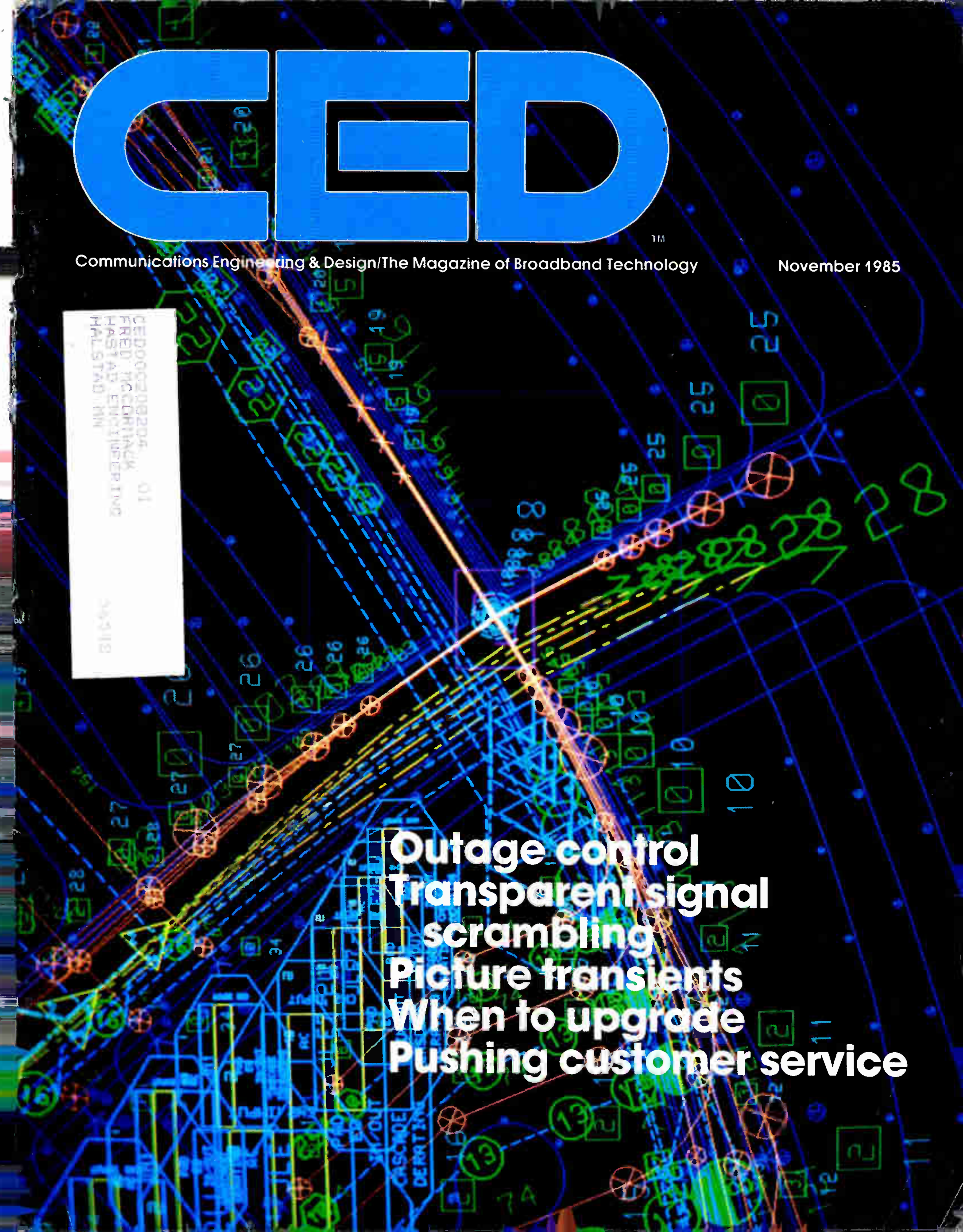

CED™

Communications Engineering & Design/The Magazine of Broadband Technology

November 1985

Outage control
Transparent signal scrambling
Picture transients
When to upgrade
Pushing customer service

The TEN DEMANDMENTS

With the FCC's intensified enforcement of signal leakage limits, you can't afford questionable quality or erratic sensitivity in a leakage detector for your system. That's why it pays to heed our Ten Demandments and not simply settle for any leakage detector.

I

Demand High Sensitivity.

You'll need all you can get, so demand *the* detector with -86 dBmV sensitivity.

II

Demand Ease-of-Use.

Make sure it's lightweight and portable. With simple controls. And no separate transmitter required for operation.

III

Demand Quality.

With proven reliability. Documented field success. Plus support from a major US CATV/electronics company.

IV

Demand Full Frequency Capability.

Be sure you can choose a detector for *any* channel frequency—from 54-300 MHz.

V

Demand Metered Readings.

For quantifiable results and measurements—not just basic "leakage/no leakage" indications.

VI

Demand Frequency Trim Adjustment.

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Demand Audible Tone Alarms.

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VIII

Demand "Standards," not "Accessories."

Be sure you get all necessary equipment—a near-field probe, tuned dipole antenna, AC charger/adapter, headphones, and 50-hr.-rated rechargeable batteries—as standard.

IX

Demand Quick Delivery.

Be sure you can get your detectors in a matter of weeks—not months.

X

Demand the Tracer.

Don't take chances with either the FCC or with any other detector. Demand the *only* leakage/detector that can meet the Ten Demandments. Demand The Tracer.

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Reader Service Number 1

Remember, back in 1951, when TV stations were low in power and antennas not very efficient? Milton Jerrold Shapp, the founder of Jerrold, didn't realize he was helping to create a new industry when he developed an amplifier that Bob Tarlton needed for his Lansford, PA community antenna system.

Cable was new, but it grew rapidly. And Jerrold grew with it, developing improved amplifiers, channel equipment, and numerous innovations that increased revenue potentials for operators, and established Jerrold as the leading supplier in the industry.

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Rebuilding? Save Money With JERROLD

Expand the bandwidth of your system - and your revenue-producing channel potential - simply by dropping in Jerrold STARLINE® SJ-330 modules. This quick and easy upgrade to 330 MHz can help you maximize your revenues and requires:

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And Jerrold has other possibilities for you too. For longer cascades and greater channel capacity, there's Jerrold Century III Feedforward amplifiers and the Jerrold STARLINE X Series. Whatever your specific needs, there's a reliable, low-cost Jerrold product to satisfy them.

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JERROLD
You know we'll be there.

Reader Service Number 2

GENERAL INSTRUMENT

CED™

November 1985

About the cover

Our cover photo represents the Mapping and Graphic Integrated Computer (MAGIC) System developed by Terry Hulseberg of SecaGraphics, Golden, Colo. Multiple-exposure photo taken by Earl V. DeWald.

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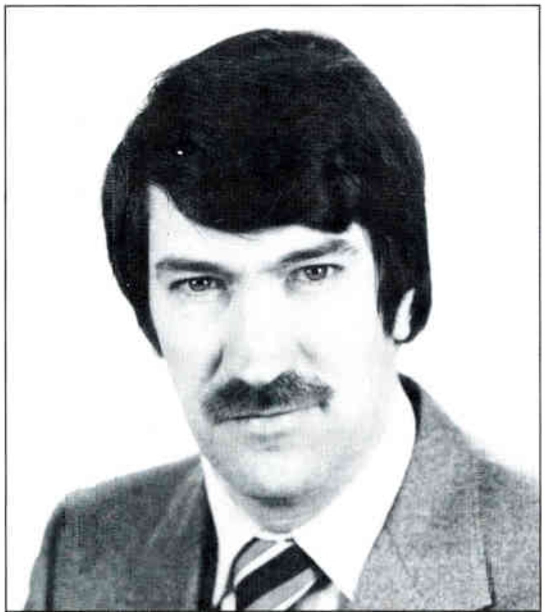
BPA



Roger Poirier

What is the most regulated industry in Canada? According to Roger Poirier, vice president, technology and planning, at the Canadian Cable Television Association, it's got to be cable. "In Canada, cable is part of what is called the Broadcasting System. Both cable and broadcast television must operate under the Broadcasting Act. Its goals include protecting Canada's cultural sovereignty, which it feels is threatened by too much American programming," Poirier explains.

As a result, Canadian cable operators are not permitted to carry any U.S. pay channels and are strictly limited on which U.S. basics they can offer. But programming isn't the only area the Canadian government has a tight hold on. Pay-per-view and commercial advertising on cable are both prohibited and, until recently, obtaining permission for a rate hike sometimes took up to two years.

To make matters worse, Canadian cable operators are finding themselves in competition with SMATV, or private cable, systems which offer American signals—both pay and basic—aplenty. And just when it seems the situation can't get much worse, backyard DBS dishes are springing up like wildflowers after a spring rain.

"A growing number of Canadians are simply opting out of our Broadcasting System. They can't see what they want on cable or broadcast TV, so they just go out and buy a home satellite dish or VCR, most of which are American-made. So where is the benefit to Canada, culturally or economically?" Poirier asks.

"We have to start asking ourselves if the cultural and social goals under the Broadcasting Act are still relevant considering the latest developments in technology. People now have access to a much greater flow of information than when these goals and regulations were first drafted.

"You just can't set a double standard for Canadians for very long. If people are allowed to obtain American programming from SMATV operators or with their own satellite dish, then cable must be allowed to offer the same programming. Our industry needs the freedom to compete on an equal footing if we are to survive and prosper in the long term," Poirier insists.

"There is a growing recognition that both cable and broadcast interests are being threatened by VCRs, TVROs and SMATV systems. Whereas broadcast TV used to perceive cable as its biggest threat, we're both in the same boat now. We are going to have to adapt and work closer together, or it is not going to make good business sense for anyone.

"The best way to even out the playing field is to allow cable access to, if not exactly the same programming (as SMATV), then at least more American programming. Barring that, our reaction is: Enforce the programming regulations for SMATV systems as effectively as they are being enforced for cable systems."

But Poirier cautions, "You must realize that, politically, this is not a popular stance for the government to take. It doesn't want to go out and prosecute SMATV systems who are providing their customers with exactly what they want. And we don't really like being perceived as the cry-baby cable operators, pressuring the government to prosecute the SMATVs. After all, our goal is to have the same programming freedom, not to deny the Canadian people the signals they want. But if the government refuses to let us play by the same rules, we must insist it enforce the current rules for everyone fairly."

"There is certainly nothing inherently wrong with the cultural and social goals the Broadcasting Act laid out. But if there is no way to enforce the regulations needed to meet those goals because of technological developments, then we might as well adapt and see how we can best benefit our country as a whole—economically and socially.

In spite of all its problems, Poirier is optimistic about the future of cable television in Canada. "We will continue to be a positive industry because we have the population support. Nobody in Canada really likes cable—except the subscribers! All 5 million of them. Many large systems have close to 90 percent penetration. And any business that manages to get into 90 percent of Canadian homes must be doing something right."

—Lesley Dyson Camino

Baud = bps?

