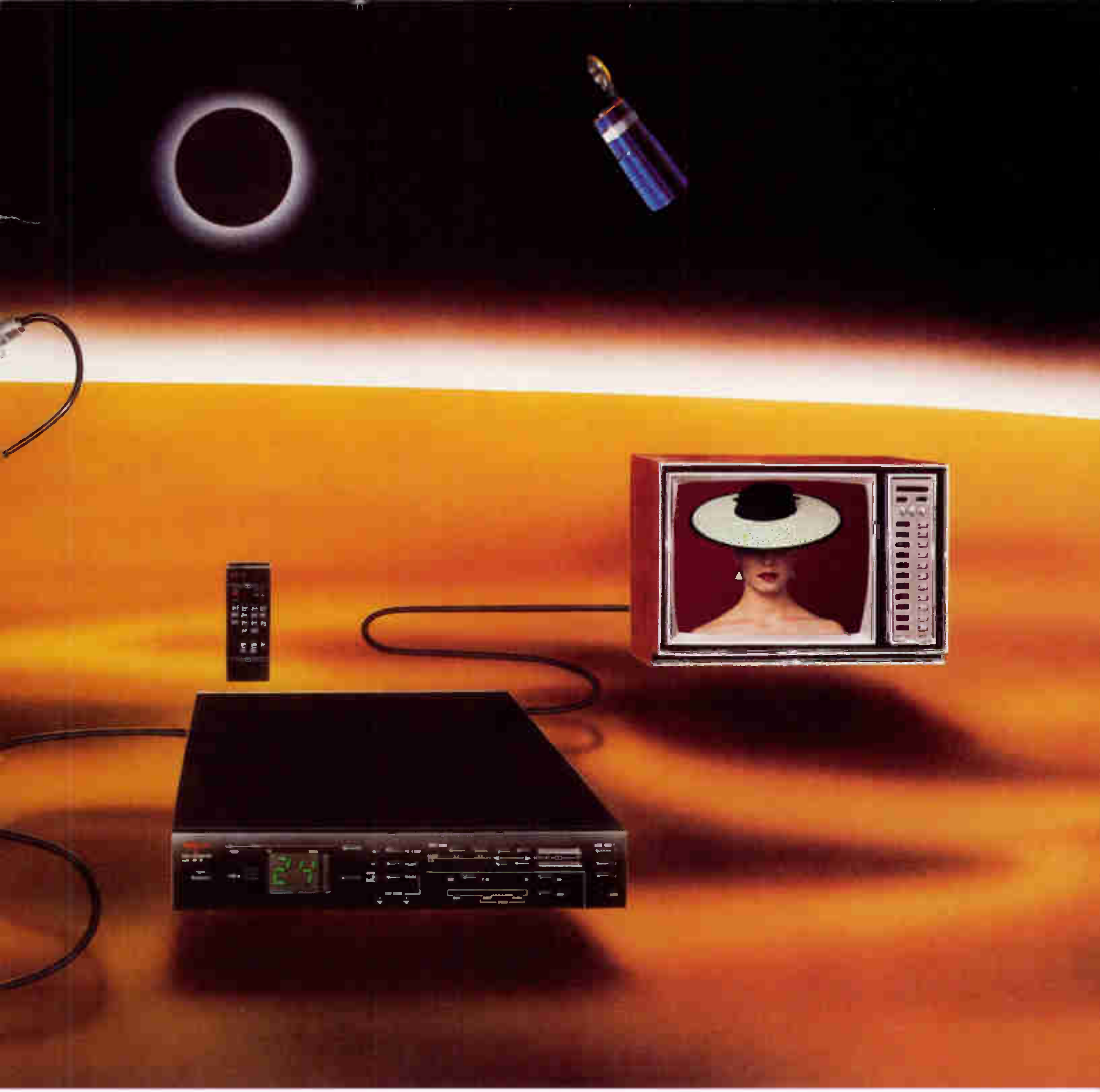
When you buy a satellite antenna system you expect a stable, clear picture with no-hassle tuning and adjustments. You get that with the M/A-COM system.

You get a better picture because the M/A-COM system is a *system*, not an unrelated collection of devices. And each part of the system is designed to do its job well—from the reflector to the receiver.

Here's what you'll find in the M/A-COM system:

The Reflector—Perfectly shaped and thermally compression molded to hold a true parabolic shape.

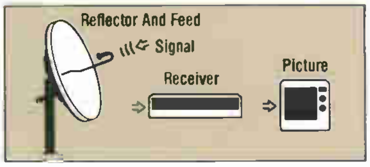
The Omni Polarizer—One of two M/A-COM approaches to polarity switching. The 100% solid state polarizer offers instant electronic polarity without tweaking.



The Omni Rotor—If you want a mechanical polarity switch, M/A-COM has that, too. The rotor has an in-line design and a sealed, weatherproof housing.

The Prodelin Mount—A true polar mount, easy to install, easy to adjust. It interfaces with Prodelin 8 ft. and 10 ft. reflectors.

The Receivers—A choice of the M/A-COM T-1 or H-1 full featured receivers with microprocessor controlled tuning, wireless remote control and parental supervision lockout feature.



Look into the M/A-COM system. You'll find that every part has features and advantages that make it a valuable buy on its own. And connected with all of the other parts of the system, it's even better.

Make sure you get the picture you want. Buy M/A-COM.

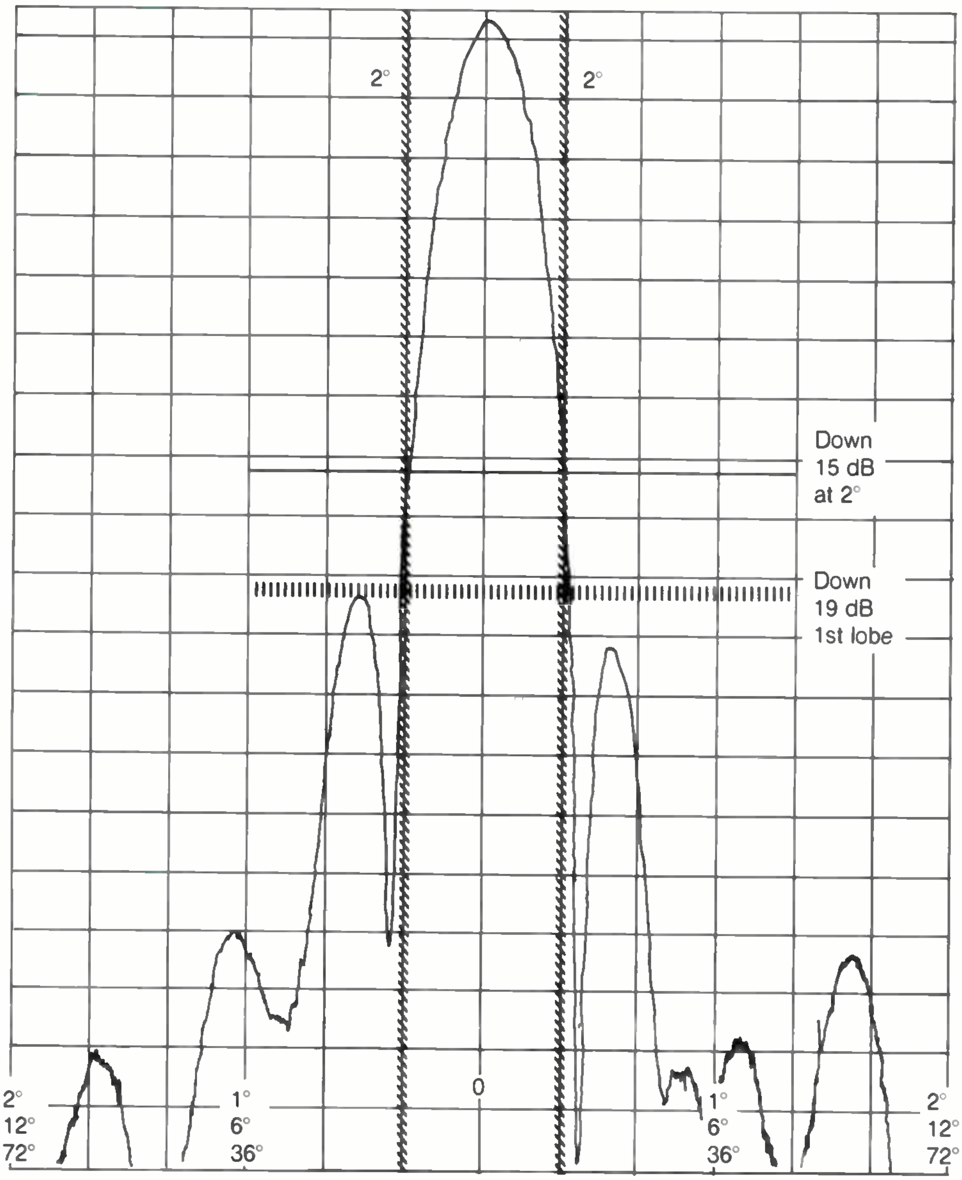
M/A-COM *Cable Home Group, Satellite Antenna Systems, Post Office Box 1729, Hickory, NC 28603 800/438-3331 704/324-2200 Telex: 802-166*

M/A-COM

CABLE HOME GROUP

The system makes the picture. M/A-COM makes the system.

Figure 2: 2.4-meter 3.85 GHz azimuth pattern (E-plane), tripod, top leg up



Two degree spacing: How it will affect you

With the implementation of 2 degree satellite spacing, how it may (or may not) impact the receive-only terminal operator is a concern shared by many in the satellite communications industry. The serious problems will be felt by uplink operators, particularly modest sized transportables as employed for remote or transient special event telecasting. The correct concern for the majority of receive-only operators should be: "Will my present or planned terminal be vulnerable to adjacent satellite co-channel interference?" This article will stress sidelobe response factors and comment briefly on cross-polarization response. In effect, we therefore are not talking about possible response within the antenna main beam itself, such as occurs with really small apertures of perhaps less than 2 meters diameter at 4 GHz. But, even there, controversy exists and rumors persist about small apertures.

By Fred Fourcher
and Dan A. Bathker
Miralite Corp

The generally accepted criterion of a tolerable carrier-to-interference (C/I) ratio of + 18 dB, endorsed by the NCTA engineering committee and recommended by the FCC, applies to systems operating with sensibly large mar-