The article titled "Addressable Modems" by Ken Leffingwell of Scientific-Atlanta (*CED* 9/85) contained an important error that rippled through the otherwise informative article.

I refer to the use of the term "baud" as a synonym for "bits per second (bps)." This may appear to be a minor issue, but it is one that I, as a data communications consultant, find to be a problem throughout the industry and the literature. Baud refers to signals per second, which is only indirectly related to bit transfer rate. The number of baud and bits per second is the same *only* if a single bit is transmitted per signal, which is typically not the case with modems operating above 300 bps. For example, most 1,200 and 2,400 bps modems operate at 600 baud, while 4,800 bps modems operate at 1,200 baud.

Nyquist's theorem implies that signalling in excess of 6,000 baud (or so) is not possible over a telephone company local loop (bandwidth 300-3,300 Hz). Thus, while 9,600 bps modems over dial-up lines are available, I would not trust any advertisement for a 9,600 baud modem over dial-up lines!

This may be viewed as a minor error in terminology, but I have found that terminology errors such as these tend to foster conceptual errors.

Thank you for your attention and your fine journal.

Gary C. Kessler,
Hill Associates, Inc.

Baud ≠ bps

Thank you for the opportunity to respond to Mr. Kesslers comments regarding my article "Addressable Modems," which you recently published.

The statements made by Mr. Kessler defining the difference between bits per second and baud rate are accurate. In this industry, which is full of buzz words and acronyms, terminology is too often chosen out of habit rather than precision.

I apologize and stand corrected.

Ken Leffingwell,
Applications Engineer,
Broadband Communications Division,
Scientific-Atlanta

Oops

I received my September issue of *CED*, and what to my wondering eyes should appear but an article by Allen Kirby on "Amplifier/equalizer basics." What is especially interesting is this article is a word-for-word copy of two separate items I wrote for a training manual several years ago. I have enclosed a copy of the manual, including illustrations and the table of contents.

You will note the astonishing resemblance these items bear to Kirby's article. Should you desire further confirmation of the origin of this work, there are a number of people I could have contact you.

I do not hold *CED* responsible for this situation, as you have no way of knowing who originated an article submitted to you. But I would appreciate the record being set straight. I find it amazing that Kirby would submit another person's work as his own. I do not seek any compensation, however. If the information presented in the article helps anyone, I am happy.

I have also enclosed a complete copy of my original training manual, which you are welcome to use in any way you see fit.

Paul Deckman,
Warner Amex Cable Communications

Our apologies to Mr. Deckman. It's an embarrassing situation that, thankfully, occurs only rarely. Never rarely enough to spare egg on an editor's face, however.

Correction

CED *regrets the omission of the Magnavox Model WP-900 modular standby power supply unit from the product profile chart in our September 1985 issue. The WP-900 uses a ferro-resonant transformer in both the utility and the standby modes, which can supply up to 15 amps of load-current at 60 volts rms in a quasi-square waveform. Given an input voltage between 90 and 130 VAC, or a battery input voltage between 31.5 and 42 VDC, the transformer will keep its output voltage between 58 and 61 VAC when supplying a load-current between 4 and 15 amps.*

Magnavox's WP-900 operates on a 36 volt system (three batteries), is short-circuit proof and features a status monitoring interface (DSS). Regulation for the WP-900 (no load to full load) is ±2 percent maximum, and normal to standby transfer time ranges from 8 to 16 msec. The physical dimensions of the Magnavox power supply are 26 inches x 17 inches x 14 inches (H x W x D).

For more information about the Magnavox WP-900 standby power supply, please call 315/682-9105.

Volume 11, No. 11

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In Perspective

You know they're behind you when you've got arrows in your back

James McKinney, FCC Mass Media Bureau chief, was shelled recently by municipal franchising officers. Speaking at their annual convention, he defended deregulation of the agency's technical rules. The audience returned heavy fire immediately.

Not everyone there indicated they were having trouble with their local cable company. But a vocal percentage did.

And let's face it. Some of the heated complaints are justified. Bill Daniels took the podium a bit later in the program, and even he admitted that while some companies are really good and others are fair, others need to improve.

Now, don't get me wrong. I'm not saying every charge is justified, that all the bad apples are on the operator side of the fence. That isn't true. But, by and large, franchising authorities are probably trying to do their job well—as are most operators.

The point is that the industry's recent success in the regulatory and legal arenas is not a license to pillage. It's a challenge to prove that we're a responsible industry capable of providing ever-improving service without the burdens of technical or economic regulation.

The FCC wants to take its technical rules off your backs. The agency says it trusts the marketplace enough to let you find your own way. That's great.

The FCC also has warned local regulators that the intent of proposed relaxation of agency technical rules is just that—and not a way to establish 50 or more sets of different rules. That would make life exceedingly difficult for vendors and operators alike.

The point is simply that you are about to be tested. You've already been given a chance to show that signal leakage rules can safely be relaxed.

But now you've got to earn the right to operate that way. You've got to prove to the FCC, state and local regulators and the FAA that you can manage your network and your business responsibly.

Some of you already are paragons of virtue. And some of you are doing all right. Perhaps you have a few things to work on but, by and large, nothing serious is amiss.

But some systems are going to put live rounds in the hands of those who would shoot you back to second-class citizenship. That kind of behavior isn't responsible. It isn't good business, and it will make life difficult for everybody else.

So, put your customers first. Care about them, find out what they really want and meet their needs. And don't think we're the only industry that can benefit from doing this.

Many of the more thoughtful pieces about U.S. productivity and competitiveness have pointed out that we tend to focus more on cost-cutting, efficiency and quick profits than providing better service. In some cases we've probably been marketing what we want to sell instead of what the customer wants to buy. And we can do better—lots better.

So, if you don't want arrows in your back, handcuffs on your wrists and mortar fire raining down on you head, use your freedom responsibly. It can always be taken away.

Gary Y. Kim

Behind every Panasonic® cable converter lies 25 years of cable know-how.

Cameras. Switchers. Monitors. Video recorders. You name it. For over two decades Panasonic has been supplying high-quality video components to both the broadcast and cable industries. In fact, we've been supplying CATV converter components for years.

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For your subscribers who want remote control, there's a Panasonic converter with a full-function infra-red control unit that fits snugly on the converter when it's not in use. You can also give them 15-channel memory for easy tuning. Two-speed up and down channel scanning. Even an optional parental guidance key for controlling the channels children watch.

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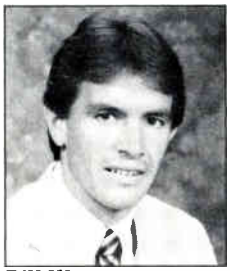
Industrial Company

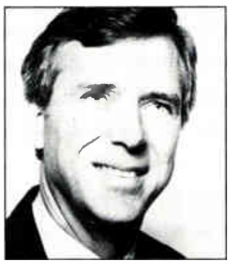
Reader Service Number 6

People



Bill Kloss

Trilogy Communications welcomed several new sales managers: **Bill Kloss**, national sales manager; **Mann Bush**, West Coast regional sales manager; **Bill Herrin**, Rocky Mountain regional sales manager; **H. Gene Faulkner**, Southwestern regional sales manager; and **Bruce Lane**, Southeastern regional sales manager. In addition **Rick Jubeck** was appointed customer service manager, and **Allan Fedor**, general counsel.



Curtis Neumann has been appointed vice president/general manager of AUGAT/ES-P Inc. Prior to joining AUGAT, Neuman was vice president/general manger of the customer services division of Data Products Corp.

Frank Blaha was appointed director of sales and marketing of the Broadcast Microwave Operation of the Harris Corp. His duties include responsibility for domestic and international sales, support, marketing, customer service, system engineering and program management.

John Shaw assumed the position of marketing manager, cable products, at Regency Electronics Inc. Shaw comes to Regency from Wavetek, where he was sales manager of the communications group.

Richard Perry, recently named president and CEO at C-COR Electronics Inc., announced the appointment of **Thomas Mathai** as vice president, sales and marketing. Prior to joining C-COR, Mathai was vice president, office message services, at Western Union Corp.

Anixter Bros. Inc. announced the elevation of several of the company's top executives and the addition of an outside director. **Alan Anixter**, president and chief executive, became chairman and remains CEO. Three vice chairman were elected: **William Anixter**, senior executive vice president; **James Anixter**, executive vice president and assistant to the president and **Bruce Van Wagner**, president of Anixter Communications and executive vice president-international. The chairman and three vice chairman comprise a newly formed executive committee.

John Pigoot, executive vice president, administration, was elected president of Anixter Bros. Inc., the parent company. **John Egan** was named president of Anixter Communications, and **Robert Wilson** became president of Anixter Wire and Cable.

Anixter's Board of Directors also has been expanded with the election of **Scott Anixter**, an independent investor.

R.L. Drake Co. announced three executive promotions. **Ronald Wysong** has been promoted from president and chief operating officer to president and chief executive officer. **Merl Powell** was named senior vice president, product development and marketing. **Tom Gardner**, formerly vice president, finance, assumed the role of senior vice president, chief financial officer and treasurer. Chairman Peter Drake, on announcing the promotions, commended the executives for their hard work and commitment.

Matthew Miller has been appointed vice president, science and technology, for Viacom International Inc. Dr. Miller succeeds Frank Bias, who retired after 15 years of service with the company. Bias will continue to act as a consultant for Viacom. Dr. Miller joined Viacom in 1984 as director of science and technology.

Synchronous Communications named **Al Johnson** as national sales manager. Johnson, formerly of Catel, will be responsible for the introduction of the company's new line of FM modems, used for data and video transmission.

Marvin Blecker was appointed vice president, engineering, of the communication systems division of Times Fiber Communications Inc. Blecker will direct all advanced development and design engineering of the Mini-Hub II product line. Prior to joining TFC, Blecker was director of systems engineering and development for COMSAT's Satellite Television Corp.

David Spaulding has assumed the position of vice president of engineering at Sytek Inc., supplier of broadband LAN products. Most recently, Spaulding was vice president of engineering for GTE SPRINT Communications. Spaulding will be responsible for product development and management of Sytek's engineering staff.

Emily Bostick

William Johnson

Microwave Filter Co. Inc. named **Emily Bostick** executive vice president and director of sales and marketing. Mrs. Bostick will direct sales, direct mail and marketing plans at the company. Her husband, Glyn, is founder and president of MFC, but it was she who suggested the company enter the cable market. In addition to her new duties, Mrs. Bostick is corporate secretary and a member of the executive committee of the board of directors.

Microwave Filter also announced the appointment of **William Johnson** as vice president and director of engineering. Johnson joined MFC in 1980 and was named chief engineer in 1983.

Gerald Goldman has joined Sadelco Inc. as vice president, marketing. Goldman's experience in RF distribution systems dates back almost 20 years. Most recently, he served as general manager of the telecommunications division of Tele-Wire Supply Corp.