Figure 1: NCTA 18 dB co-channel C/I

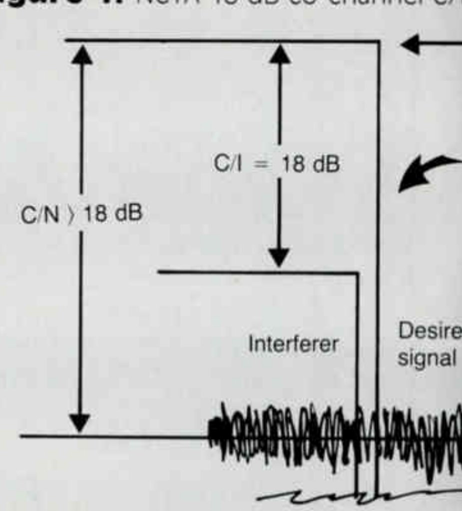
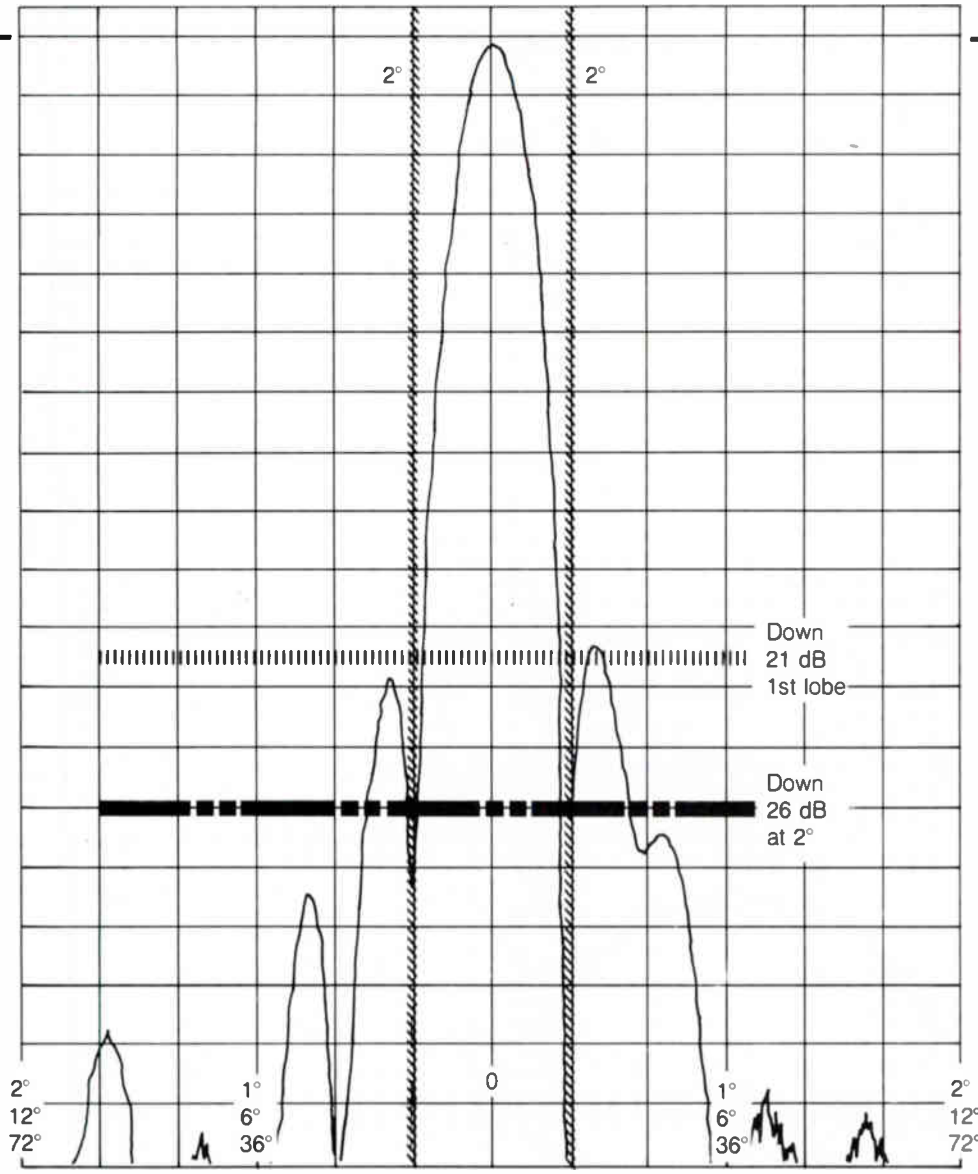
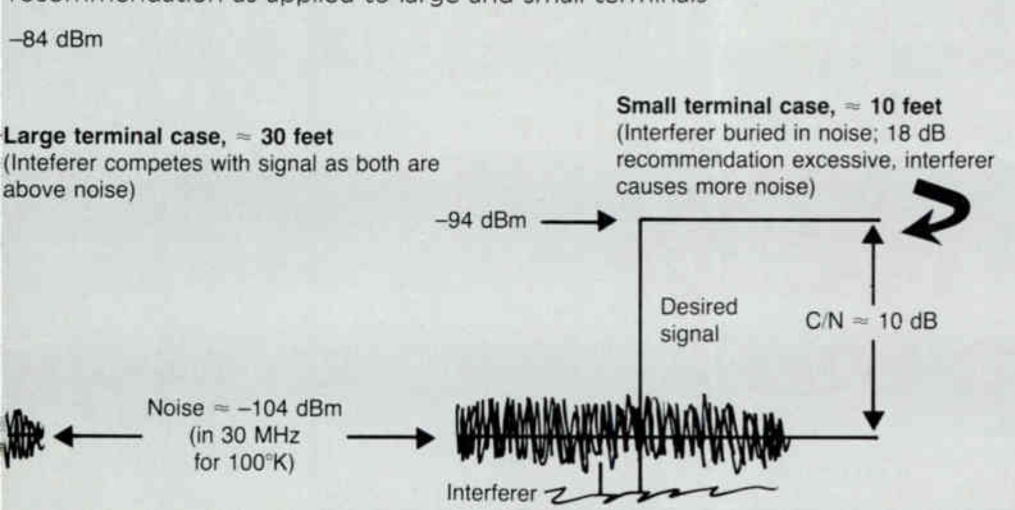


Figure 3: 3.7-meter 3.85 GHz azimuth pattern (E-plane), tripod, top leg up



'Be very careful to obtain and evaluate radiation patterns in the geosynchronous orbit plane. . . where the potential interference hangs out'

recommendation as applied to large and small terminals



gins. With a large margin, a C/I of +18 dB will place the interference above the receiver noise level, as the receiver debates what to do with the two available signals. With a small or no margin, a C/I of +18 dB will place the interference below the receiver noise level, and the receiver simply deals with more "noise." Claims of an acceptable C/I ratio of only +12 dB (or even slightly smaller numbers) are not totally incorrect: some good results have been achieved using the desired signal close to the minimum useful (small dish signals). Lastly on this point, the receiver detector type also will influence the final video quality. So, be prepared to hear "unusual claims" regarding adequacy of a low numbered C/I ratio for some time to come from small dish advocates. Many small dishes, in fact, will work quite well.

In terms of absolute gain levels, in decibels referred to isotropic, the 29 - 25 log θ co-polar and 19 - 25 log θ cross-polar pattern response recommendations mean, at 2.2 degrees off axis, the response cannot exceed +20 dBi (co-polar) nor +10 dBi (cross-polar). Although 2.2 degrees seems like an "odd" number, in fact it isn't. "Two degree" satellite spacing means 2 degrees of Earth longitude, which is measured from the center of the Earth. The actual separation of satellites, as seen from the surface (not the center) of the Earth varies, from almost 2.4 degrees (2.356 degrees exactly), if you happen to be on the equator and looking straight up, through 2.2 degrees at about latitude 48 degrees (Seattle), to the minimum of 2.0 degrees if you are robust enough to live beyond 81 degrees north or south latitudes. These numbers apply when the antenna is looking south in the Northern Hemisphere (or, of course looking north if you are in the Southern Hemisphere).

When looking near the horizons, either east or west, the actual separation angle, as seen from the antenna, does approach 2.0 degrees. So, do not be misled into looking at range patterns, even good ones, at the "magic" 2 degree point; look a bit farther, about 2.2 degrees. Table 1 illustrates several earth station view angle separations that can be used to determine the pattern "decibels down from

Table 1: Effective earth station view angle separations for 2 degree geosynchronous orbit satellite spacing

Antenna location	North latitude in decimal degrees	Maximum angular separation in decimal degrees	Minimum angular separation in decimal degrees
81 degrees North	81.00	2.000	2.000
Fairbanks, Alaska	64.83	2.105	2.000
Seattle, Wash.	47.60	2.203	2.000
New York, N.Y.	40.67	2.239	2.000
Denver, Colo.	39.73	2.243	2.000
Santa Ana, Calif.	33.75	2.277	2.000
Miami, Fla.	25.75	2.308	2.000
Equator	0.00	2.356	2.000

Note: Maximums occur looking due south; minimums occur looking to either horizon

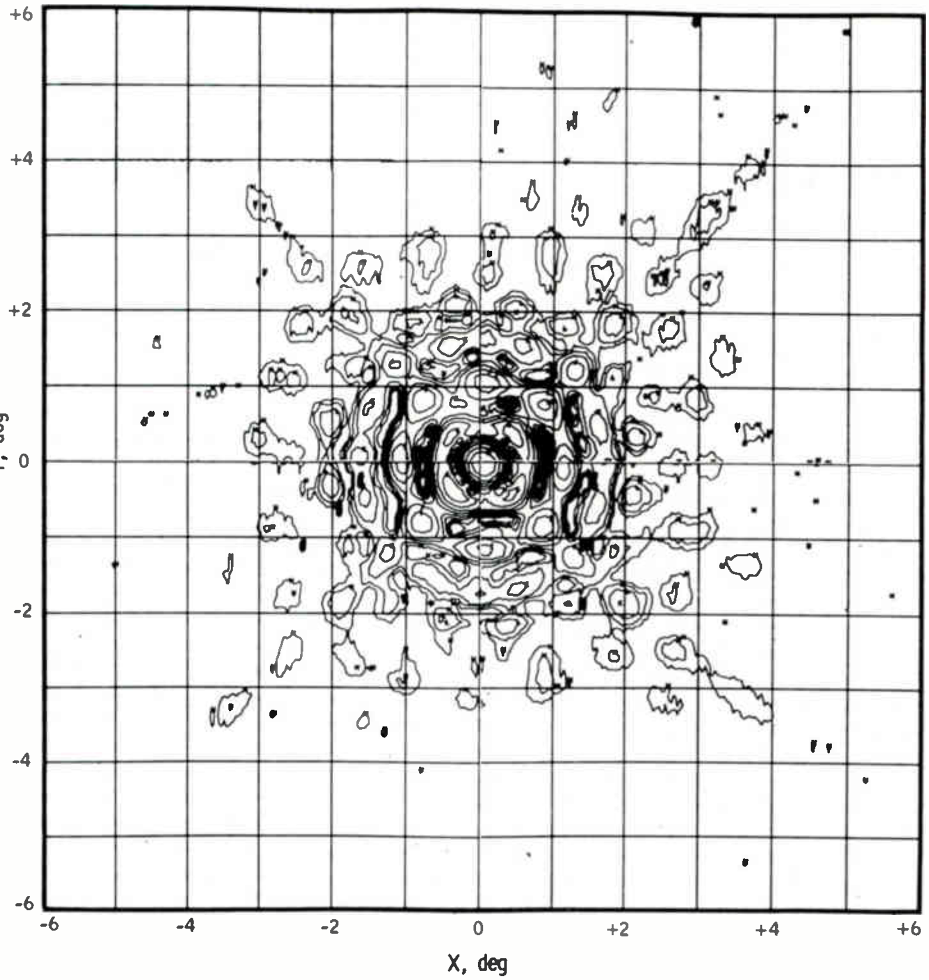
peak." A few tenths of a degree can make a big decibel difference when the pattern has a high slope ("falloff") in that region.

Compliance considerations

To determine compliance with the recommended pattern response requirements, obtain the antenna peak gain, in dBi, and obtain the 2.2 degree pattern relative level, in dB below beam peak. Take the difference between the two numbers. If greater than +20 dBi, that system does not comply. Example: an antenna having +42 dBi peak gain with response at 2.2 degrees of –22 dB relative to the peak "just makes it." Had the 2.2 degree pattern response been –20 dB relative to the peak, the absolute gain at 2.2 degrees would be +42 dBi –20 dB = +22 dBi; 2 dB too high. Should an operator elect not to comply with the recommended pattern response that operator could "push it" as follows (for one equal effective isotropic radiated power [EIRP] interference satellite): Obtain the 2.2 degree pattern level, in dB below beam peak. Compare with the 18 dB NCTA recommendation. Example: an antenna having response at 2.2 degrees of –18 dB relative to the peak (4 dB worse, or stronger, than the earlier example that "just made it" for recommended pattern response) does make the –18 dB recommendation. But, there is no guarantee the interfering satellite has equal EIRP; this must be looked at on a case-by-case basis. And, if two equal power interfering satellites are adjacent to the intended, and equal in EIRP to the intended, we can "power add" the interferers and determine the antenna must respond at –21 dB (18 + 3) to just make the 18 dB C/I recommendation. Even so, different modulations on the interferers will upset the above simple approach. But, with non-moving video (the toughest) on all three, and equal EIRPs, the –21 dB pattern response at 2.2 degrees off


AS OTAS™ GOES UP, LOSS OF REVENUE GOES DOWN
Put OTAS in your system and you have the ultimate in cable system security. An unbeatable ACTIVE TRAP (PATENT PENDING) secures the signal at the pole. The OTAS Data Controller, located at the headend, controls 7 active traps plus basic service for up to 100,000 subscribers. This security cannot be defeated in the subscriber's home.
PICO's software package provides an extensive menu including billing and global command, allowing marketing opportunities such as pay-per-view and creative program packaging.
We have a lot to show you. Visit our Corporate Demo Center and see why so many system operators are up on OTAS. To schedule your visit, contact PICO.
PICO PRODUCTS, INC
Pico Products, Inc.
103 Commerce Boulevard
Liverpool, New York 13088
1-800-822-7420
In New York State Call
(315) 451-7700
Actual Installation
(Approx. Wt. 16 lbs.)

Figure 4: Contour plot antenna pattern showing quadripod induced sidelobe 'features' in diagonal planes



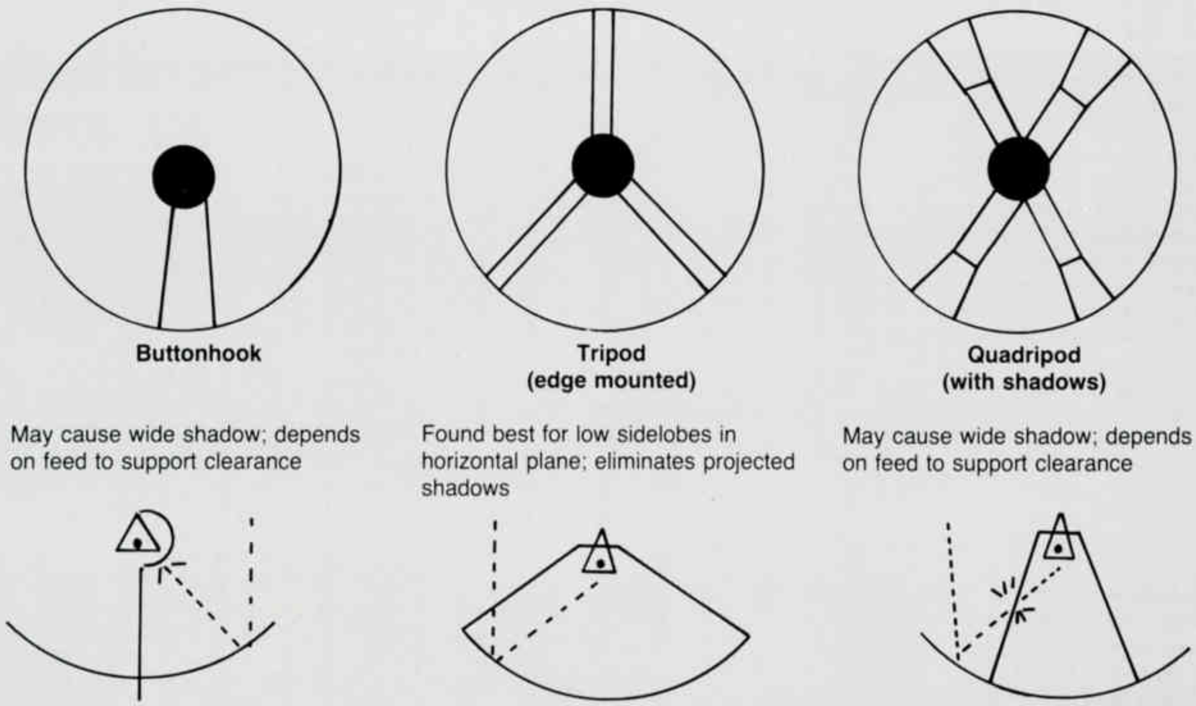
axis will be fine. Moving video and/or data services are less of a problem, and poorer antennas (such as −16 dB response at 2.2 degrees) will work fine under the three equal EIRP 2 degree spaced satellite conditions.

The aforementioned criteria applies to co-polarized satellites, meaning both (or all 3) have the same transponder/polarization format. Example: all satellites have odd-numbered transponders horizontally polarized (H-pol) and even-numbered ones vertically polarized (V-pol). Should the FCC ultimately achieve cross-polarization of adjacent 2 degree spaced satellites, the performance question largely evaporates. Example: satellites A-B-C, where A and C transmit H-pol from transponders 1,3,5,7, etc. and B transmits V-pol from transponders 1,3,5,7, etc. With even "dime store" ground equipment, an immediate 15 to 20 dB, or even more, additional isolation results, hence evaporation of the performance question, provided ground antenna cross-polarization response is sensible. Ultimately, as new satellites enter service, "oddballs" retired and others jockeyed into best positions, the FCC will almost certainly achieve the ideal cross-polarized (alternating) satellite spacing plan.

The importance of the azimuth

A few final remarks regarding antenna patterns. One must be very careful to obtain and

Figure 5: Feed support types



evaluate radiation patterns *in the geosynchronous orbit plane*. After all, this is where the potential interference "hangs out." Because range patterns are usually obtained on azimuth/elevation (Az/El) fixtures, the truth is that the *azimuth* pattern is the best data, provided that antenna will later be mounted on a *polar* mount. Picture it this way: observe, with a "tripod" feed support, the top leg, as it "rolls" to the left (when looking at the *back* of the dish, as it points toward the east, in the Northern Hemisphere). When pointing over toward the east, that top leg remains 90 degrees or "crossed" to the satellite arc. Therefore, the azimuth range pattern effectively and advantageously "rolls with the dish roll" on the installation polar mount.

Should the installation be an Az/El mount, life is not so simple. Now the satellite arc, as it "dips" towards the east or west, does *not* align with the azimuth (nor with the elevation) range pattern, but aligns somewhere in between. Figures 2 and 3 illustrate the conventional range patterns of well-performing 2.4- and 3.7-meter systems, with tripod feed support legs, one of which is properly attached, at the rim and at the top. Figure 4 is a third very interesting *contour plot* antenna pattern, taken from a NASA report. Imagine being in space, looking down on the Earth and "seeing" the antenna pattern (as though temporarily converted to a 4 GHz transmitting system). The figure shows the main beam contours occupying only the central "target" zone. All the other "bumps" are sidelobes. Of greatest importance to understand and appreciate, are those "features" running diagonally across the figure at ±45 degrees. Those features are hotter (stronger) sidelobes caused by none other than the four feed support legs of this particular antenna, which are not arranged vertically and horizontally, but rather at (you guessed it) ±45 degrees with respect to the horizon. This may be excellent for close-adjacent satellite applications, as it may place those hotter or stronger lobes "out of the satellite belt." If this particular figure is obtained from space and looking "down and towards the north," it follows the antenna is looking "due south and up." Then, it is true the hot lobes are "away from the satellite belt," being ±45 degrees oriented as shown in Figure 4.

What happens when one "cranks" the antenna over, far to the east or west? The answer depends on the *mount*. If the mount is *polar*, just like advantageously happened with the tripod (with one leg up) discussed earlier, the legs (therefore the pattern) "roll with the dish roll," and the satellite arc remains nearly exactly along the Y = 0 (horizontal) line in the figure. If the mount is Az/El, the "roll" doesn't happen; those ±45 degree plane hotter sidelobes stay "glued to the sky," so-to-speak.

Figure 6: The Earth as seen from geosynchronous orbit, 110 degrees west longitude

Spacecraft antenna circular cross-section beam −3 dB and −10 dB footprints centered near Denver. (Useful in conjunction with Figure 4 to show Az/El versus polar mount sidelobe differences.)

Then, looking far to the east or west, there will be an *interception* of one of those ±45 degree plane high sidelobe lines with the satellite arc as the arc "dives" into either horizon. Under those conditions (Az/El mount, ±45 degree 4-legged feed support, and operating "low and towards the east or west"), the operator will suffer more interference due to higher sidelobes now occurring along the satellite arc.

Problem solvers

In the near future, you will be reading and hearing more and more about "clear aperture" or "offset fed" dishes, and/or "sidelobe suppression in the plane of the satellite arc." The former, at the cost of requiring a non-symmetrical antenna structure, eliminates the portion of sidelobes due to tripod or four-legged feed supports nicely, but does nothing to cure bad feeds, poor surface contours, and may increase cross-polarization response, although this is perhaps not a major factor. The latter, "sidelobe suppression in the plane of the satellite arc," is illustrated with the valuable contour plot figure.

Another way to achieve better sidelobe suppression is with an elongated antenna. Instead of a 3.7-meter diameter reflector, why not a reflector of, say, 1.8 x 7.3 meters, which has equal area? When oriented with the 7.3-meter dimension horizontal, that is ideal for viewing the satellite arc, if looking due south. A very narrow beamwidth of about 0.8 degrees results, in line with the arc, while a wide (3.2 degree) beamwidth crosses the arc vertically; but, to enjoy the narrow beamwidth in line with the arc when looking low towards the east or west we need, of course, our old standby again, the *polar* mount. With the polar mount, as we have seen, the dish "rolls" when looking low, thus the elongated reflector must be mounted high enough for ground clearance. A proper feed for an elliptical outline dish is possible, but somewhat difficult if done well.

One final note on the value of the contour plot antenna pattern: don't underestimate it. When used knowledgeably, it can be a very effective tool in determining antenna response characteristics. If this is the only message you've received from this article, it has been a success.

Measuring noise, cross-modulation and hum modulation

This is Chapter VIII of the "Technical Handbook for CATV Systems." Each month another installment of this excellent technical tool will be presented.

By Ken Simons
Consultant to Wavetek CATV Division

Measuring noise

The noise level measurements presented here were done with a Jerrold field strength meter (FSM) Model 704B. The 704B was designed to measure the RF voltage and the dBmV levels of CW, FM and television picture signals in cable systems. Although it is not calibrated for noise levels, with suitable correction the meter can be used for this purpose. Two factors prevent it from reading noise levels directly and both must be taken into account in the correction. One source of error is the fact that the bandwidth of the 704B is approximately 0.6 MHz. Since noise levels in CATV are usually specified for a 4 MHz bandwidth, the meter would read approximately 8 dB low if this were the only source of error. (Noise power is proportional to bandwidth, and a power ratio of 4/0.6 = 6.7 corresponds to 8.2 dB).

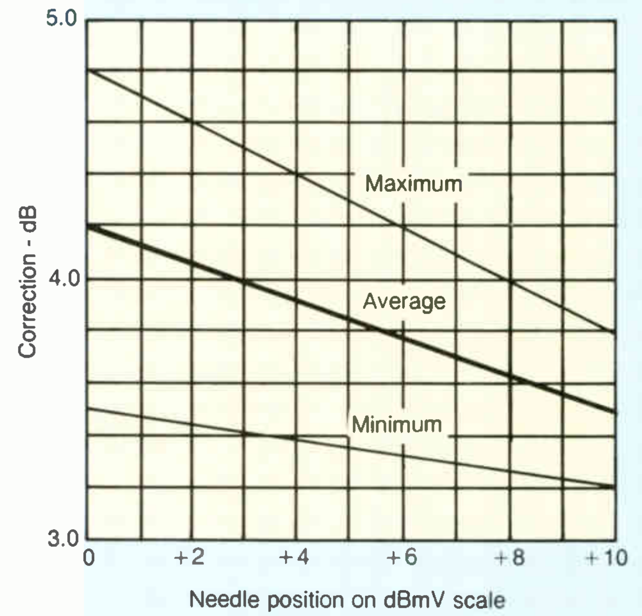
A second source of error acting in the opposite direction is the response to noise of the peak detector in the FSM. Since it is designed to respond to the peak of the TV picture signal, it attempts to follow the noise peaks rather than reading the rms noise. Since noise has a higher peak-to-rms (root-mean-square) ratio than a carrier wave (CW) signal, the detected output reads high, reducing the correction required. As its output is reduced, the efficiency of the detector is lowered and it reads closer to rms so more total correction is needed at the low end of the meter scale.

The curves in Figure 59 indicate the total correction required. They are based on noise calibration tests on 10 704Bs showing the variations as well as the average correction. To use the curves, the level of the noise is measured, reading the meter as if a signal was being measured. The correction corresponding to the needle position on the scale is then added to the measured level to obtain true noise level.

To determine the signal-to-noise ratio in a trunk-line system:

1. Connect the FSM input to the output of the last amplifier (or the output of any other amplifier where the signal-to-noise ratio is desired).
2. Disconnect all signals from the input to the first amplifier (except the pilot tone if it is needed for normal ALC operation) and terminate that point.

Figure 59



To obtain noise level for 4 MHz bandwidth:
1. Measure noise level as if it were a signal.
2. To meter reading add average correction shown opposite needle position.

3. Tune the FSM to the highest and the lowest channels used in the system and read the meter as if a signal were measured.
4. Obtain the corrected noise level for each channel by adding a correction taken from the "average" curve. Or, for greater accuracy, from a noise calibration of the particular FSM as described below.
5. Subtract the corrected noise level for each channel from the normal channel level at that point in the system to obtain the signal-to-noise ratio at that point.

Noise calibration of a field strength meter

It is sufficient to use the average curve for *any* 704B if accuracy in the order of plus or minus 1 dB is acceptable. For greater accuracy in noise measurement, the individual field strength meter must be calibrated on a known noise source. One convenient way of doing this is diagrammed in Figure 60. An amplifier having an accurately known noise figure is

Figure 60: Set-up for noise calibration of FSM

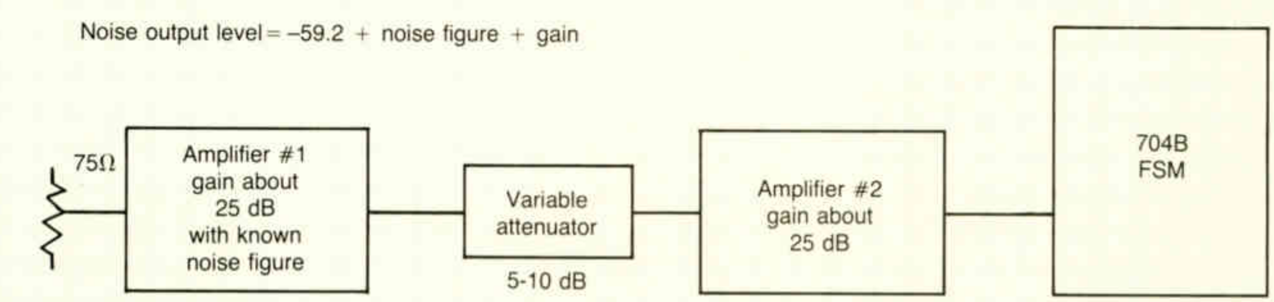
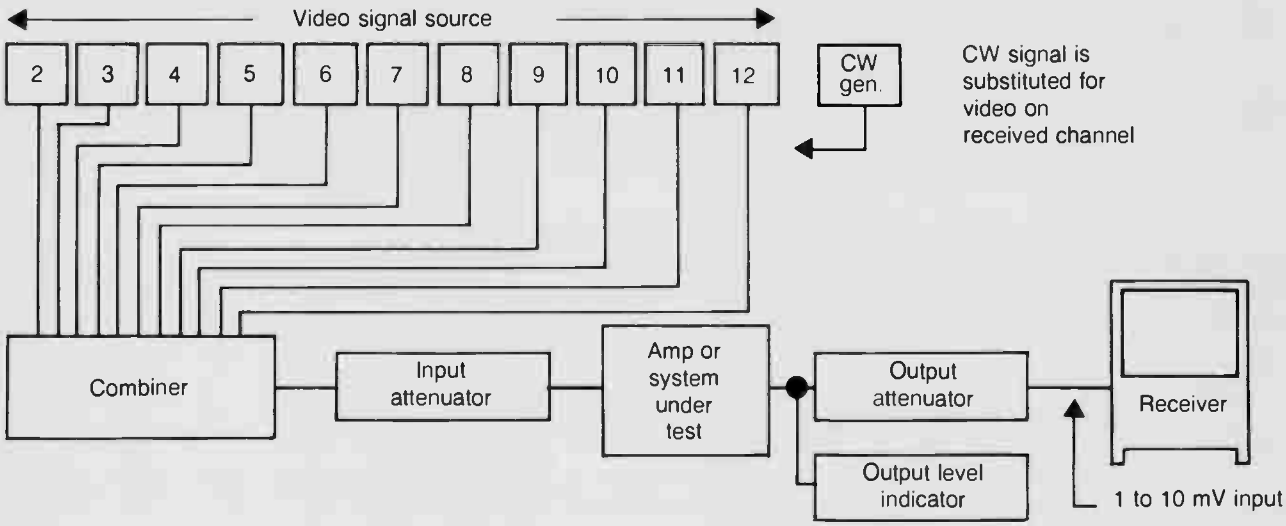


Figure 61: Basic test for cross-modulation



required. The input to this amplifier is terminated, and its output is connected through a variable attenuator to the input of the second amplifier. The output of the second amplifier is connected to the RF input of the FSM.