LRC Electronics Inc. announced the appointment of **George Ornelas** to product manager for its Vitek product line. Ornelas will assume responsibility for promotion, development of new products and markets and will act as liaison between the company and its customers.

Also at LRC, **Paul Zauner** was named field support specialist. Zauner was formerly regional manager for the Midwest Augat-Broadband communications group.

Limited Offer! Sept. 1 thru Dec. 15, 1985 Reduced introductory price and free freight!

Channell's CPH-508 5-inch pedestals...Reduced introductory price and free freight!

Here's your chance to save big bucks on Channell's new 5-inch CPH-508 pedestals.

For a limited time, you can purchase any quantity of Channell's CPH-508 pedestals at an introductory price of just **$10.50** ($11.50 with bracket)—**A savings of almost 20%.** And Channell pays the freight!

Designed for housing **Magnavox, Scientific-Atlanta,** Regal, RMS and other taps, or for above ground service wire applications, the CPH-508 provides cost savings of 5% per mile of plant (even more at this special price) and offers added features found only in Channell's complete line of enclosures:

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- High security locking system.
- "TV" permanently molded into top hood.
- Available in light green, beige, or dark green.

This special offer is available only directly through Channell. There is no distributor participation. Minimum order is 12 units and contract or blanket orders are good only through December 31, 1985.

To take advantage of this introductory price **and** free freight, don't delay. Call Channell today—toll free—1-800-423-1863 (818-963-1694 in California).

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Reader Service Number 7

Satellite scrambling

The cable transparency question

By Graham S. Stubbs, Vice President, Science and Technology, Oak Communications Inc.

The NCTA's recent proposal of a consortium to implement a common scheme for scrambling of satellite-delivered television signals and the sale of those signals to backyard TVRO owners has sparked new interest in the scrambling technology that will be required. As adoption of a standard for scrambling becomes more likely, it is appropriate to examine these satellite signals and, in particular, the paths by which they eventually reach the consumer.

In most cases, the satellite-delivered signal will be retransmitted, in one form or another, via coaxial cable. In the case of cable systems, this entails reception at the headend with subsequent transmission through distribution equipment (trunk, feeder and drop cables). For SMATV systems, it requires reception and distribution through homerun or loop-through wiring within apartment buildings, hotels, etc.

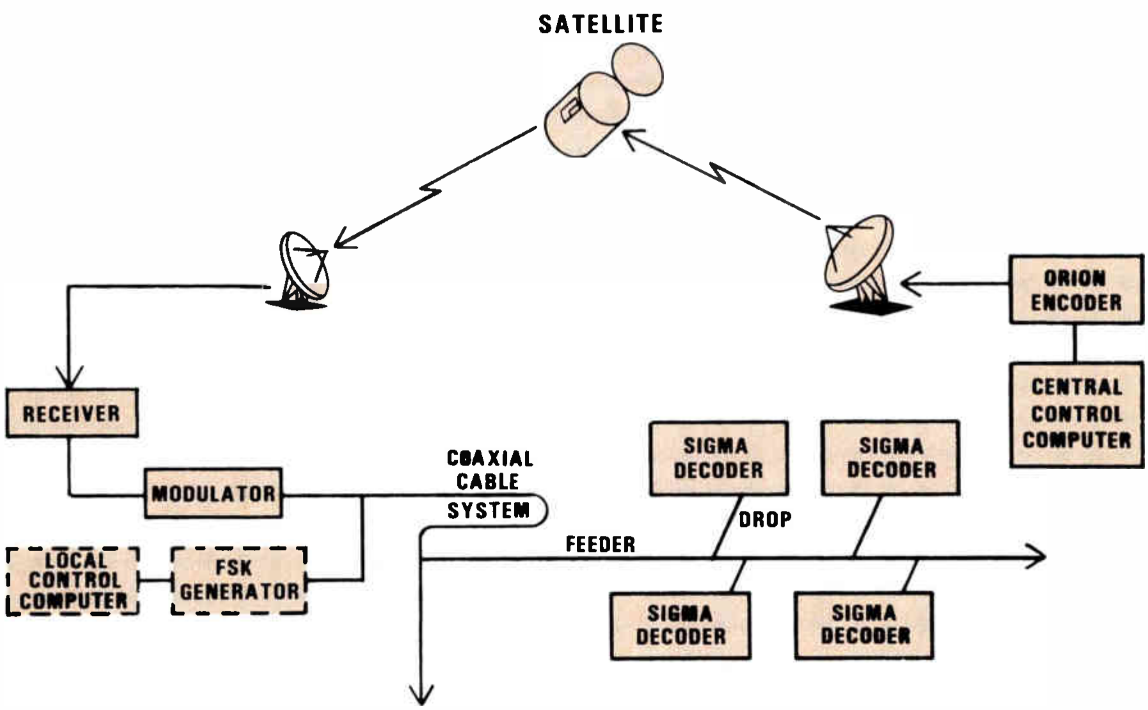
Many larger cable systems are already equipped for individual control and delivery of premium signals using addressable hardware. For these systems it is sufficient to descramble the satellite-delivered signal at the cable headend and rescramble it using their existing facilities.

Headend descrambling of satellite-delivered signals is not always necessary, however, to provide service for subscribers of cable systems which are not already equipped with cable scrambling equipment. Neither is it necessary to descramble satellite signals before distributing them in an SMATV system.

Transmission of the satellite scrambled signal through the cable network or SMATV system can provide a very secure way to deliver premium programming to individual subscribers without the need for rescrambling—provided the scrambling technique is "transparent" to the existing cable plant and can be treated as just one more television channel. Transmission of the satellite-encoded signal through cable also can provide control and billing without the cost of computer control systems—an especially important factor for smaller cable systems and SMATV installations.

The scrambled components of satel-

Figure 1
Encoded signal transparency system configuration



DYNAMIC DUO

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Thousands of CATV, SMATV, and broadcast operators everywhere have placed their trust in DRAKE's professional equipment — and for good reason. Our name has been synonymous with excellence and reliability in the communications field for many, many years.

And this proud tradition continues with our professional VM2410 Modulator and ESR2240 Earth Station Receiver. Operated together or separately, the VM2410 and ESR2240 are an unbeatable choice for solid dependability and performance.

The DRAKE VM2410 Modulator

With the Drake VM2410 a single modulator provides 60 channel frequency agility. A simple push of a button will set the VM2410 output to any VHF Broadcast, Mid-Band, Super-Band and Ultra-Band channel up to 400 MHz.The VM2410 also features video low pass and IF SAW filtering for reliable operation in the most crowded systems. A full 57 dBmV output ensures maximum performance.

The DRAKE ESR2240 Earth Station Receiver

A true step ahead in design technology. Some of the ESR2240's outstanding features include fully synthesized transponder and subcarrier selection, block down conversion with our BDC-24 Block Converter or LNB, IF loop-through for easy multiple receiver installation, SAW filtering for maximum interference rejection and adjacent channel performance, full signal metering on front panel — and much more.

When the bottom line is reliability, long-term service, and simple peace of mind — demand a DRAKE!

Call or write us today for more information.

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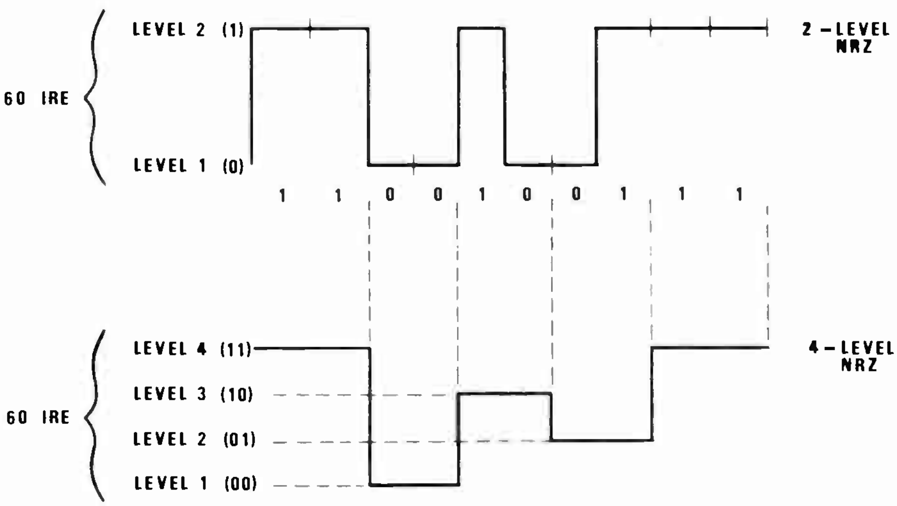
Reader Service Number 9

Figure 2
Coding: two-level versus four-level



lite signals can be transparent to cable and SMATV systems if the signal coding is correctly designed. The Oak ORION-NET System, which has been proposed in response to the NCTA's Request for Proposals, uses an encoded signal specifically designed for transparent operation through both the satellite and cable transmission paths. Not all encoded television signals designed for satellite applications can be readily distributed via cable, however.

During the ORION-NET development, a number of criteria were used to evaluate the potential for trouble-free operation in a variety of cable and SMATV environments. Table 1 lists these criteria and the corresponding ORION-NET signal and equipment characteristics.

Cable headend modulators designed for vestigial sideband modulation of signals in a 6-MHz-wide RF channel naturally impose frequency response limitations and distort signals which exceed the video spectrum of standard NTSC transmission. To be effective, a transparent system must restrict video signals and audio (carried as bursts of high-speed data) to the standard NTSC video spectrum.

Existing cable systems, especially smaller ones and SMATV systems, must work using the existing standard channel plan; signals which inherently require additional bandwidth are not readily usable.

Cable systems, both large and small, also are subject to a variety of transmission imperfections, some of which are especially harmful to the high-speed data used to encode audio and addressing/control information in highly secure scrambled signals. The signal encoding scheme must be forgiving of delayed echoes, noise and other distortions.

As the security of the scrambled signal increases, so does its complexity—the result can be a very complex (and expensive) decoder. ORION-NET uses third-generation devices already developed for Oak's mature Cable SIGMA scrambling system.

With increasing emphasis on "user friendliness," cable operators are looking forward to truly cable-compatible television receivers which will handle channel tuning and use a module for descrambling a baseband signal provided through a connector on the set. Compatible use of ths EIA Interface Plug would represent the ultimate in signal transparency.

Coaxial cable transparency of scrambled satellite signals is perfectly feasible, but only if the scrambled signal is designed for transparency from the beginning.

Signal coding

In selecting an encoding technique for satellite television signals, a number of stringent requirements must be met. Some of the mandatory features are:

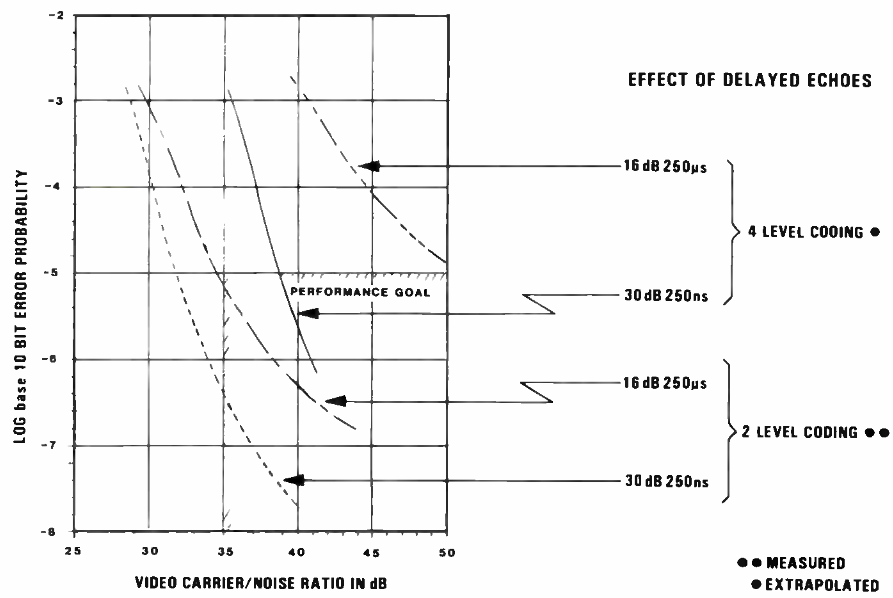
- **Security:** The system must be immune to any anticipated attack—now or in the future.
- **Control:** Conflicting requirements exist for addressable control of TVRO/SMATV decoders and affiliate headend equipment. The system must meet these requirements and provide for future growth.
- **Signal Quality:** Studio quality signals, including stereo, must be delivered to cable headends.
- **Reliability:** Continuous high-quality service must be provided to the consumer.
- **Penetration:** To achieve maximum penetration, satellite television signals must be delivered to the consumer through many different transmission media in addition to their paths through space.

In order to meet security and stereo audio requirements, the systems being seriously considered employ digitized encrypted audio encoded into the horizontal blanking interval. These bursts of high-speed data require particular care in system design.

Table 2 illustrates some of the signal coding techniques considered during early development of ORION-NET in light of the desire for a coaxial-cable-transparent system. The factors involved in each of these techniques are discussed below:

- Multiplexed Analog Components (MAC) coding of television was developed in Europe for high quality delivery of television signals by separating the luminance and chrominance portions of the picture for transmission. This technique uses sequential transmission

Figure 3
BER for HBI data symbol rate 4.1 Mbps



of the color and luminance signals, sending each of these signals in a shorter time interval than NTSC. This necessarily requires increasing the video bandwidth. The wider video bandwidth, in turn, demands increased RF bandwidth for cable transmission, making this technique incompatible with standard channel plans. Thus, it is difficult to mix MAC and NTSC signals for use in cable or SMATV plants.

● While analog scrambling of NTSC video solves the video bandwidth problem, digital encoding of stereo audio presents another challenge. Leaving the active video intact allows only a very restricted window of time in which to transmit the digital audio messages. An efficient method of digital coding is required and four-level coding (Figure 2) provides such efficiency. Data is sent as symbols represented by any of four discrete amplitude levels. Each symbol represents two successive bits; thus, the bit rate is twice the symbol rate. Symbol rates of 3.58 MHz easily can be transmitted within the required spectrum and, incidentally, are convenient for lock reconstruction of color burst.

Because the transitions between symbols are small (only one-third the amplitude of two-level coded signals), four-level coding is particularly vulnerable to echoes arising from mismatches in coaxial cable, especially when the echoes are combined with system noise. Four-level coding was rejected outright for ORION-NET (and Oak's Cable SIGMA) for this reason.

● Data transmission at twice the color burst rate (7.16 Mbps) using two-level coding also was given careful consideration. Two-level NRZ coding is much more robust than four-level in a cable

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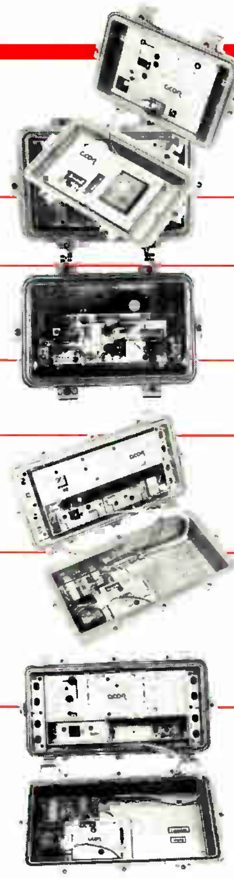

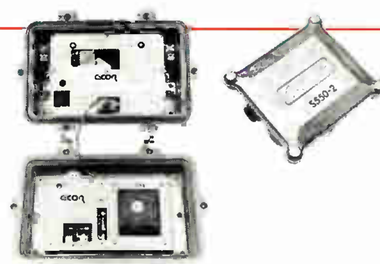

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Table 1
Transparency

Criteria for evaluating the potential for a satellite scrambled signal to be transmitted through cable without descrambling at cable headend.

CRITERION	ORION-NET CHARACTERISTICS
Sensitivity to headend processing/ interface with headend equipment	Maximum data rate (4.09 Mb/S) is well within standard NTSC video spectrum. Needs clamp modification to standard cable modulators.
Compatibility with existing frequency plans	RF Bandwidth same as NTSC signal.
Sensitivity to distribution system imperfections (echoes, noise, etc.)	Data format same as SIGMA with proven cable operation. Works through AML.
Complexity of cable decoder	Similar to the Oak Sigma Decoder.
Future interface with cable-compatible TV receivers	Data and scrambling formats already tested during EIA interface development.

environment. However, the high bit rate (much higher than teletext's 5.75 Mbps) places onerous requirements on the phase linearity of headend equipment and increases the cost and complexity of the logic circuits and tuning portions of the home encoders. For the same reason, it also makes the ultimate goal of TV receiver transparency more difficult to meet.

- The coding selected for ORION-NET uses the same bit rate (4.09 Mbps), filtering (raised cosine) and amplitude (60 IRE) as the Oak Cable SIGMA system and assures cable transparency in the same way. The 4.09 Mbps data rate is derived from the 3.58 MHz color burst (8/7 ratio). SIGMA has been providing trouble-free service for two years. The data rate is compatible with headend equipment and permits transmission within the standard 6 MHz channel with acceptable bit-error-rate performance.

Bit error rate

In an encoded television signal using video scrambling and encrypted digital audio and control information, the high-speed digital data is the component most vulnerable to cable transmission imperfections and distortions. When a digital channel is severely impaired, the results can be devastating.

Impairment to data transmission is commonly measured as bit-error-rate (BER). For acceptable reception of encrypted digital audio, a BER of 1 in 10^5 is considered satisfactory, assuming some form of detection, cancellation or concealment of errors is included. The ORION-NET system uses audio data rates on the order of 250 kbits/second; thus 1 in 10^5 represents 2.5 errors per

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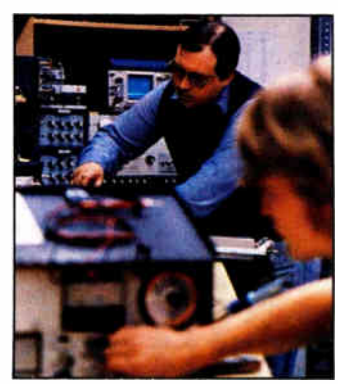

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Reader Service Number 15

Table 2
Signal coding considerations

REF.	ACTIVE VIDEO	HBI AUDIO DATA SYMBOL RATE/CODING	COMMENTS
I	M A C (MULTIPLEXED ANALOG COMPONENTS)	7.16×10^6/ SEC. 2 LEVEL	VIDEO B.W > 6 MHz OCCUPIES MORE THAN ONE RF CHANNEL.
II	N T S C (WITH HBI AUDIO DATA)	3.58×10^6/ SEC. 4 LEVEL	UNACCEPTABLE PERFORMANCE WITH EVEN MODERATE CABLE ECHOES.
III	N T S C (WITH HBI AUDIO DATA)	7.16×10^6/ SEC. 2 LEVEL	UNACCEPTABLE PHASE DISTORTION IN HEADEND AND RECEIVER EQUIPMENT.
IV ●	N T S C (WITH HBI AUDIO DATA/ WITHOUT COLOR BURST)	4.09×10^6/ SEC. 2 LEVEL	DESIGNED ESPECIALLY FOR CABLE OPERATION WITH PROVEN RECORD.

● SELECTED FOR ORION-NET

second on average.

Four main sources of bit errors affect an amplitude modulated signal transmitted through a cable network:

- **Delayed echoes:** These arise from multiple reflections (multipath) between mismatches. Echoes are particularly likely to occur in cable drops and building wiring and can be as large as 16 dB below the desired signal. Delays typically range between 100 nanoseconds and 1 microsecond in duration and can last up to several microseconds.
- **Noise:** It is really echoes in combination with system noise which cause the most serious deterioration of BER performance. Good cable plant is designed for a carrier-to-noise ratio in the range of 43 to 45 dB or better. However, some margin for temporary degradation must be built into the system. Only a few dB change in carrier-to-noise ratio can cause BERs to increase by several orders of magnitude, resulting in total loss of the audio channel. For ORION-NET and SIGMA, a C/N of 35 dB in the presence of -16 dB multipath of any delay or carrier phase has been established as the worst-case criterion.
- **Phase distortion:** Headend equipment and converters or TV receivers all can contribute to phase distortions and carrier phase jitter, further degrading BER.
- **Interference:** Ingress of interference and interference from amplified distortions also can affect the BER of digital signals passed through a cable system.

Figure 3 illustrates the effects of some of these factors on the BER of digital audio signals used in ORION-NET. The design goal for the system is to work with no noticeable degradation in audio performance (no worse than 10^{-5} BER) under the following conditions:

- Carrier-to-noise ratio = 35 dB
- Delayed echo amplitude = -16 dB (with worst case delay time and carrier phase).

The curves for ORION-NET's two-level coding demonstrates acceptable performance even in the worst case. Note that these curves are from practical measurements and include the effects of headend and receiver filters as well as phase jitter and clock recovery phase lock loop performance.

Also note that the curves for four-level coding (extrapolated using relationships derived theoretically) show totally unacceptable performance at any C/N in the presence of a -16 dB echo. Echo cancellation circuits are theoretically possible, but extremely costly if intended to work well with multiple echoes.

The data rate and format selected for the ORION-NET encoded signal is the same as for Cable SIGMA. By measurement, and by practical operating experience, this scheme has been shown to provide a reliable cable-transparent signal. For additional details on this application, the reader is directed to the references listed below.

Conclusion

Cable engineers should not underestimate the importance of ensuring that a scrambled TV signal selected for satellite transmission also can be passed through coaxial cable without impairment. Neither should it be assumed that all systems currently being proposed for satellite scrambling are designed for cable transparency. They are not!