Calibration is made as follows:

1. Tune the FSM to a convenient channel having no local signal. Set it on the –20 dBmV (300 microvolts full scale) range and adjust the tuner compensator to the calibrated point.
2. Adjust the variable attenuator to the setting which gives a full-scale reading on the meter (300 microvolts or –10 dBmV).
3. With the attenuator at this setting, measure the gain from #1 input to #2 output, and measure the noise figure (NF) at #1 input. (If the net gain from #1 input to #2 input is over 15 dB, it is safe to assume that the noise figure of the combination is the same as that of #1 amplifier.)
4. The noise output into the FSM is –59.2 + NF + gain. If, for example, the noise figure measured 8.4 dB, and the net gain were 44.5 dB, the noise output would be –59.2 + 44.5 + 8.4 = –6.3 dBmV.
5. The correction for the FSM at full scale is the number of dBs that must be added to the reading (–10 dBmV) to equal this calculated noise level. (In our example, since the noise level is –6.3 dBmV, the correction is 10 – 6.3 = 3.7 dB.
6. Find the additional correction required at other points on the scale by inserting additional attenuation, 1 dB at a time, and noting how far below the dB marks the needle reads.

Measuring cross-modulation

The basic test for cross-mod is a simple one; Figure 61 shows a block

Figure 62: Jerrold cross-modulation test set

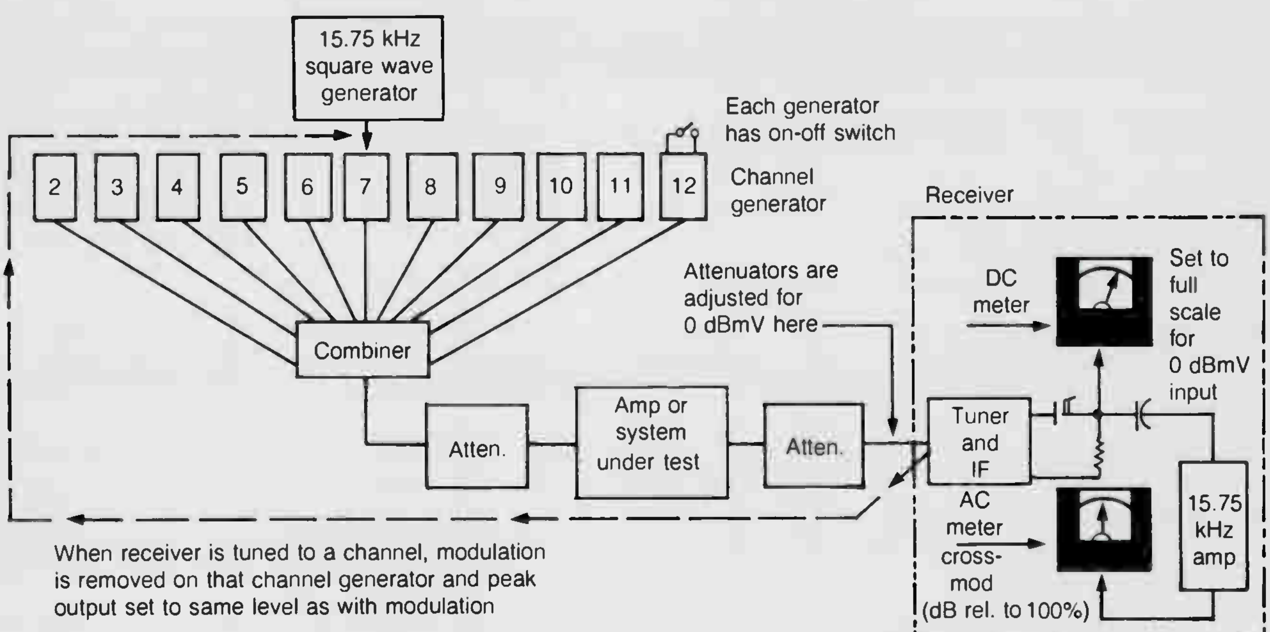


diagram of the set-up. A number of picture signals at the various channel frequencies are combined and fed through the amplifier or system under test. While viewing one of the output signals on a good television receiver, the amplifier output levels are increased, keeping the receiver input constant, until windshield wipers become just perceptible. The level at which this occurs is the maximum usable output of the system.

This test has a weakness in the fact that, when viewing TV programs, windshield wipers can be seen much more readily on some pictures than on others. The accuracy of the test is greatly increased if a CW signal is substituted for the picture signal on the channel being viewed. This provides a white screen which does not change during the test, so more consistent and critical observations can be made. Since system characteristics are generally not the same for all channels, this test is complete only when it is made on each channel, the CW signal being substituted in turn for each of the channel signals. The maximum usable output is that which gives barely visible interference on the worst channel.

A cross-modulation test set

While the "white-screen" test is simple and direct, the resulting output ratings depend somewhat on the judgment of the person carrying out the test. For more accurate results an instrument is needed which gives repeatable readings. A brief description of the test set used in our laboratory and factory will show the essential elements of such an instrument.

Figure 62 shows a block diagram of the test set-up. Any combination of the 12 crystal-controlled carriers is available. Each one is 100 percent modulated with a 15.75 kHz square wave, except the one to which the receiver is tuned; this carrier is unmodulated, but its amplitude is the same as the peak amplitudes of the modulated carriers. The receiver gain is kept constant so that, when the channel levels and attenuator settings are adjusted for full scale reading on the DC meter, the receiver input is standardized at a convenient level (0 dBmV). The amplifier output level in dB is then the same as the dB attenuation of the output attenuator.

The second detector output contains a small 15.75 kHz component due to cross-modulation. This is amplified through a high-gain, narrow-band, 15.75 kHz amplifier, and its level indicated on a meter calibrated in dB below 100 percent modulation.

To carry out a test, the amplifier is connected, the desired channels turned on, and the channel levels and attenuators adjusted for rated output on each channel. The receiver is tuned to each of these channels successively and the cross-modulation readings are recorded. The amplifier rating is based on that channel which shows the greatest cross-modulation. When a trunk-line amplifier is being tested, its "behavior" is determined by changing the settings of the two attenuators to alter the output levels in, for example, 2 dB steps to find if the cross-modulation follows the "two-for-one" law expected of a "well-behaved" amplifier.

Measuring cross-mod with a 704B and picture signals

While specialized equipment like that described in the foregoing allows rapid and accurate measurement of cross-mod in the laboratory, reasonably accurate measurements can be made in the field using system signals and a selective receiver, such as the 704B. While the method is sensitive enough to measure cross-mod in complete systems, or in distribution amplifiers, it is not sensitive enough to measure it in trunk-line amplifiers at their normal operating levels.

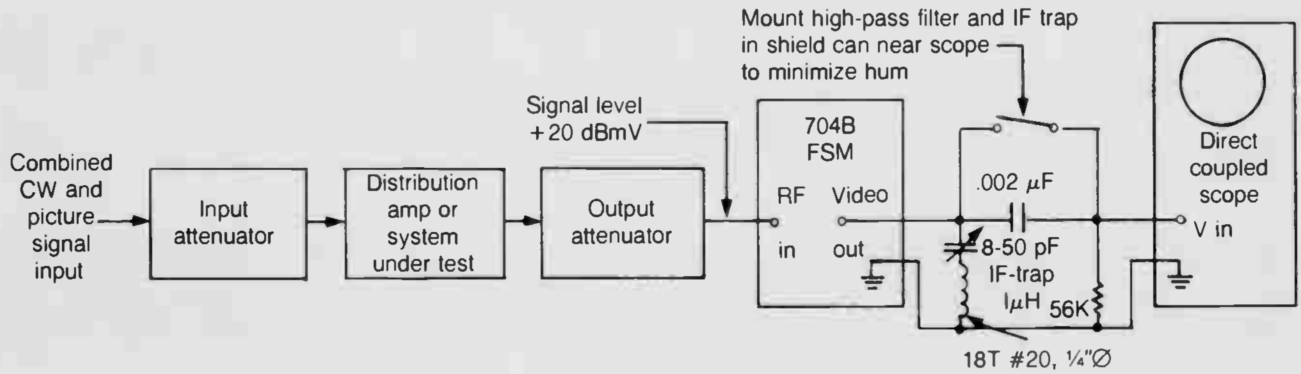
The equipment set-up for this test is diagrammed in Figure 63. The required signals are obtained from the system or directly from the headend converters. A CW signal is obtained on the channel being measured by using a CW signal generator, or switching the converter to a "signal replacement" condition. To make the cross-mod readings agree with those made on a test set of the type described previously, modulation on all channels other than the one being measured should be synchronous. Where tuneable converters are used, this can be accomplished by tuning them all to receive the same station.

The high-pass filter shown between the video output of the FSM and the oscilloscope passes any cross-mod components (in the vicinity of 15 kHz) but rejects hum components (near 60 Hz) so they do not obscure the measurement of cross-mod. There is an appreciable IF (25 MHz) component in the video output of the 704B. This caused a shift in scope centering when the Tektronix 503 scope we used was set at maximum gain with AC coupling. If this happens, tune the IF trap for minimum shift, or for minimum RF voltage as measured with a VTVM at the scope input.

Measurement is accomplished as follows:

1. Introduce the CW signal on one channel, and interfering signals on other channels as required, into the amplifier under test. Using the 704B as an output indicator, set the channel levels and the input attenuator to give rated output on each channel.
2. Tune the 704B to the CW signal frequency, insert attenuation in the output attenuator until the level at the input to the 704B is close to +20 dBmV. This level is a compromise; lower levels would have more noise, higher levels would increase the possibility of cross-mod occurring in the tuner of the 704B. Now adjust the "tuner compensator" for full-scale reading on the meter.
3. Close the switch shorting out the high-pass filter, and adjust scope gain and centering until the trace is on the bottom line of the screen with the signals temporarily removed from the input, and on the top line with the signals connected. Assuming 10 divisions on the scope screen, this sets the relation between CW level and scope deflection so that one division on the scope corresponds to a 10 percent change in CW level, and thus to 10 percent cross-modulation.
4. Open the switch, increase the scope gain 10 times, center the trace vertically, sync the scope to the horizontal line frequency and observe any modulation of the CW due to the other channels. Each division on the scope now corresponds to a 1 percent change in CW level and thus to 1 percent cross-mod.
5. With one interfering channel, or when all the interfering channels have a common sync source, the indicated cross-mod will vary somewhat with the degree of white in the interfering picture signal.

Figure 63: Set-up for cross-modulation measurement with 704B



Accuracy is increased by observing the scope until a maximum of cross-modulation is seen, corresponding to the time when the interfering signal is experiencing a maximum variation.

6. When the interfering signals derive their sync from various sources, their horizontal frequencies will differ slightly so that the relative timing of the various horizontal sync pulses will change constantly. The maximum cross-modulation under this condition will occur when a number of the sync pulses occur momentarily at the same time, and it will be necessary to observe the scope trace for some time to estimate the deflection corresponding to this maximum condition.
7. To be sure that there is no cross-modulation in the 704B circuits, nor in the mixing circuits where the various input signals are combined, it is advisable to test the cross-modulation with the input signals connected to the 704B input via the attenuators, with no amplifier. Adjust for equal levels near +20 dBmV at the 704B input, tune to the CW signal and measure cross-mod as above.
8. The video output from the 704B is approximately 1 volt p-p when the meter reads full scale. When using a scope with a sensitivity of 1 mV/cm, the gain can generally be increased up to 100 times for a maximum sensitivity of 0.1 percent cross-mod per division.

An example of cross-mod measurement with TV modulation

The accompanying scope diagrams illustrate the measurement of the cross-modulation in an amplifier onto a CW carrier from one video-modulated carrier. The amplifier was a solid-state Model SA-1 with both signals at +60 dBmV (1 volt rms) output. The CW was on channel 13, the modulated signal on channel 2. The oscilloscope used was a Tektronix Model 503 with a maximum sensitivity of 1 mV/cm.

The 704B was set on the +10 range, reading full-scale on either signal with 40 dB attenuation inserted. With the 704B tuned to the CW signal, scope gain and centering were adjusted so that the trace was on the bottom line (Figure 64) with the RF input temporarily disconnected, and moved up 10 divisions to the top line (Figure 65) with the RF input connected and the meter at full scale. The scope vertical input attenuator was on the 0.1 volt-per-division step.