Coaxial cable transparency of scrambled satellite signals is perfectly feasible, but *only* if the scrambled signal is designed for transparency from the beginning. Cable transparency of satellite-scrambled signals cannot be applied as an afterthought.

Design decisions relating to the digital data used for control signals and audio transmission are fundamental to cable transparency of a satellite scrambling system. There is now sufficient practical cable experience with scrambled signals using digital audio to indicate what the critical parameters are and to show that the necessary criteria can be met. Scrambled signals with data rates and formats appropriate to satellite scrambling have been performing reliably in cable for several years using the Oak SIGMA system. CED

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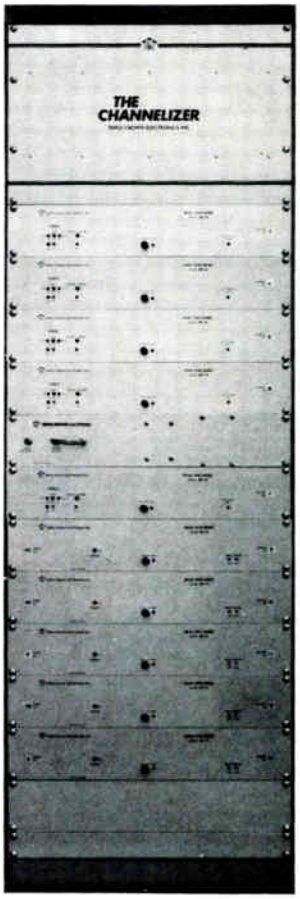

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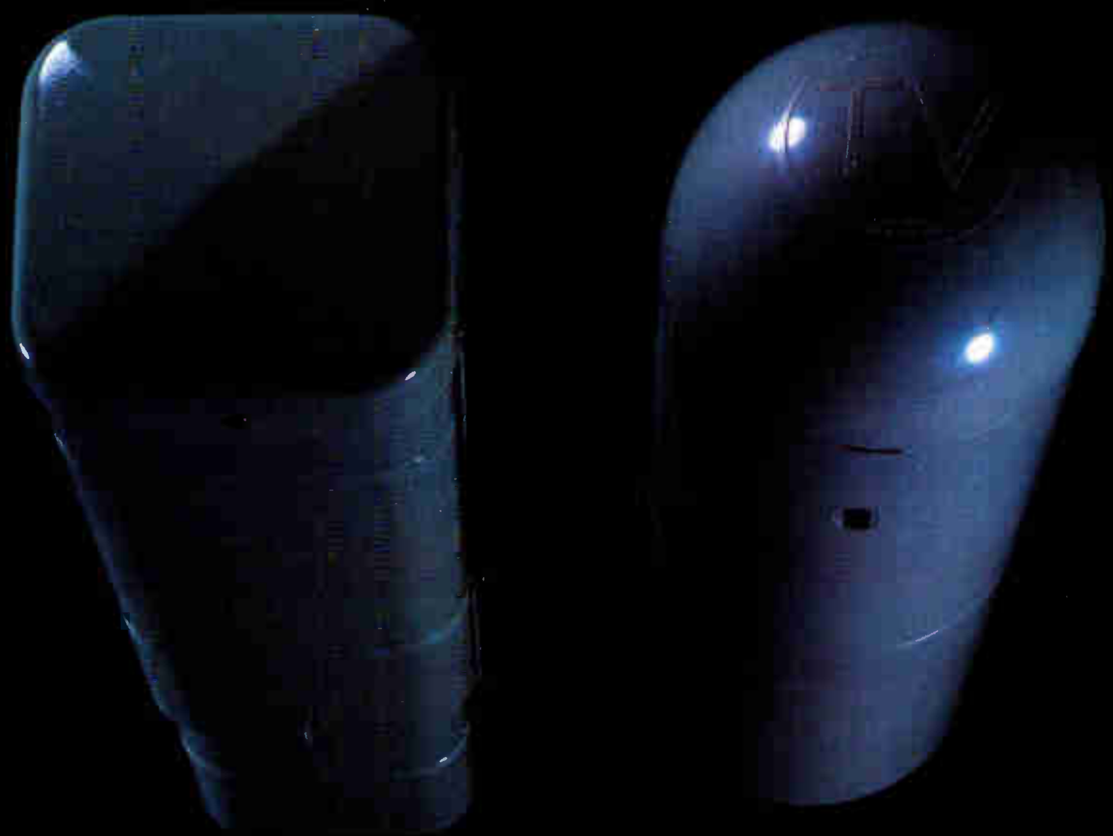

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OUTAGE CONTROL

Part One

By Roy Ehman,
Director of Technical Services,
Storer Communications

With the majority of frantic franchising and massive building operations behind us, cable has entered an age where marketing and efficient system operation, both from a customer service and a technical standpoint, must take their rightful place as our top priorities. One technical aspect that shows up in the top three subscriber complaints is continuity of service or, what we call, outages. Our customers resent short breaks of three to four seconds or up to a minute or two as well as outages ranging from half an hour to several hours. The former usually are caused by necessary changes, such as an equalizer or an amp module, and obviously should be kept to a minimum. If a large percentage of plant is to be affected, these self-induced outages should be programmed to take place in the early morning hours. If the breaks are to be frequent or prolonged, subscribers in the affected areas need to be kept informed using your own character generator channel, bill-stuffers or the press as appropriate.

One can empathize with a subscriber who settles down to watch a movie and, after investing an hour of his time and interest, is cut off for the next 40 minutes or more by an outage. Typically, we rationalize the situation away by saying that outages are a fact of life and most of them are beyond our control anyway since they are mainly caused by:
a. malfunctioning equipment (dead amps)
b. an accident of some kind (truck hit pole)
c. an act of God (lightning)

Actually, there is much that can be done to reduce both the number and duration of outages. Some of the suggestions below may sound labor intensive; but if we are in this game for the long term, we need to "go the extra mile."

The outage defined

Some terminology would be helpful at this time. For instance, what exactly is the difference between an outage and a service call? This is important for proper record keeping. A service call is a situation where *individual* subscribers call in because they are having reception problems with one or more of our services. An outage has occurred when a *group* of subs is completely off for any reason (usually for the same or similar cause).

It also is helpful to differentiate between a major outage and a minor outage. This definition may vary between MSOs, but it should come close to being major for any outage involving trunk or greater, with all others classified as minor. Another definition which helps clear some confusion is that of the system impairment. This refers to a (large) group of subscribers who, instead of all being off, all have impaired reception—probably for the same cause. Here again, a breakdown into major and minor categories is helpful.

The dispatch function

Let's start by talking about the role of the dispatcher in an outage situation. The importance of the dispatcher and the dispatch function tend to be greatly underestimated. When you stop and think about who actually is running your system (plant) from minute to minute, especially after the office closes, it is the dispatcher. Even the best answering service is a poor substitute for a real live dispatcher who is answerable to the Company, who knows your system and who can take the right action immediately. It is difficult to comprehend the systems that shut down tight at 5 p.m. and leave their several million dollar investment during *peak viewing hours* to an answering service that cannot do anything but add to the list of service calls.

Surprisingly, it is cost efficient to keep a dispatcher on until 11 or 12 p.m. Not only is he available to handle an outage promptly and appropriately, but he just has to walk one or two customers through a fine tuning procedure, for example, to save two truck rolls and his evening shift is justified. He also can be responsible for certain building security functions, setting up the next day's routing (in systems where this is done manually) and finalize any of the day's dispatch paper work—time sheets, vehicle logs, etc. This unloads some of the paperwork from the day shift, enabling them to concentrate more fully on responding to the radio and incoming reception-problem calls. The latter is important if we are to cut down on wasteful "no-problem" type calls and increase "problem-solved-by-phone" scores.

The dispatcher also should monitor and log all channels once an hour and take action on any degraded signals. His monitoring facility should include a hard-wired non-adjustable VU meter or similar to assist in evaluating sound levels. The problem of severely mismatched modulator audio levels has been with us for many years without a totally effective solution. If the headend is convenient to the dispatcher, he can adjust the incoming levels of these out-of-spec audio signals (not the modulators!). None of these tasks can be performed by an answering service, and the cost of their service could better be used to help offset extended dispatch hours.

Dispatch is the ongoing, active link with all our field personnel and, as such, the duty person ideally should have technical knowledge and experience equivalent to the technicians under their control. The first person to become aware of an outage usually is the dispatcher unless you have all incoming lines entering via the switchboard or, worse yet, going to the customer service representatives, who usually are not qualified to handle outages and have no means of interpreting the incoming information or dispatching appropriate manpower and equipment to the correct area.

In order to handle outages properly, it is necessary to have a phone directory listing under the heading of "reception problems" with two or more direct lines going to dispatch or other designated person(s) with the time and the qualifications to handle reception problems and outages. In

In less than 20 minutes...

It's 7:30 p.m., Friday night. A drunk driver has taken out a third of the system. It happens to be the part where the Mayor and his City Council live. After an hour has elapsed and one hundred and eighty-seven names and addresses have been taken down by the answering service, they finally decide to call someone. They call the first name on the list—the chief tech. No reply.

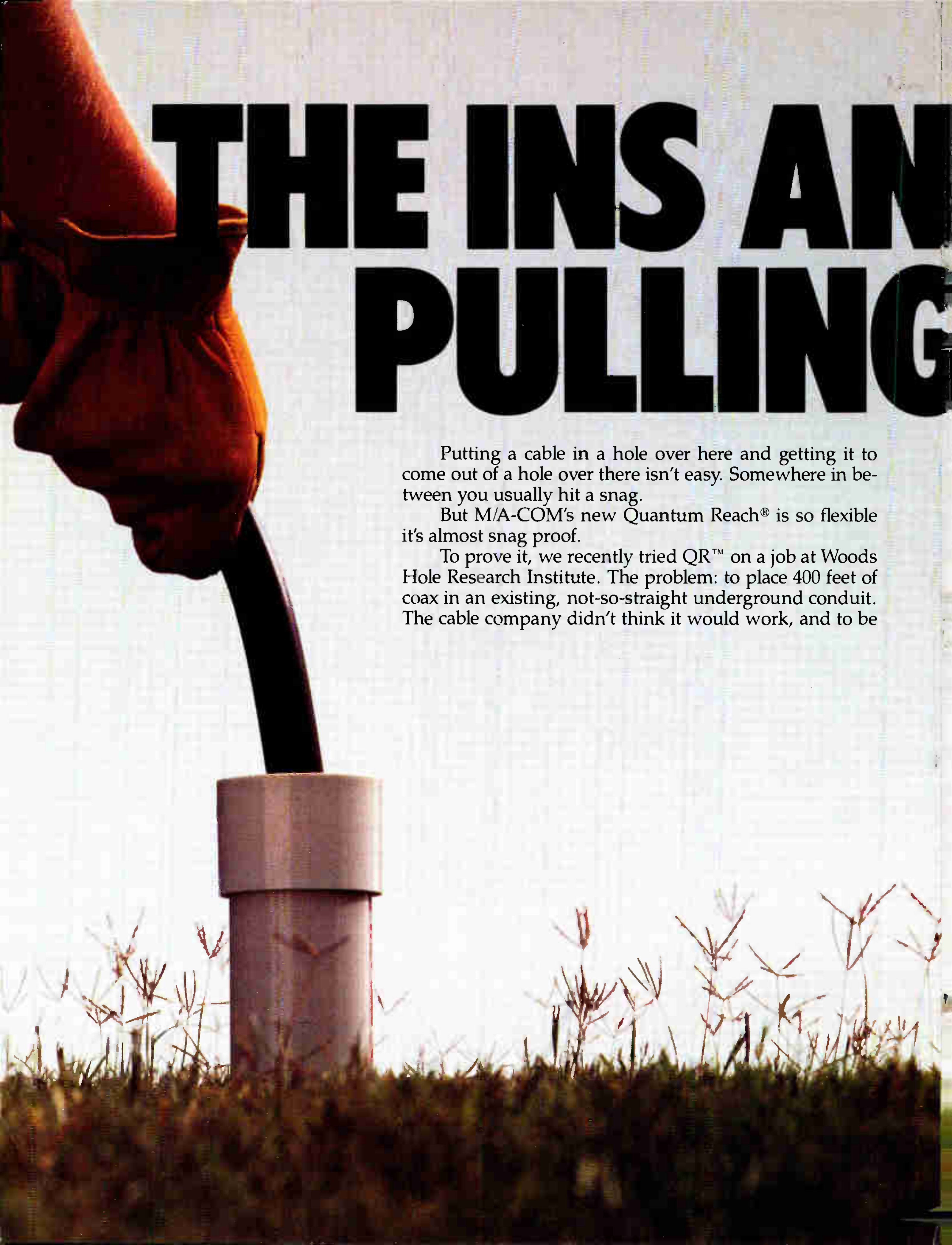
So, after answering another dozen or two outage calls, they call the technical manager who is second on the list. Good man. He's at home finishing off his budget proposal. He calls the chief tech who is still out. So the technical manager jumps in his car and in less than 20 minutes he is at the office and has the name of the duty tech. He beeps the tech's pager and waits. No call. Nothing daunted, our resourceful manager looks up the number and calls the duty tech. The wife answers. Yes, he's home, but he just stepped out for a pack of cigarettes. A message is left, and the tech manager goes home secure in the knowledge that the problem is about to be taken care of.

In less than 20 minutes, our tech is back home as promised. He changes into something more suitable for work and then drives his own personal car to the headend to get his truck. In less than 20 minutes, he's at the headend, but the compound is locked. No one to be seen. Can't get the truck out.

The tech drives to a call box and calls the tech manager. In less than 20 minutes, he's back at the headend with his bunch of keys and opens the compound and, in less than 20 minutes the tech is at the scene of the outage.

It's going to take two people and a bucket truck to replace the span. The tech goes to a phone to call out another tech, who then goes to the headend to get his bucket truck.

In less than 20 minutes...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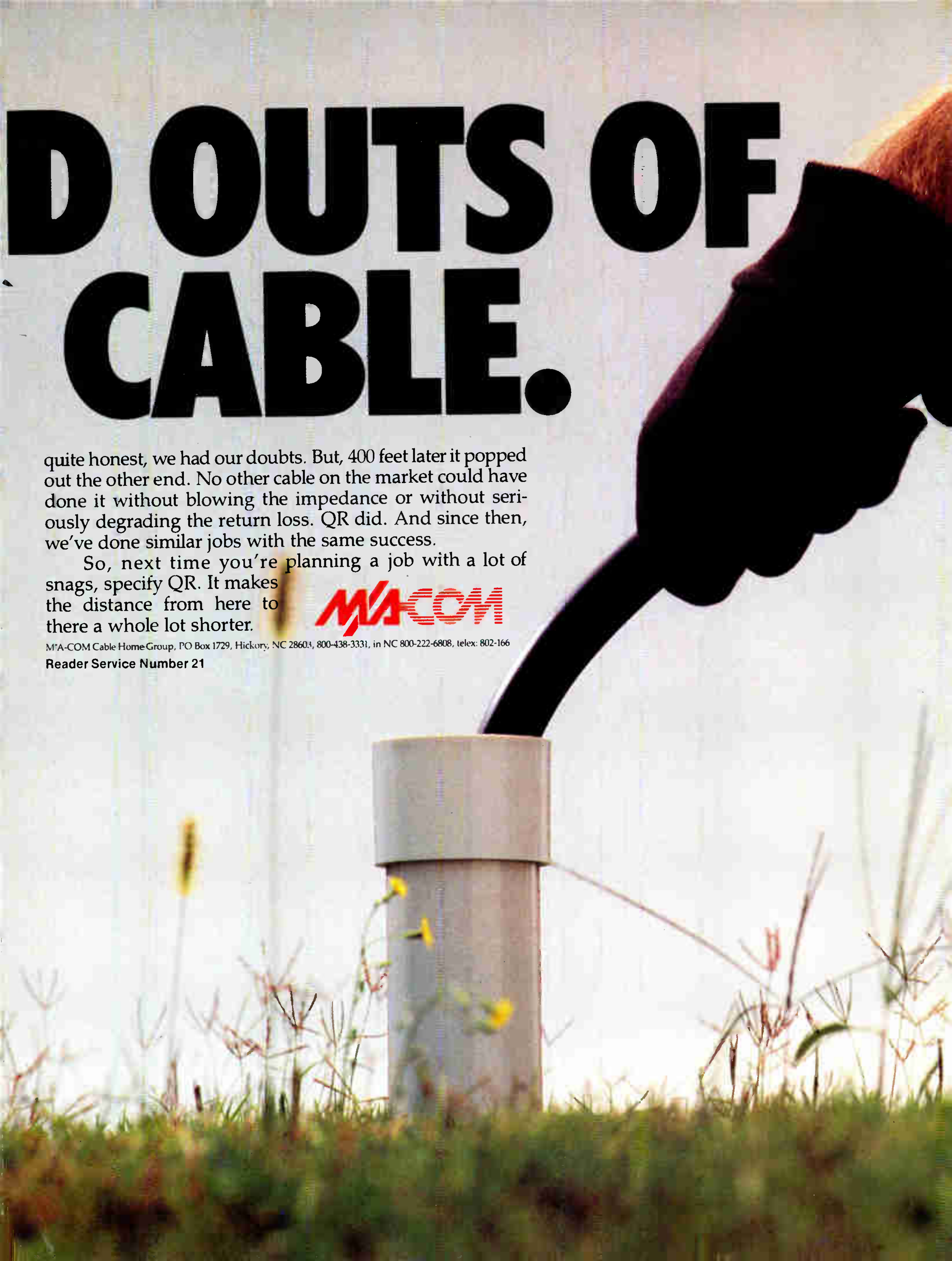
D OUTS OF
CABLE.
quite honest, we had our doubts. But, 400 feet later it popped out the other end. No other cable on the market could have done it without blowing the impedance or without seriously degrading the return loss. QR did. And since then, we've done similar jobs with the same success.
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Reader Service Number 21

this way, the main numbers of the system will not be blocked by the usual deluge of calls when there is an outage. Avoid using the word "service" in any phone listing since it means so many different things to different people. There should be more lines on the dispatch rotary than normally are required so that an outage will be immediately self-evident when all lines light up at once.

The ideal telephone directory listing for medium to large cable operations is as follows:

ACME CABLE CO.
Customer Service (CSR rotary #)
Billing (Customer billing #)
Reception Problems (Dispatch Rotary #)
Administration (Main switchboard #)

The advantage of these categories is that when "Reception Problems" lines are all blocked up with an outage, the CSRs can continue their job of selling service and handling install appointments and inquiries unhindered. Likewise, when the billing number is backed up with the inevitable monthly or bi-monthly inquiries, the rest of the Company can get on with its normal functions. This is like having an extra switchboard operator at no cost! Assuming that the various positions are adequately manned, especially at the peak times

Actually, there is much that can be done to reduce both the number and duration of outages. Some of the suggestions. . . may sound labor intensive; but if we are in this game for the long term, we need to "go the extra mile."

determined by your hourly call count (such as lunch hour), this arrangement goes a long way toward eliminating the often heard subscriber complaint that they can't get through. Surely, we in a communications industry can overcome this by skillfully deploying our staff with judicious use of overlapped and split shifts based on our experience.

One last, vital point on telephones: The dispatchers must have a single, direct, unlisted number which cannot be pre-empted by anyone with which to dial out. When all incoming lines are jammed with outage calls, the dispatcher may need this line to call out to the city electric company, a TV station, the chief tech or plant manager after hours or an emergency service such as fire or police. The dispatcher should have a dialer on this phone to obviate look-ups and fumbled numbers during a pressure period.

Effective outage management

For maximum outage control effectiveness, we need to ask ourselves the following questions:

♦ Are there written instructions? A procedures manual for the entire system is necessary—doubly so for the dispatch function. Try to think of every contingency and write it up. Include such things as after-hours building security, channel monitoring and logging procedures. Include instructions for outages and other situations that you know have gone wrong in the past so they won't happen again. Of course, your procedures manual will need to be reviewed and updated periodically in light of experience and changing circumstances.

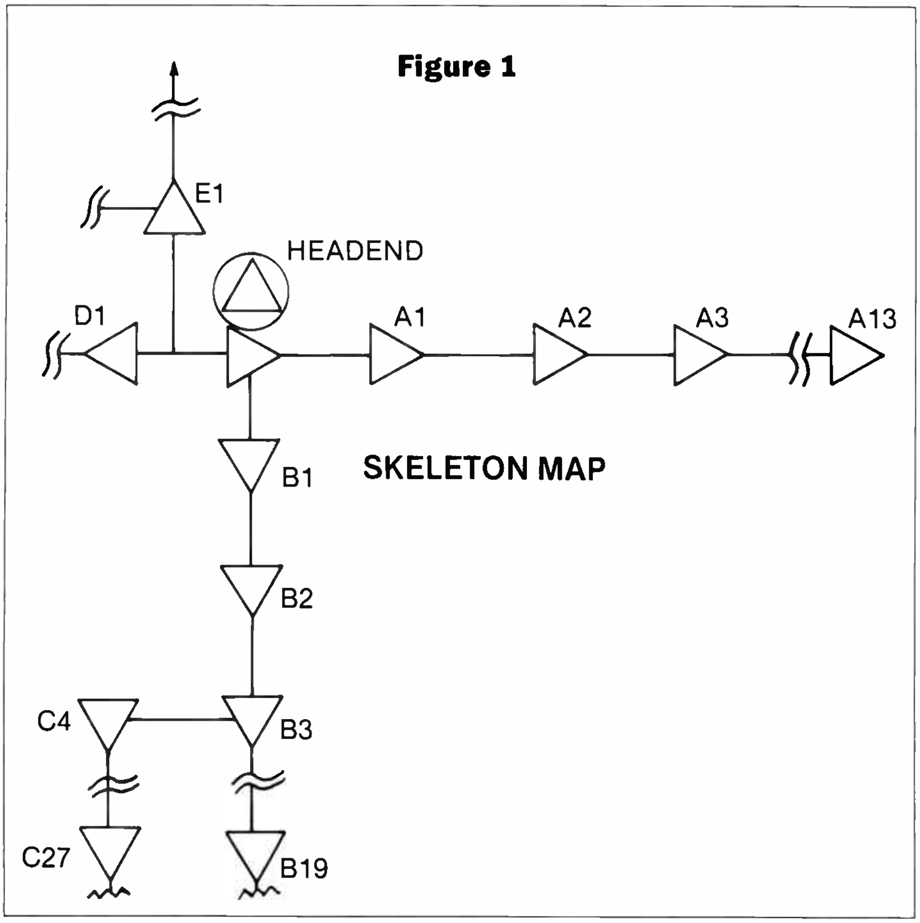
♦ Do the dispatchers have a hard copy of all significant telephone numbers? Try to acquire the control-room or switcher phone numbers of the TV stations carried. The TV stations usually are quite defensive at first, but once rapport has been established they tend to appreciate feedback. All emergency numbers such as city electric (afterhours number), police, fire, key personnel home numbers, etc., should be on a dialer with auto-redial. Experience has shown that you may need as many as 30 or 40 such numbers instantly available. Some may require persistence to obtain.