The switch was opened, inserting the high-pass filter, and the scope gain increased 100 times. The trace was observed until a maximum variation occurred (indicating full modulation of the interfering signal) and then photographed with the result shown in Figure 66. The peak-to-peak deflection is about seven divisions (averaging the fuzzy sync top) indicating 0.7 percent cross-mod. The same amplifier when tested on our cross-mod tester under the same conditions showed –43 dB, almost exactly matching this result.

Using sine wave modulated signals for measuring cross-mod

When picture signals are not available, the signals from laboratory signal generators with sine wave modulation can be used to measure cross-modulation. Because of the different form of modulaton, correc-

Figure 64

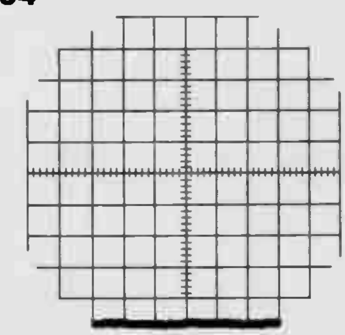


Figure 65

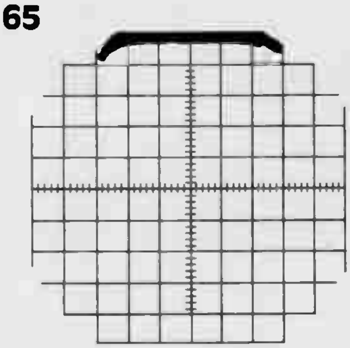
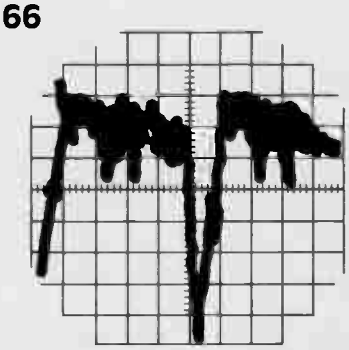


Figure 66



tions must be made if the results of these measurements are to agree with measurements made with TV modulated signals. The following section describes the necessary corrections.

Definition of terms

E_{max} designates the RF peak voltage at the modulation maximum; E_{min} designates the RF peak voltage at the modulation minimum; m designates the modulation factor for symmetrical sine wave amplitude modulation; it is a number between 0 and 1, defined by:

$$m = \frac{E_{max} - E_{min}}{E_{max} + E_{min}};$$

100 m is the percent modulation, between 0 and 100 percent; R designates the modulation ratio for any form of amplitude modulation; it is a number between 0 and 1, defined by:

$$R = \frac{E_{min}}{E_{max}};$$

Modulation factor and modulation ratio are related as follows:

Since $E_{min} = RE_{max}$,

$$m = \frac{E_{max} - E_{min}}{E_{max} + E_{min}} = \frac{E_{max} - RE_{max}}{E_{max} + RE_{max}} = \frac{1 - R}{1 + R}$$

and conversely $R = \dfrac{1 - m}{1 + m}$

Relation between apparent cross-mod and modulation ratio

The definition for cross-modulation assumes that the interfering signal(s) is a TV signal fully modulated down to white level. Since the FCC specifies a nominal white level at 12.5 percent of sync peak, the modulation ratio for such a signal is 0.125.

For sine wave modulation a modulation ratio or 0.125 would correspond to approximately 78 percent modulation since:

$$m + \frac{1 - R}{1 + R} = \frac{1 - 0.125}{1 + 0.125} = \frac{0.875}{1.125} = 0.778$$

Many laboratory signal generators cannot be modulated to this extent, so it is convenient to know the correction that is required for other degrees of modulation.

For a "well-behaved" amplifier or system, mathematical analysis shows that the apparent cross-modulation is given by:

Apparent cross-mod (in percent) = $100\ KE_i^2(1-R_i^2)$

where: K is a constant determined by system distortion

E_i is the rms output voltage of the interfering signal at sync tip.

R_i is the modulation ratio of the interfering signal.

Table K is calculated from this relationship. It shows that correction to be applied when a sine wave modulated signal generator is used to measure cross-modulation in order to find the percent cross-modulation.

This table also shows that with very little error, no correction is required when the modulation on the interfering carrier is between 70 percent and 100 percent. The fact that the interfering carriers on our cross-mod set are modulated 100 percent, for example, introduces no appreciable error.

Determining rms voltage corresponding to peak with sine wave modulation

Since all level measurements with TV modulated signals are expressed in terms of the rms voltage corresponding to sync peak, it is necessary to express levels in these terms when using other forms of modulation if the measurement results are to agree. Where symmetrical sine wave modulation is used, levels are commonly expressed in terms of the rms voltage of the unmodulated carrier. In such a case the rms

Table K: Cross-modulation correction when modulation of interfering signal is non-standard

On interfering signal		To obtain cross-mod corresponding to TV signal modulation:		
% modulation (for symmetrical mod.)	Modulation ratio $\left(\frac{E_{min}}{E_{max}}\right)$	Multiply indicated % XM by:	or	Add dB to indicated XM (in dB)
10	0.818	2.97		9.5
20	0.666	1.77		4.9
30	0.538	1.39		2.9
40	0.429	1.21		1.7
50	0.333	1.12		1.2
60	0.250	1.06		0.5
70	0.177	1.02		0.2
77.8*	0.125	1.00		0.0
80	0.111	1.00		0.0
90	0.053	0.99		–0.1
100	0.000	0.99		–0.1

*Corresponding to full modulation of a TV signal.

voltage corresponding to the peak of modulation can be found from the relation: $E_p = E_c (1 + m)$

where: E_p is the rms voltage at the peak of modulation
E_c is the unmodulated carrier voltage
m is the modulation factor (% modulation ÷ 100).

A field strength meter is usually available and can conveniently be used for measuring output levels. When this is done no correction is needed since the meter measures a modulated signal (with either TV or sine wave modulation) in terms of the rms voltage corresponding to the modulation maximum.

Examples of cross-mod measurement with sine wave modulation

To illustrate the procedure, the cross-modulation in the same amplifier used in the TV signal example was measured using two commercial signal generators. The equipment set-up is diagrammed in Figure 67. The output signals from the two generators, one on channel 2 and the other on channel 13 picture carrier frequency, were combined through a high-pass, low-pass band-splitting filter to prevent one from cross-modulating the other. The combined signals were introduced into the amplifier and the output levels set at +60 dBmV (1 volt rms at modulation maximum) as indicated on the FSM. A modulation frequency of 1 kilohertz and three different modulation settings were used on the modulated generator. For each one the output setting was readjusted to give +60 dBmV output as read on the FSM.

Figure 67

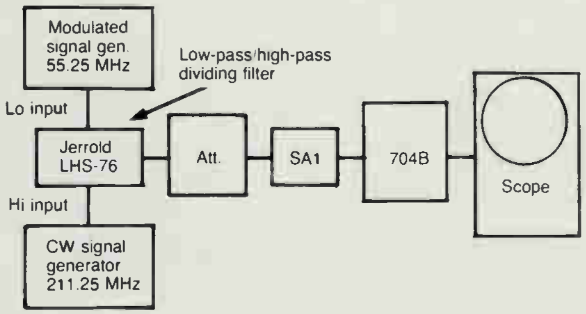


Figure 68: Demodulated output—interfering signal

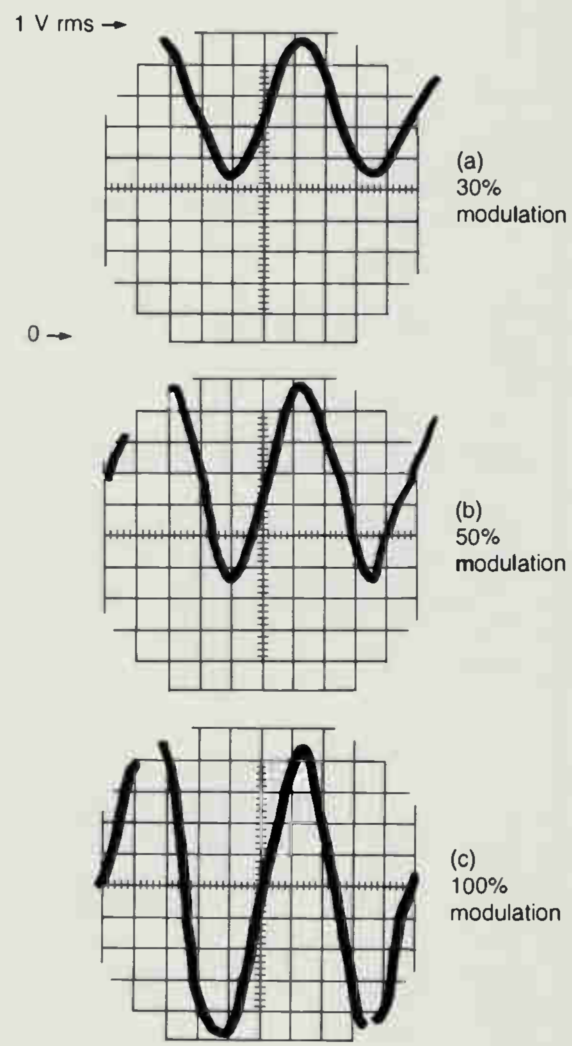


Figure 68 shows scope traces indicating the demodulated output of the FSM when tuned to the interfering (modulated) signal. In each case the scope was operated in the DC mode, with gain and centering adjusted so that 0 input corresponded to the bottom line on the screen and 1 volt rms to the top line. Note that, since the maximum is at 1.0 volt in each case, the voltage at the minimum should equal the modulation ratio (0.54 for 30 percent modulation, and 0.33 for 50 percent modulation).

Figure 69: Demodulated output—CW signal

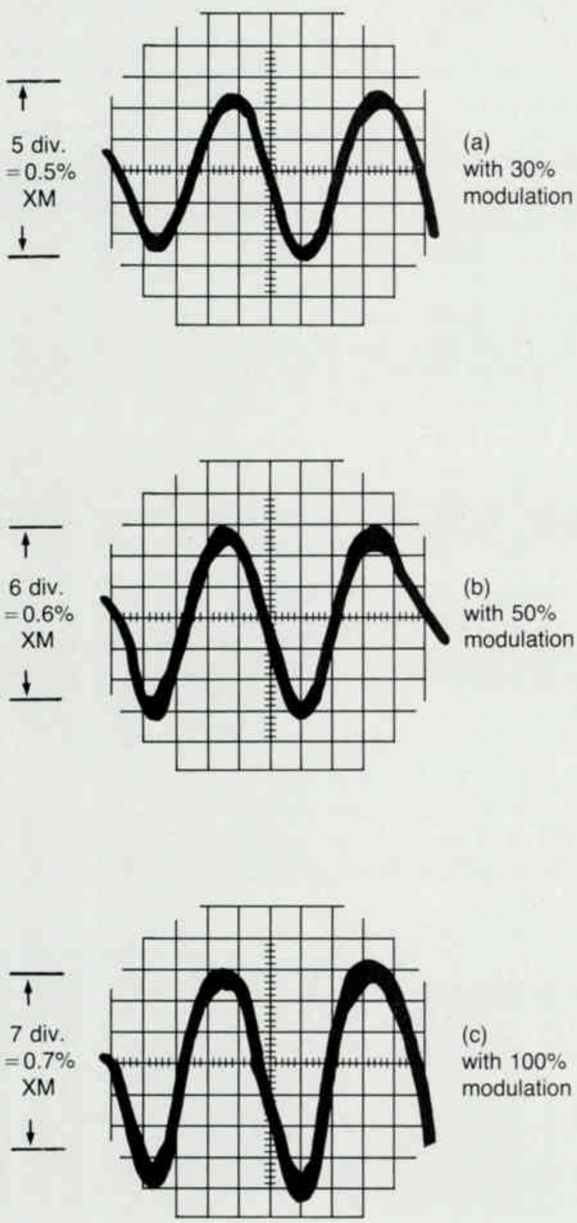


Figure 69 shows scope traces indicating the demodulated output of the FSM when tuned to the wanted (CW) signal. In each case the scope was operated in the AC mode and the gain increased so that each division corresponds to 0.1 percent cross-modulation. Applying the correction factors from Table K to each measurement gives the following result:

% modulation of interfering signal	Apparent % cross-mod	Correction	Corrected % cross-mod
30%	0.5%	1.39 x	0.7%
50%	0.6%	1.11 x	0.67%
100%	0.7%	1.00 x	0.7%

Comparing these results with those obtained on the same amplifier with the cross-mod tester and with TV signal modulation, it is apparent that there was good agreement.

Measuring hum modulation

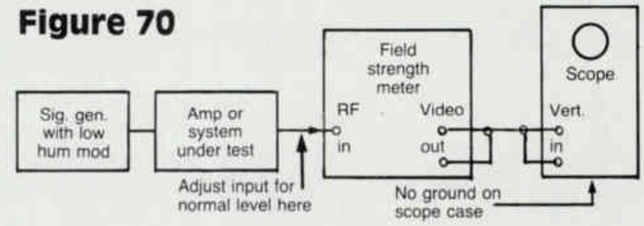
Since most CATV amplifiers are powered with 60 cycle AC, the possibility exists that power supply ripple will modulate the signal going through the amplifier. Hum modulation can show up on the customer's receiver as horizontal bars that move slowly up or down, so it is necessary to test amplifiers and systems to be sure this effect is not present.

With a direct-coupled scope and a hum-free source of CW signal, a 704B field strength meter can be used for measuring hum modulation. Because some hum is inherent in the instrument, the test is limited to relatively high levels of hum modulation (–50 dB or worse). Thus the 704B can be used for testing hum modulation in complete systems, but is not good enough for testing individual amplifiers intended for trunk-line service.

For testing hum modulation, proceed as follows:

1. Connect the signal source to the input of the amplifier or system under test, and the 704B to its output, as shown in Figure 70.

Figure 70



2. Set the source to a convenient frequency (the center of the band is usually a good choice), and adjust its output so the amplifier or system output is at normal level.
3. Connect the video output of the 704B to the scope vertical input with a shielded lead as shown on the diagram. To minimize stray hum loops, be sure there is no other ground on the case of the scope. If it has a three-pin power plug, use a two-pin adapter (which has no ground pin). Sync the scope to the "line" at a frequency of 30 or 60 cycles.
4. Set the 704B to "manual gain" and adjust gain until meter reads full scale (100). Now adjust scope gain and centering so that, with the signal source temporarily disconnected, the trace is on the bottom line of the scope screen, and with the source re-connected it goes up to the top line. Assuming the screen has 10 divisions, this adjustment sets the relation between scope deflection and CW level so that each division on the screen represents a 10 percent change in level. Since hum modulation is usually symmetrical (varying both above and below the unmodulated level) percent modulation follows the rule:

$$\text{percent mod} = 100\ m = 100 \times \frac{E_{max} - E_{min}}{E_{max} + E_{min}}$$

Since the average (or unmodulated) level is $\frac{E_{max} + E_{min}}{2}$,

and the peak-to-peak variation = $E_{max} - E_{min}$, it follows that: $\text{percent modulation} = 100 \times \dfrac{\text{p-p variation}}{2 \times \text{average level}}$

$$= 50 \times \frac{\text{p-p variation}}{\text{unmodulated level}}$$

In this case the scope has been adjusted so that the unmodulated level corresponds to 10 divisions, so:

$$100\ m = 50 \times \frac{\text{p-p variation (in div.)}}{10\ \text{div.}}$$

$$= 5 \times \text{p-p variation (div.)}$$

Thus a peak-to-peak variation of 10 divisions would represent 50 percent modulation, two divisions would represent 10 percent and so on.

5. For convenient measurement, switch the scope to AC coupling without changing the gain, and center the trace vertically. If the percent modulation is so low that it cannot be measured, increase the gain of the scope 10 times.

   Now percent modulation = 0.5 x peak-to-peak variation.

6. To be sure the signal source, the FSM or the scope is not producing a hum indication, it is a good idea to test the system first with the source output connected directly to the FSM. Under this condition, the hum modulation should be well below that measured on the amplifier or system, if that measurement is to be trusted.

Example: The scope tracings in Figures 71 to 74 illustrate the technique.

Figure 71

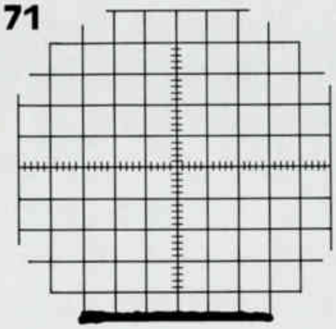


Figure 71 shows the trace at the bottom of the screen with no input to the amplifier.

Figure 72

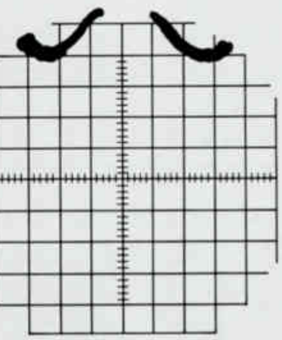


Figure 72 shows the trace with the input set for normal amplifier output, and scope gain is set so the average deflection is 10 divisions.

Table L: Increase of hum modulation in a cascaded amplifier system (worst case: assuming identical amplifier and phased hum)

No. of cascaded amplifiers	To get system mod (dB) add to dB mod for 1 amp	No. of cascaded amplifiers	To get system mod (dB) add to dB mod for 1 amp	No. of cascaded amplifiers	To get system mod (dB) add to dB mod for 1 amp	No. of cascaded amplifiers	To get system mod (dB) add to dB mod for 1 amp	No. of cascaded amplifiers	To get system mod (dB) add to dB mod for 1 amp
1	0	11	20.82	21	26.44	31	29.82	41	32.26
2	6.02	12	21.58	22	26.84	32	30.10	42	32.46
3	9.54	13	22.28	23	27.24	33	30.36	43	32.66
4	12.04	14	22.86	24	27.60	34	30.62	44	32.86
5	14.00	15	23.52	25	27.96	35	30.88	45	33.06
6	15.56	16	24.08	26	28.30	36	31.12	46	33.26
7	16.90	17	24.60	27	28.62	37	31.36	47	33.44
8	18.06	18	25.10	28	28.94	38	31.60	48	33.62
9	19.09	19	25.58	29	29.24	39	31.82	49	33.80
10	20.00	20	26.02	30	29.54	40	32.04	50	34.00

Figure 73

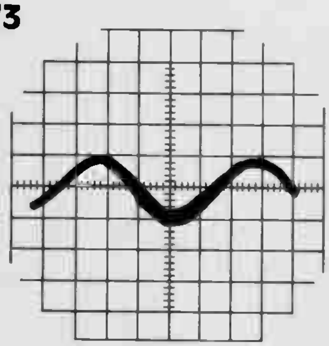


Figure 73 shows the scope trace centered, with no change in gain. The peak-to-peak deflection is two divisions, indicating modulation of 5 x 2 divisions or 10 percent. This degree of hum modulation would be excessive in an amplifier intended for CATV use; the scope trace was made while using an amplifier whose hum had been increased above normal by removing a filter capacitor.

Figure 74

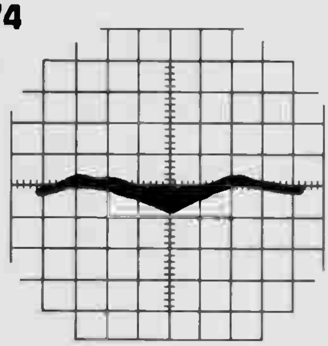


Figure 74 illustrates the hum modulation with a high-grade commercial signal generator connected directly to the input of a 704B. All of the steps have been followed, and the scope gain increased 10x, so the percent modulation indicated, with a deflecton of about 0.7 div. p-p is about 0.5 x 0.7 or about 0.35 percent, which is quite good.

Expressing hum modulation in dB

It is often convenient, particularly when dealing with cascaded systems, to express hum modulation in dB rather than as a percent. The percent figures from measurement are converted to dB as follows:

$$\text{Hum modulation (dB rel. to 100\%)} = 20 \log_{10} \frac{\%\ \text{modulation}}{100}$$

For example:

Hum modulation (dB rel. to 100%)	Percent modulation
-6	50.0
-20	10.0
-40	1.0
-60	0.1

Hum modulation in cascaded amplifier systems

When each one of a chain of cascaded amplifiers produces a certain amount of hum modulation, the system hum modulation will increase directly with the number of amplifiers, unless the phase of the modulation from some of the amplifiers is different from that of others. To be safe, it is good practice to calculate system hum modulation based on the "worst case" where they are all in phase.

In this worst case, the percent hum modulation is doubled each time the number of amplifiers is doubled; or in dB terms, the hum modulation (in dB relative to 100 percent) increases 6 dB each time the number of amplifiers is doubled (i.e., the negative dB number gets smaller). To aid in system calculations, Table L shows the increase in hum modulation for up to 50 cascaded amplifiers.

This chapter of the "Technical Handbook for CATV Systems" is being reprinted courtesy of the General Instrument Corp.'s Jerrold Division. To obtain a complete copy of the "Technical Handbook," send $10 plus $1.50 for postage and handling to: Technical Handbook Order, Customer Service Department, General Instrument Jerrold Division, 2200 Byberry Rd., Hatboro, Pa. 19040. Jerrold customers may place orders with their customer service rep. (Make checks payable to General Instrument Jerrold Division.)

WHO WE ARE

Bruce M. Brown Associates is an executive search firm serving clients in fast growth and high technology industries.

We specialize in the search for exceptional management talent to turn opportunities into achievements.

WHAT WE DO

— We perform a professional consulting service in the search for top management talent. The search process includes these key steps:

— Definition of the position; including the qualifications, specific responsibilities, and performance results of a successful candidate.

— Research of strategically targeted industries and widely diversified sources to identify prospective candidates.

— Evaluation of the very best candidates, both to achieve the position objectives, and to function smoothly within the client's organization.

— Counseling of both client and selected candidate in the presentation and acceptance of a position offer.

HOW WE DIFFER

We offer first hand line experience in defining business objectives and in organizing to achieve performance goals.

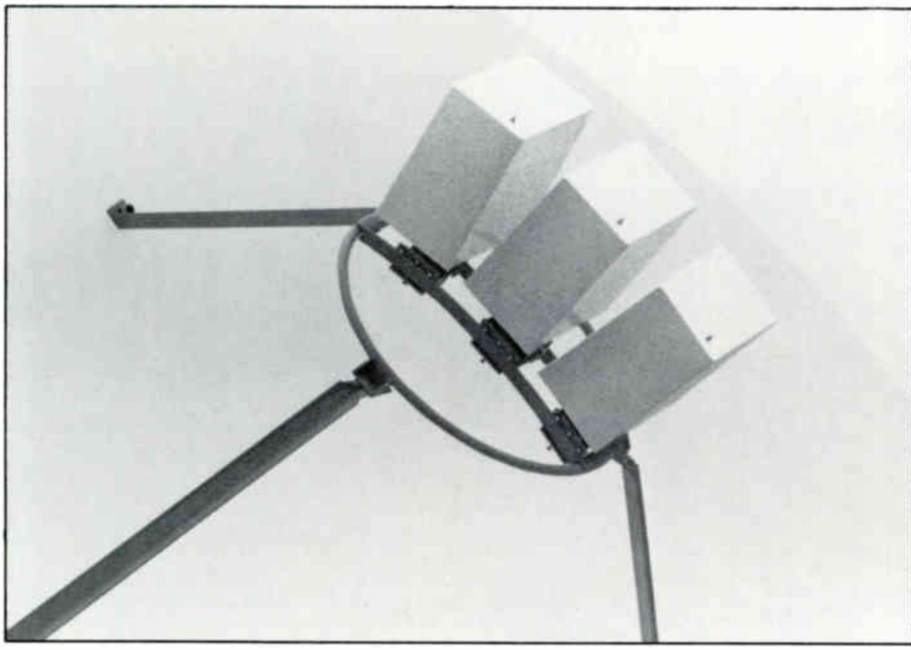
Plus a successful record of consulting services to major corporations engaged in the pursuit of high technology opportunities.

Plus a general management perspective in matching people to organizations and motivating teamwork for high productivity.

Six Landmark Square
Suite 400
Stamford, Connecticut 06901
203 359 5720

— Bruce M Brown Associates

Management Consulting
Executive Search
Organization Planning



Multiple feed system

Microdyne's multiple satellite feed system (MSF) can now be used on Andrew's 4.5-meter and Scientific-Atlanta's TVRO antennas, in addition to Microdyne's own line of satellite communications antennas.

The MSF allows a broadcaster or cable system operator to simultaneously receive up to five satellites on a single antenna, with little or no perceptible loss in the antenna gain. When installed on a 5-meter antenna, isolation between beams is better than 20 dB, with a loss of about 1 dB at 4 degrees off boresight. The MSF can be easily retrofitted, in the field, by changing only the struts and feed support brackets.

For more information, contact Earl Currier, Marketing Department, Satellite Communications, Microdyne Corp., P.O. Box 7213, Ocala, Fla. 32672, (904) 687-4633.

High-speed multiplexer

Infotron Systems Corp. has introduced a low-cost, time-division multiplexer designed to handle high-speed link rates up to 64 kbps. The new Infotron TL300 can handle six synchronous input channels; by connecting additional units to the first two channels, the bit-interleaved TDM can provide up to 16 channels at a single site.

Dip switch settings on the front of the TL300 allow the operator to select line rates and channel speeds. The system's high-speed output link can operate at 16, 32, 48, 56 or 64 kbps. It also provides 64 different combinations of speeds and is available 60 days ARO.

For more information, contact the Communications Department, Infotron Systems Corp., 9 North Olney Ave., Cherry Hill, N.J. 08003, (800) 345-4636.

Microwave retrofits

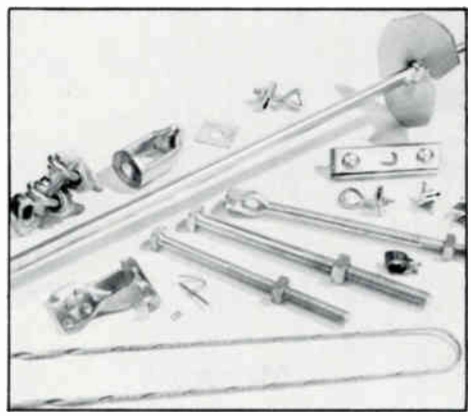
Avantek Inc. has expanded its line of solid-state retrofit kits for traveling-wave tube amplifiers to include several new microwave radio terminals in the 5925-6425 MHz common carrier band.