♦ Do the dispatchers have a set of full-scale maps of the entire plant and multiple dwelling units on a pull-out wall-rack? These are used by the dispatcher and/or the chief tech during outages and also routinely in directing personnel to proper locations. Obviously, the maps need to have the latest plant extensions, including MDUs, brought up to date. How often have we heard from technicians who couldn't find pedestals, lock-boxes, etc. This happens frequently in large systems where technicians cannot hope to be familiar with every nook and cranny in the system.

♦ Is there a one-sheet "skeleton" map of the system? While the set of large maps is valuable for detailed directions, dispatch also will need a single sheet skeleton map of the system. This map should have just the numbered amps on it. See sample section in Figure 1. During the initial stages of an outage, the skeleton map is used in conjunction with the incoming calls to determine to within an amplifier or so where the outage has occurred. It also is used after the outage to determine the number of amps that were off.

When taking outage calls the dispatchers need to try and get the names, addresses and telephone numbers of the three callers nearest the headend. There are no "brownie points" for dispatch or anyone else answering zillions of outage calls. People know that when the lines are busy during an outage, other folks are already calling. The subscribers' "info-card" should state this fact.

Once the data on the nearest three callers has been captured, the dispatch



person should concentrate on expediting the outage. Try writing or purchasing a program so that dispatch can call up any system area on their screen and "zoom-in" for the amplifier identifiers and other pertinent data, such as number of amplifiers downstream that are affected. The three nearest subscribers are to be called back after the outage has been reported restored to verify that it is restored and that it stays restored. The field tech should "stay at the scene" until he gets a confirmed all-clear and is released over the radio.

Record keeping

Stoicism has no place in outage control. Every outage must be a personal challenge to either prevent it happening again or to reduce its duration. To this end, we need to keep a log for each and every outage. If you have not been doing this, you will be amazed at the trends you will see when you have analyzed a few dozen outages. Several MSOs and systems were kind enough to send me some outage logs. Of the 98 I read, only 18 were genuine amplifier failures or accidents! The period covered several months and included the lightning season with attendant surges which killed power supply modules and blew fuses. In fact almost all the remaining 80 outages were power/surge related. As an industry we just don't seem to have gotten a handle on surge control —lightning induced or otherwise. This can be controlled for all but a direct hit, which you will easily recognize if you ever get one!

Let's talk about the outage control log in Figure 2. This is a useable sample and illustrates some things to look for.

The logs should be numbered consecutively on the top line for easy reference, continuity and avoidance of loss. The first main category block contains various notification times. This is valuable during a "post mortem" to determine who was called out, when they were called and at what stage additional help was sought in a difficult situation. Systems would have their own parameters to be met here. For instance, you might specify that if the tech does not have a handle on the problem within twenty minutes of arriving at the scene, the chief tech is to be notified. The chief tech would carry full responsibility from the point on and use his own discretion as to whether he will handle the outage from the dispatch position, drive out and take over personally or simply leave it to the tech, especially if the outage is small. It's his decision. At some point during a disastrous outage, it would be a matter of courtesy, not to mention diplomacy, to let the system manager know what's happening.

The next block logs the outage location(s). After reading many reports you will probably find that certain types of problems occur one or more times a year at the same area. This should trigger a detailed examination of the area. Is it a high-lying escarpment subject to lightning induced surges? Is there some heavy industry nearby producing high-level surges or transients? Or is the location simply "accident prone"? From this you will know what remedial measures to take.

Block three records the cause of the outage. Insist that this be filled in for each and every outage. If it is not clear, call for more detail. If there is not enough room, more can be written on the back of the sheet. If we all understand clearly what caused the outage, we are halfway to solutions for the future.

The following block is for those more organized and meticulous people who record the history of every module they own. It's a great idea if you can pull it off with everyone's co-operation.

The fifth block is very important, indeed. This is where you will find much valid advice over and above such facetious remarks as "install two-way plant and status monitor every amp." The one hour parameter is appropriate for your circumstances. One operations manager makes a practice of having the chief tech bring the over-one-hour sheets to him personally, and they have a think session on what can be done. The purpose of this is not to beat-up on the personnel but rather to make a sincere attempt at co-operative problem solving while everyones' memory is fresh.

Fuses, fuses & more fuses

You will find fuses mentioned over and over under "cause of outage." Most of these are simply nuisance outages that serve no purpose but to irritate the customers and waste technicians' time. Most can be fixed in under an hour, but they shouldn't happen at all. There are three principal reasons:

♦ Manufacturers fuse lightly to protect their equipment and their good name. They are not responsible for your surges or outage performance. Change to slo-blo when replacing, and stay with them. If you are already using slo-blo, go one size higher. For instance, go from 1.5 amp to 2 amp. Keep good records and note if you burn any power supply modules. Keep increasing the fuse until you lose a couple of modules, then back off to the last size you used and keep using that size for that type amp permanently. This will significantly reduce the number of nuisance outages caused by fuses.

The importance of the dispatcher and the dispatch function tend to be greatly underestimated. When you stop and think about who actually is running your system (plant) from minute to minute, especially after the office closes, it is the dispatcher.

♦ Apart from being on the light side, most fuses must blow because of surges. There is always a potential for this type of outage, but surges can be dramatically reduced using the proper devices and good "private" grounds. More on this on another occasion.

♦ Many fuses are totally unnecessary. An example of an unnecessary fuse can be found in certain power inserters such as the old Jerrold SPJ. Is the fuse there to protect the power supply or the plant? Who knows. Modern power supplies are pretty close to being indestructible. They will work forever into a dead short even when the transistors are chopping on standby with no harm. If your standby or regular power supply is suitable, either replace the power inserter with one of the many fine units that have no fuses or wire across the front of the circuit board with a number 16 copper wire. Some older Jerrold SPJ units caused their fuses to blow because the fuse clips were not securely rivited to the

OUTAGE CONTROL LOG. #

SIGNED Date / / Chief Tech.	SIGNED Date / / Manager.

NOTIFICATION TIMES	
Technician dispatched :	Chief Technician Notified :
Time Manager notified :	Additional Manpower :
Specify additional Techs called	

OUTAGE LOCATION(S).

CAUSE OF OUTAGE.

EQUIPMENT DOCUMENTATION by SERIAL NUMBER/LOCATION.

FOR OUTAGES OVER ONE HOUR SUGGEST POSSIBLE WAYS TO REDUCE FUTURE DOWN-TIME

(use back of form --->

A) OUTAGE END TIME: B) - START TIME:________ C) = OUTAGE DURATION: (Minutes) D)NUMBER OF AMPS OFF: E) TOTAL PLANT AMPS:	DATE: DUTY DISPATCHER: OUTAGE TECH:
$\frac{C \times D}{E}$ = F (Outage time Normalized to 100% Plant Equivalent =	F) Min

Figure 2

circuit board. This caused them to heat the fuse until it blew.

An example of a fuse in the wrong place can be found on some amplifier power supply modules which have a surge protecting crowbar *after* the fuse, thereby guaranteeing an outage every time the crowbar works. This is far too high a price to pay to save a few modules. Far better to work on the root of the problem. You will either have to catch the surges before they get to this type module or else put in 10 amp fuses and rely on the crowbars. In modern amplifier power supplies, the transformer and its design form an integral part of surge protection. Transformerless supplies do not have this advantage.

Some 60 VAC supplies have fuses in the secondary. These should be hard wired since the ferro-resonant transformer current is self-limiting at about 22 amps for a 15 amp supply and can operate indefinitely into a short.

Next month we will conclude with some thoughts on standby power, personnel training and deployment for effective outage control and discuss an easy method of generating a reliability index from the outage log sheets which will enable a system to track outage performance and progress through the various seasons and make comparisons with other systems. CED