Designated the AWA-64100 Series, these TWT retrofit kits contain all parts and instructions required to replace the TWT and associated power supply in: Collins MW-109E, MW-109E-1 (Sieman's TWT), MDR-6 (1 for N) and MDR-6 (hot standby); Raytheon KTR-3A, KTR-3E, KTR-3Ts and RDS-6200 (right or left side and data uplink with 56 dB gain); Western Electric TH-1, TH-1 (with 230 V supply) and TH-3; GTE Lenkurt 775A and RCA MM600 microwave radio transmitters. In addition to the significantly improved reliability that comes from a solid-state power amplifier (MTBF of at least 16 years), the retrofits also offer such improvements in performance as a reduction in power drain to less than 3.2 amps at –4 VDC or 1.6 amps at –48 VDC, AM/PM converson of 2°/dB or better, 10 dB maximum noise figure and .25 dB output power flatness. A universal transmitter amplifier fits all listed transmitters in minimizing the need for spares.

The solid-state GaAs FET (gallium arsenide field-effect transistor) power amplifier delivers 10 watts of linear RF output power with 41 dB of gain. To ensure compatibility, the amplifier incorporates a variable attenuator, which permits it to operate with a wide range of input drive levels, as well as providing a variable output power level. It includes its own integral power supply that operates directly from –24 VDC battery plant.

When installing the Avantek retrofit, there is no need for any complicated power-up procedure, according to the company, because the amplifier is simply installed and adjusted for the +40 dBm (10 watt) output power level under actual operating conditions. Compact in size, measuring 16½ inches in length, 6½ inches in width and 4 inches in depth, the retrofit kit is fully FCC type accepted, and its installation requires no FCC notification by the user.

For complete information, contact Scott Hellinge, Avantek Inc., Telecommunications Division, 481 Cottonwood Dr., Milpitas, Calif. 95035, (408) 943-4470.



Line hardware

Poleline Corp., a wholly owned subsidiary of RMS Electronics Inc., announced a new hardware line, the Prestige™ series. The series is manufactured to meet or exceed ASTM specifications. To introduce this line of products, the Prestige™ Series catalog is available. It contains a product index, information regarding standard packaging and shipping weight, a common usage glossary, and illustrations for each product.

Qualified industry personnel may obtain a free copy of this catalog by writing to: Poleline Corp., 20 Antin Pl., Bronx, N.Y. 10462.

Stereo processor

Leaming Industries has developed the FMU622C1 stereo processor for Turner Broadcasting's Cable Music Channel (CMC).

According to the company, the cable operator will find that this versatile unit provides the most sophisticated method of supplying CMC in full dimension stereo to the subscriber. The FMU622C1 state-of-the-art design includes exclusive Leaming user-friendly features, such as agile output frequency, directional coupler, clean RF output, and high density (1.75-inch H) packaging.

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

Barricade tape

A new line of barricade tape was announced by Panduit Corp.'s Electrical Group. The non-adhesive tape is made of flexible polyethylene and is used to warn against temporary hazards. Standard tapes have "Caution" and "Men Working" legends and are printed in black on bright yellow backgrounds. Custom legends and colors are available from Panduit.

The barricade tape attaches easily to posts, walls, and other objects using staples, nails, etc. Standard tape width is 3 inches with 2-inch high legends; standard roll lengths are 200 feet.

For a free sample and further information, contact Manager, Inside Sales, Panduit Corp., 17301 Ridgeland Ave., Tinley Park, Ill. 60477-0981, (312) 532-1800.

Satellite antenna

A new TVRO satellite antenna, introduced by CWY Electronics, offers system operators the opportunity to serve rural areas and markets beyond their density limitations, according to the company, because the antenna is economically priced. Available for leasing, renting or selling options, the antenna's features include a durable, heavy-duty (7 gauge steel) plated frame assembly, baked enamel finish, high quality positioning actuator and a one-piece spun aluminum (H12) reflector with eggshell color baked enamel finish. Antenna diameter permits legal width transporting, and the polar frame and mount maintains the parabolic shape of the antenna. A declination adjustment provides exact tracing of geostationary orbit.

For further information, contact CWY Electronics, P.O. Box 4519, Lafayette, Ind. 47903, (800) 428-7596, or in Indiana, (800) 382-7526.

SMATV modulator

Macom Industries/OEM Enterprises has introduced a new modulator, Model MIF, for use in SMATV applications. The MIF provides IF modulation and loop-through capability enabling a high quality VSB filter to provide harmonic reduction of 60 dB (at 63 dB output) and an extremely flat gain response, according to the firm. The MIF mounts to standard 19-inch racks and is available from stock.

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

Video cameras

Panasonic Industrial Co. introduced a pair of portable cheek rested color video cameras designed for low light applications to capture high-quality video images. The WV-3040 and WV-3050 feature f1.2 lenses, auto white balance and 6X power zoom lenses.

The WV-3050 portable color video camera features auto focus and a power zoom f1.2 lens that needs just 0.7 footcandles to generate an image. The lens has a macro capacity and comes equipped with a 49mm filter. Iris control is automatic. The viewfinder on the WV-3050 is a 1-inch black and white CRT with record review capability. The scanning system is NTSC composite. Automatic white balance is a standard feature. The pick-up tube is a ½-inch 4.3 MHz Mg-St Newvicon; horizontal resolution is 300 lines at the center. The signal-to-noise ratio is 46 dB. The sync system is internal and the video output is NTSC compatible.

Optional accessories for the WV-3050, which weighs only 2.9 pounds, include a lens filter kit, compact tripod, extension cables with stereo audio, and VTR adaptors for BETA VCRs.

Model WV-3040 features a low-light 4.3 MHz ½-inch MT-ST Newvicon tube that needs just 0.7 footcandles to capture a sharp video image. Iris control is automatic, as is the white balance function. The WV-3040 has a 6X power zoom lens with macro function and 49mm filter. Resolution at the center is 300 lines. The S/N ratio is 46 dB and the scanning system is NTSC composite. The unit has a 1-inch black and white CRT viewfinder with record review capability. Internal viewfinder indicators include white balance, VCR battery level and light levels. The WV-3040 weighs just 2.4 pounds, is NTSC compatible and is backed by a line of optional accessories.

For complete details, contact Panasonic, 1 Panasonic Way, Secaucus, N.J. 07094, (201) 348-7183.

Ultra-sensitive mic

The ultra-sensitive MU-6200E super beam microphone from JVC Co. of America doesn't miss a thing, according to the company. Its sharp, horizontal directivity is seven times greater than conventional shotgun microphones. The sensitivity of the MU-6200E measures 50 mV/Pa at 1 kHz with a frequency response from 50 to 15,000 Hz.

Designed for both studio and remote locations, the microphone features continuous variable directivity and remote control of tone and directivity. The remote control unit and an AC power supply are optional. Sound signal can be sent at line level by the built-in amplifier with 15 dB gain. The microphone weighs 4.1 pounds and measures 45 inches in breadth.

For complete specs, contact JVC Co. of America, 41 Slater Dr., Elmwood Park, N.J. 07407, (201) 794-3900.

Cable going down the tube?

By Anthony J. DeNigris
Nationwide CATV Services Inc

In examining the techniques of cable installation in underground applications where conduit is called for, my faith in good old-fashioned, down to earth, and commonsense engineering has been renewed. The appearance on the market of what is referred to in the industry as "Comm-Duct" is, in my opinion, a great step forward in what I like to term "doing underground right." I have always been an advocate of conduit in underground for a multitude of reasons, but especially because of what conduit and now duct, if placed properly, can do for the future of that cable.

Emphasis on procedure

Placement of that tube, which ultimately protects the often abused delicate coax, is critical. I would like to mention at this point, that whatever type of tubing (conventional rigid conduit or the flexible duct) is used, many of the same basic rules apply. Let's review what some of them are:

1) The cable inside must always be protected! This means that all the necessary steps that have to be taken to maintain the integrity of the tubing, must take place. Holes, cracks and similar damage to conduits must be guarded against. Water cannot be allowed to seep in anywhere and build up. If this should happen, and the area has freezing weather, ice will develop inside the tube and either flatten the cable within or burst the tube open from its expanding displacement. In either case the damage is severe.

   One of the most common places water gets into conduit is right inside the pedestal or vault. I have seen exposed ends in numerous systems throughout the northeast, and I might add that especially in vaults, with the conduit stopping at the bottom of the vault (which is a foot or so below the ground level) any good size rain storm will cause some degree of water build-up in the vault. Guess where the water will drain? I also have seen too many conduits left open at the base of poles where they rise to aerial feeds.

2) The turns or bends in the tubing must not be too severe! This rule is not followed merely to obtain an end result in itself; but in situations where cable is to be pulled in at a later date, the proper determination of minimum radii in bends will surely facilitate ease of installing cable at any time in the future. The lack of proper engineering in conduit layout can cause severe damage to cables and conduit at the time of pulling.

   When utilizing the duct with pre-installed cable, care must be taken to assure that one apparent advantage of using duct (and that is its flexibility) is not taken for granted. Applying too tight of a radius in some bends can ultimately kink the cable within, and it will not be readily apparent.

3) Plan for "future-ability." I would think that we have learned our lesson in view of all the rebuild activity that has and is taking place. I am sure that in many systems, a certain degree of "proper" planning for the future some time ago would have allowed for expanded technology to take place without the need for a rebuild today, so to speak. So, when it comes to conduit or duct, leave room for future cables to be pulled in. And this means looking far down the road for what might be contemplated later. It also calls for precise engineering of the present layout considering cable sizes and overall space inside the tube.

Duct vs. conduit

As I have stated earlier, my faith is renewed! Comm-Duct has it all over conventional conduit. The reasons are very simple. Ease of installation is foremost, and virtually any cable configuration can be obtained. I don't care how any rigid conduit was installed, have you ever tried to pull four trunks and four feeders in at once? The craftsmen truly earn their pay at that task. Flexibility and full reel lengths are also some of the special advantages of duct. Rigid conduit is placed in trenches in sections with couplings; and bends for any turn have to be either purchased as sweeps or made on the spot. Labor cost for this service will certainly be higher for conduit and time for installing it will be longer. Don't forget, the added cost of labor for pulling the cable in and the necessity for specialized equipment used in the pull (winches, pullies, etc.), which invariably add to the installation cost.

The cable plow, often considered a piece of equipment that saves the labor cost of trenching and restoration, can be used quite effectively to put in Comm-Duct. By doing so, the advantages of a conduit system may be obtained for a relatively slight increase in cost due to the fact that flexible duct can be plowed in. However, my own opinion as far as plowing duct in is that it should be limited to the smaller size ducts; and in fact is limited by practicality of size by design.

As for strength in the overall analysis of the two systems, it should be understood, however, that rigid conduit is just that! The rigidity of schedule 80 PVC conduit makes for a system, that, if installed right, will outlive the designers of the system and their kin. Back to the basic thinking that probably led to the Comm-Duct product in the first place. It eliminates numerous problems in installation and allows for a better future-ability aspect as well. But, I might add, that planning for the use of duct is a little tricky. What I am talking about here is the putting together of the footages of each configuration of cables that are going to be installed, involves accurate measurements on the system maps and the tallies taken have to be precise to the utmost degree. There may be some runs of cable that might not allow for the purchase of limited amounts of duct due to their relative shortness.

'If you can use flexible duct instead of conduit. . . the cost savings will be great and the system more trouble-free'

However, when all is said and done, if you can use flexible duct instead of conduit and you do the proper planning, the cost savings will be great and the system more trouble-free.

Although I have seen versions of cable in duct used in applications where in short runs—say for instance 250 feet between pedestals in apartment complexes—the cables were installed in polyethelene tubing on the site, it was just recently that engineers designed a way for longer "ducted" cable lengths to be supplied.

Anthony DeNigris is president and chief executive officer of Nationwide CATV Services Inc. The company is a complete service CATV construction firm offering engineering, consulting, aerial and underground plant construction, headend and system design.

Larry Cockrell has been named vice president, eastern division, for **Zenith Sales Co.**, a division of Zenith Electronics Corp. He succeeds **J. Philip Reichmann**, who was named senior vice president, sales-distribution, Zenith Sales Co. Cockrell joined Zenith in September 1982 as a regional sales manager for consumer electronics products. Prior to joining Zenith, Cockrell held sales management and marketing positions with Amana Refrigeration Inc. Contact: 1000 Milwaukee Ave., Glenview, Ill. 60025, (312) 391-8181.

Roger Poirier, Canadian Cable Television Association director of engineering since spring 1982, has been named vice president, technology and planning. The appointment, effective immediately, was approved by the association's Executive Committee and marks the first phase in implementing the CCTA Board of Directors' plan to augment and strengthen its engineering and planning capacities. Contact: 405, 85 rue Albert St., Ottawa, Canada K1P 6A4, (613) 232-2631.

McDonaugh

W. Lawrence McDonough has been named national sales manager at **Panduit Corp.** McDonough, who formerly held the position of Chicago district sales manager at Panduit, joined the company in 1978 as a salesman. Contact: 17301 Ridgeland Ave., Tinley Park, Ill. 60477-0981, (312) 532-1800.

Chatman

Lawrence Chatman Jr. was recently named product manager-video teleconferencing products for the newly formed Telecommunications Sales Division of the Broadband Group of **General Instrument Corp**. Prior to joining General Instrument, Chatman was product manager of OEM video tape recorder equipment for RCA Broadcast Video Systems in Camden, N.J. Contact: 2200 Byberry Rd., Hatboro, Pa. 19040, (215) 674-4800.

C-COR Electronics Inc. has hired **Ben Dody** as president of its Anaheim, Calif., power products operation. Dody will be responsible for managing and directing every aspect of the Anaheim plant. Prior to joining C-COR, Dody was president of Sawyer Industries, Arcadia, Calif., for five years. Prior to that he held operations management positions with Bell & Howell and the Bonded Structures Division of Simplex Industries. Contact: 1240 N. Blugum, Anaheim, Calif. 92806, (714) 630-6750.

Joseph Preschutti, vice president-engineering for C-COR, has been elected a senior member of the Institute of Electrical and Electronics Engineers Inc. Preschutti joined C-COR in 1972 as a design engineer. He was promoted to chief engineer in 1977, to director of engineering in 1979 and to vice president-engineering in 1983. Contact: 60 Decibel Rd., State College, Pa. 16801, (814) 238-2461.

Larry Nicholas has been appointed to the new position of public relations manager of **Ampex Corp.**'s Audio-Video Systems Division. Nicholas comes to Ampex from Bozell & Jacobs/PR, where he was account manager for clients such as ITT/Qume and Cromemco Inc. He also has served in staff and management positions with J. Walter Thompson, Varian, Santa Clara County Transportation Agency, GTE-Lenkurt and the US Army-Europe.

Ampex also announced that **M. Michael D'Amore** has been appointed business manager-video recorders for its Audio-Video Systems Division. D'Amore was previously midwest regional sales manager for the division. Prior to joining Ampex, he was with Hitachi Broadcast Systems Inc. Contact: 401 Broadway, Redwood City, Calif. 94063, (415) 367-4423.

Goldman

Compucon Inc., a subsidiary of A.C. Nielsen Co., announced the appointment of **Scott Goldman** as director of business development for Communications Services. Goldman, who most recently was in Compucon's Communications Marketing Research Group, has been actively involved in the communications services business since 1973, acting as director of operations and sales manager for two radio common carrier companies in Texas. Contact: P.O. Box 809006, Dallas, Texas 75380-9006, (214) 680-1000.

Richard Hagan recently joined **Casat Technology Inc.** as accounting manager. He comes to Casat from M/A-COM MVS Inc., Burlington, Mass., where he was most recently senior cost accountant and financial analyst. Contact: 6 North Blvd., Unit 5, Amherst, N.H. 03031, (603) 880-1833.


THE PERFORMANCE KIT
Patent pending
• Custom fiberglass cover protects all electronics
• Measured* multibeam satellite antenna performance at 3°
• Over 300 installations world-wide, including most major MSO's
• Performance kits available for these antennas:
Scientific-Atlanta All models
AFC All models
Comtech 5 meter
Hughes All models
Anixter-Mark 5 meter
Fort Worth Tower All models
Andrews 4.5 meter
Harris All models
Prodelin 4.5 meter
Microwave Specialty All models
Gardiner 5.6 meter
*Patterns available for all these antennas
Superior Satellite Engineers
(916) 791-3315

Are you technically obsolete?

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

Technological obsolescence occurs to more than old pieces of equipment; it happens to people just as easily. Not just senior people, it can happen at any age and at any position—from installer to vice president of engineering.

And as with equipment obsolescence, cable technical personnel do not become technologically obsolete overnight with a thud. It comes on ever so slowly and quietly.

Despite the best efforts of our Federal Communications Commission regulators, trade journals, the National Cable Television Association, the Society of Cable Television Engineers, state associations and internal company memos, many of us just are not taking enough time to keep abreast with our ever-increasing complex technical industry. When did you last attend a national technical seminar? How many month's worth of unread trade journals are sitting on your desk right now?

An apple a day

Keeping up is a day-by-day task for today's cable field. It cannot effectively be done at yearly conventions (although they are extremely important) or monthly staff meetings. Those who have even tried to take a pile of magazines home to read over the weekend know how poorly that works.

Time needs to be set aside every day to browse not just through the primary industry technical journals, but carefully read all the many, well-written articles on today's key technical issues: FCC regulatory matters, pay security, addressability operations, quality assurance, signal theft, set-top repair, test procedures, stereo TV—to name a few. Even if they do not seem important to some today, they are likely to be important sooner than you think. When they do, you often will not have the luxury to read and absorb the information in today's more tranquil pace. Many articles will require multiple readings to grasp the full value (like *Communications Technology*'s August articles on "Feedforward" by Joe Preshcutti and Colin Horton, "Increasing channel capacity" by Paul Brooks and "Module change outs" by Fred Rogers). Some articles will require a note pad to help digest the concentrated information or to keep track of questions or ideas specific to your operations. Sometimes a meeting of other technical minds within your organization might be called for to more fully discuss those questions or ideas.

Library

It is useful to maintain a small but organized library of trade journals and other reference books. Usually keeping the primary technical trades for three years, along with up-to-date classic CATV and electrical engineering handbooks, and SCTE and NCTA publication sets, will make an excellent start. Often, advanced articles refer to other previous (usually more basic) articles that will aid your overall understanding. Today's technical development pace almost guarantees that the backup information will be contained in your three-year term library.

Added to your library might be the current vendor catalogs of those you are presently doing business with or those you expect to do business with. The included manufacturers' specification sheets are a reference tool whose value is not to be underestimated when resolving countless technical topics.

You can lead a horse to water...

Of course, these tips are by no means an exhaustive game plan to ward off personal technological obsolescence. Buy they will serve as a good start for the initiated.

As the old saying goes though, "You can lead a horse to water, but you can't make him drink." This is very true with personal technological obsolescence. All of the libraries, books, articles, seminars, conventions and memos in the world are worthless if unread. It seems one of the prime reasons technical personnel do not make time to keep up with new developments is they are totally unaware that they are slipping ever so steadily behind.

There is another saying, "Insight is the first step to recovery." Usually it is an event like being passed over for a promotion, or worse, caught in a RIF (reduction in force) that jolts someone's realization as to how well they measure up in today's cable industry.

The following quiz is presented as a means to privately assess your technological obsolescence. Hopefully, insights gained through this quiz will provide the same stimulation to take corrective action, but without the panic of the more recurring motivator—loss of job.

Cable obsolescence quiz

This is a quiz of your present knowledge and alertness to changing CATV technology. It should be answered in your "as is" closed book status if your final results are to be of value to your own personal assessment.

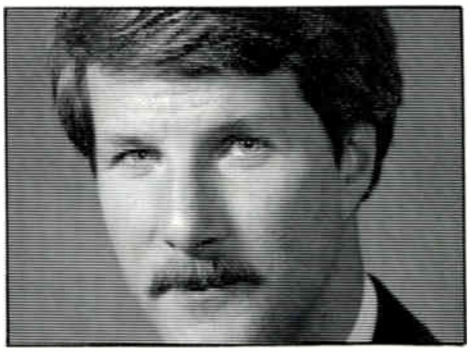
Technical knowledge

1) 10 volts across a 20 ohm resister would cause how many amps to flow?

a) 200 c) .2
b) 20 d) .5

2) 10 -5 watts in a CATV distribution cable equals how many dBmV?

a) 28 c) 53
b) 34 d) 14



3) What is the approximate half dipole length of a resolute dipole operating at channel E picture carrier frequency?

a) 20 inches c) 18 inches
b) 4 inches d) 54 inches

4) What is the formula for predicting the composite triple beat performance at the end of "N" identical CATV amplifiers if the single amplifier performance is known?

5) Is it possible to predict the relative level of a single second order distortion product at the end of a 20 identical amplifier cascade?

Yes No Maybe

6) Is the improvement credited to harmonically related carriers ______?

a) measurable
b) only subjective
c) a combination of both

7) In normal foam coaxial cable, how does attenuation vary with the temperature of the cable?

a) inversely
b) directly
c) not enough to worry about

8) How is an amplifier's distortion performance related to its gain?

a) high gain = high distortion
b) low gain = high distortion
c) depends on some other factor

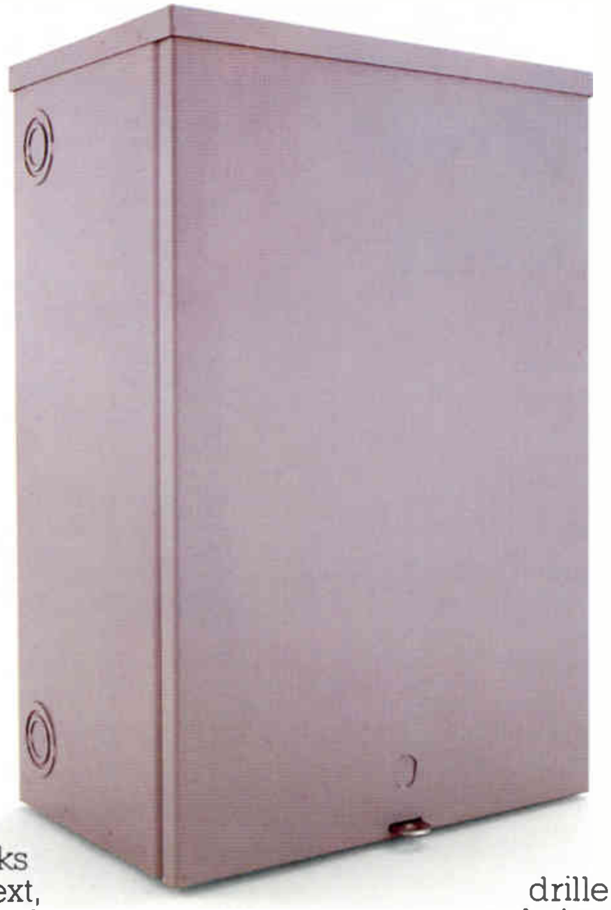
9) In cable television amplifiers, an equalizer is used to ______

a) compensate for amplifier characteristics
b) compensate for cable characteristics
c) compensate for losses

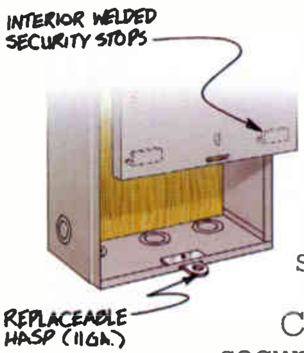
10) If no converter is supplied to the subscriber, Class I visual carrier frequencies shall be maintained 1.25 MHz ± ______ above the lower frequency boundary of the channel.

a) 10 kHz
b) 25 kHz
c) 250 kHz
d) unregulated

Details Enclosed



Since one multiple dwelling enclosure looks pretty much like the next, you have to take a close look at the details. And when you do, you'll find that CWY has designed significant advantages into every apartment security box.

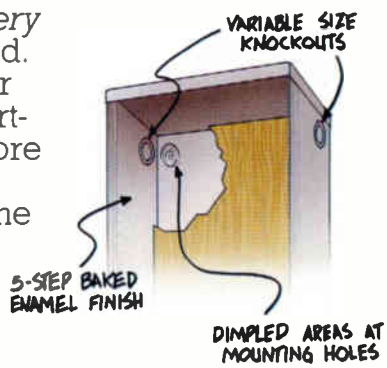


For example, CWY's all-welded enclosures are constructed of heavy 16-gauge aluminized steel—shown to outlast unpainted galvanized steel *at least five-to-one.* For added security, CWY enclosures feature security stops welded inside the front cover...a hingeless, secure cover removal system...knockouts for optional cam locks...and extra heavy-duty plated 11-gauge *replaceable* hasps.

Plus, CWY enclosures are pre-drilled to accommodate the revolutionary CWY Omni-Rack™ system, which uses a unique panel and rail design to make apartment boxes more orderly, secure and serviceable. The Omni-Rack means quick and easy audits and subscriber status changes. Your service personnel save time, so you save money.

And while you're looking at detail, don't forget the bottom line. You'll find CWY's enclosures to be *very* competitively priced.

So take a closer look at CWY's apartment boxes. For more information about CWY's complete line of enclosures and other cable TV solutions, write or call toll-free today.



Not just supplies. Solutions.

CWY electronics

P.O. Box 4519—Lafayette, IN 47903—Call Toll Free: 1-800-428-7596—Indiana: 1-800-382-7526

RELIABILITY.

Hamlin's 66 channel cordless remote convertor.

Available with built-in descrambling

Hamlin CR-6000
66 channel cordless
remote, handheld
channel selector.

FEATURES OF HAMLIN'S CRX CONVERTORS

1. 66 channel capacity (450 MHz).
2. Easy to read channel display (LED).
3. Recentering fine tune control.
4. Will operate in non-standard (offset) systems.
5. NTSC, HRC and IRC frequency configurations.
6. Available with built-in descrambling. (CR 6000M).
7. Available with A/B switch on remote unit for dual cable operation (CR 6000D).
8. Designed for hard use.
9. Infra-red wireless remote control.
   a. instantaneous channel selection
   b. on/off control
   c. high sensitivity switch for remote channel selection
   d. accelerating scan up-down channel select
   e. favorite channel memory

Call our toll free "Hot Line"

800-323-0436

In Illinois call 1-(800) 942-0905

ANIXTER COMMUNICATIONS

In an emergency, weekends and holidays or after 5 p.m., call toll free 1-(800) 323-8166.
CORPORATE OFFICES: ANIXTER BROS., INC. 4711 Golf Road, Skokie, IL 60076, (312) 677-2600