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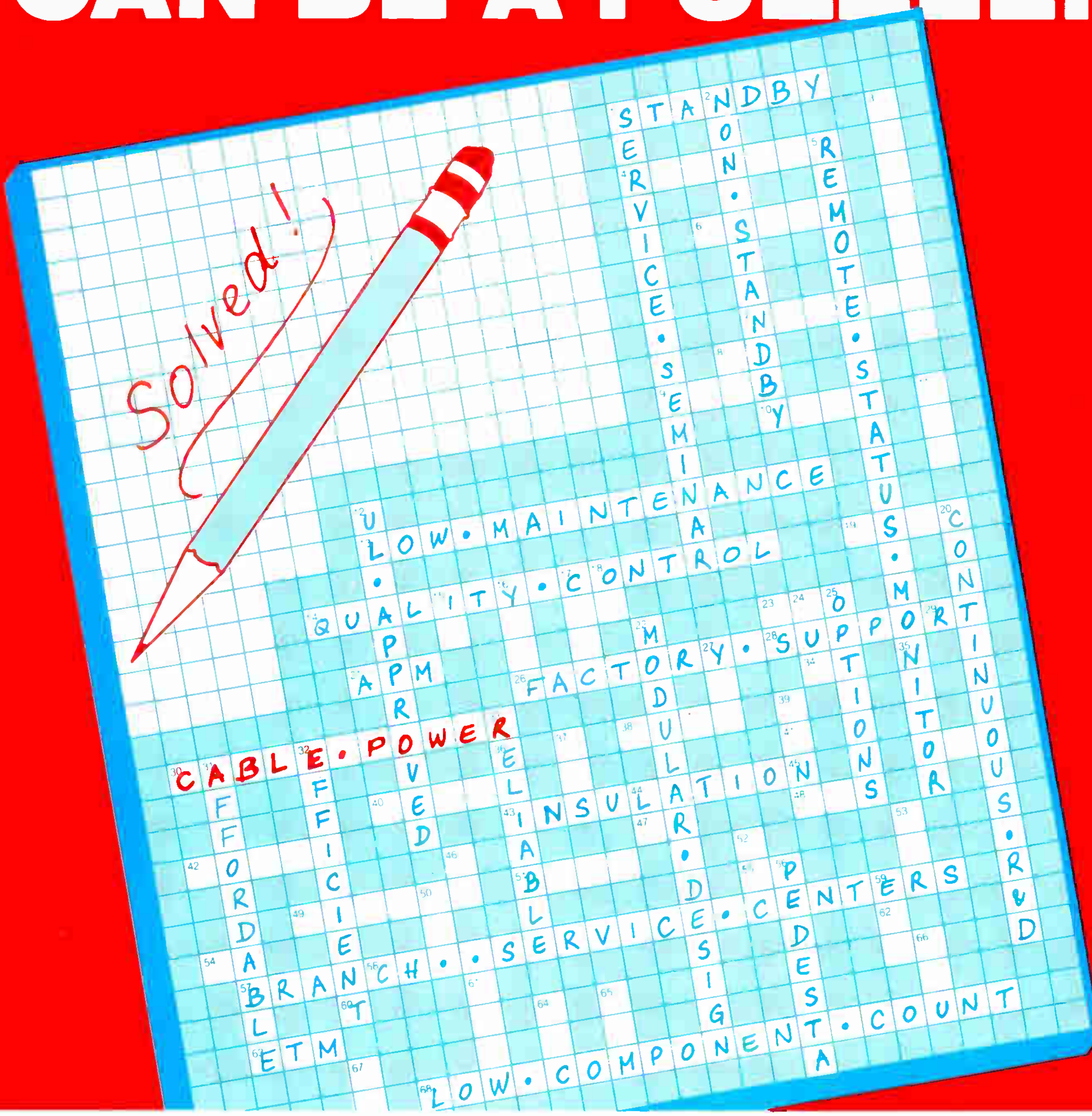

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Reader Service Number 29

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Television transmitter luminance transient response

Part Two

By T.M. Gluyas, FELLOW, IEEE

We have seen that it is impossible to approach perfection in transmitter luminance transient response when employing a particular demodulator. But it may be a waste of time to do this if the results do not closely resemble pictures on home receivers.

In setting a reasonable goal for transmitter performance, we need to know answers to the following questions:

1) What transient response would be considered good to excellent by an overwhelming majority of viewers?
2) What is the threshold of detection of transient response distortion?
3) If the picture is perfect on the station monitor, what will it be like on home receivers?
4) What is the spread in performance among receivers?

The first question is easy. The answer has been carefully researched by the British Post Office and the BBC[2,4] and further interpreted by Siocos[5].

From a review of these reports, we arrive at a conclusion that most viewers rate pictures either good or excellent when $K=2$ percent. Half of the observers vote "excellent" when $K=3$ percent.

A Bell Telephone study[6] on echo visibility helps provide an answer to question 2. Based on observation of still pictures, and equating echo visibility to transient response distortion, we conclude that 90 percent of the viewers would either barely perceive or would not perceive distortion when $K=$ 1.5 percent.

It has been widely reported elsewhere that 1 percent echoes under laboratory conditions are at the threshold of visibility. While this is probably true for ordinary picture material, echoes from high-contrast titles against a uniform background are easier to see. We have observed that, when critically viewing titles, is it possible to detect 1μs echoes or 1-MHz ringing of 0.5 percent, especially if picture controls are manipulated to block highlights and change blacks into greys.

Questions 3 and 4 will be dealt with jointly. The approach to this question is to evaluate distortions in the frequency domain and then show what spread in corresponding transient response can be expected with different receivers.

We saw in previous slides that 2 T sine-squared pulse ringing was associated with a dip in frequency response at ap-

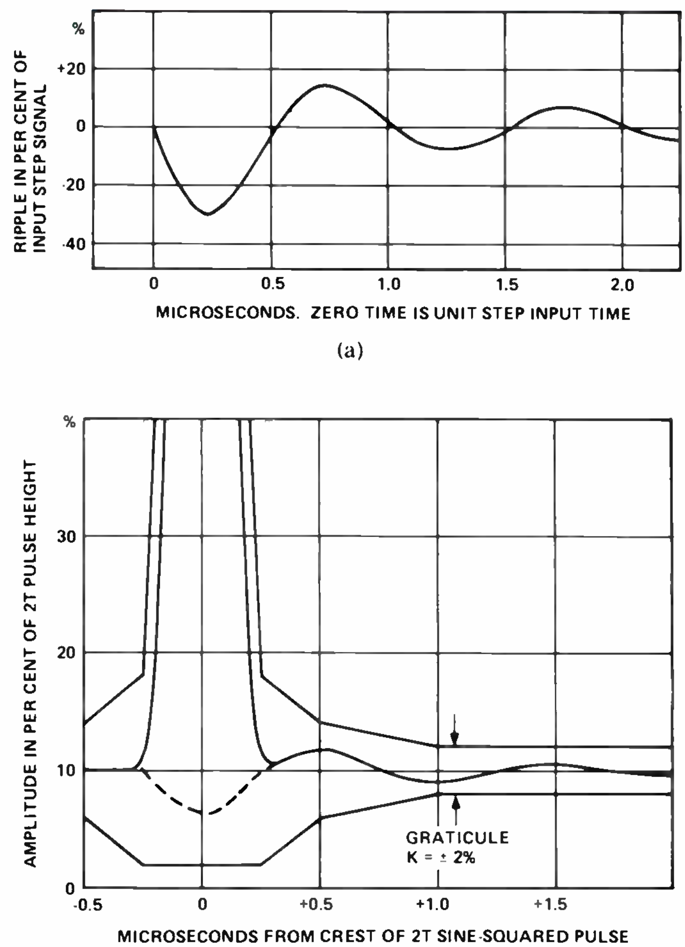

Figure 15 Simulation of 1 MHz ringing (close-in echoes) with video resonant circuit, $Q=$ 2.5. (a) 1 MHz circuit ringing. Unit step excitation. (b) Base of 2 T sine-squared pulse with 1-MHz ringing.

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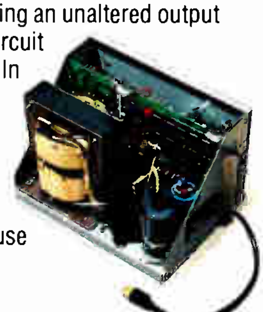

This concept needs fewer components which translates into **higher reliability**. Because the inverter cannot be activated, even with the line relay contact "stuck", this concept also gave us the fail-safe feature that helped us to obtain both **UL** and **CSA** approvals. And that gives a good product a good name.

Of course there are more reasons for Alpha's leadership and good name in Standby Power. Features such as **Temperature Compensated Charging** matched to the battery type and **Automatic Selftest** and **Equalizing**, to name just two.

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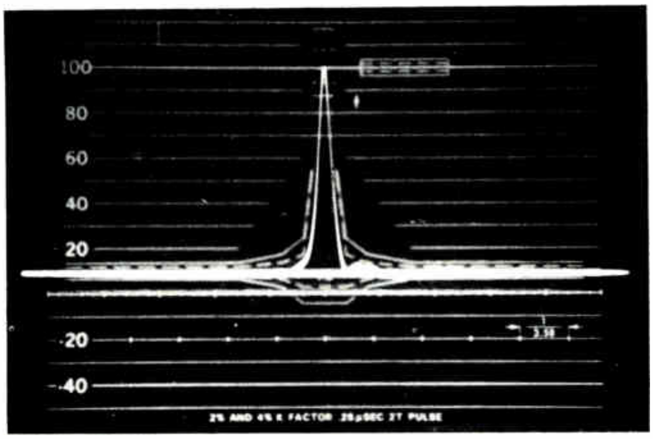
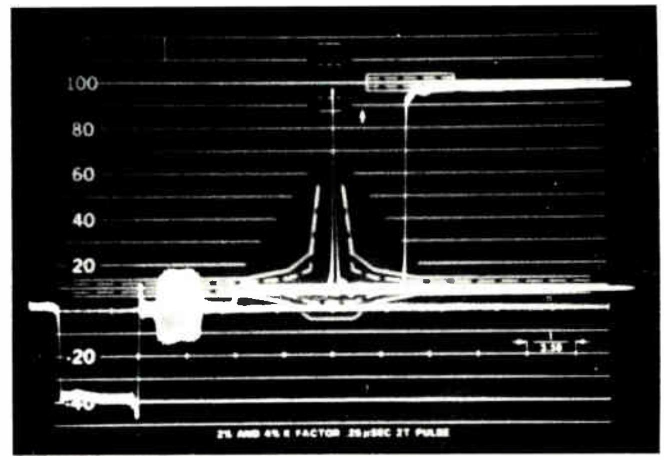


(a)



(b)

Figure 16 Observed system response to sine-squared pulse and bar to be compared with calculated response Figure 15.(a) 2 *T* sine-squared pulse. (b) 2 *T* sine-squared pulse and 20-μs white bar.

proximately 1 MHz. This can be analytically simulated with a 1 MHz video trap circuit. We let the trap circuit damping factor be $K = 0.2$ ($Q = 2.5$).

The transient response of this circuit to a step waveform is shown in Figure 15(a). The first peak is 30 percent of the applied signal; the second, 15 percent; the third, 7.5 percent; etc.[7]

Since the previously noted 1 MHz dip in frequency response was 1 dB, or 12 percent, the corresponding perturbation in the waveform is 12 percent of 30 percent which equals 3.6 percent for the first transient (undershoot), 1.8 percent for the second (overshoot), 0.9 percent for the third, etc.

The effect of the initial negative peak of the error signal is to reduce the pulse-to-bar ratio by 3.6 percent and round off the corner of the leading edge of the white bar.

In Figure 15(b) the transient error is subtracted from a 2 *T* sine-squared pulse. The result agrees fairly well with the waveform observed in one instance at the output of a Telemet demodulator as shown in Figure 16. Computing the transient with a step function and then applying the result to the sine-squared pulse and bar requires some justification, but this has been relegated to the Appendix.

Estimate of performance variations among receivers

To obtain some insight into how one receiver might behave differently on two transmitters, or how two receivers might

behave differently on one transmitter, we proceed by estimating the amplitude versus frequency and delay versus frequency of the several combinations.

Figure 17 shows the amplitude and phase response of two filterplexers—one VHF and one UHF. The VHF filterplexer is the most recent design. Because it has more lower sideband "shoulder" and cuts off faster at band edge, it has less phase error at —0.75 MHz and more phase error at —1.1 MHz, below visual carrier.

From the sample receiver attenuation characteristics previously presented, we have constructed two curves in Figure 18 representing receivers with the greatest and the least lower sideband response. Only one receiver phase characteristic is shown and, for what follows, it is assumed to apply to both

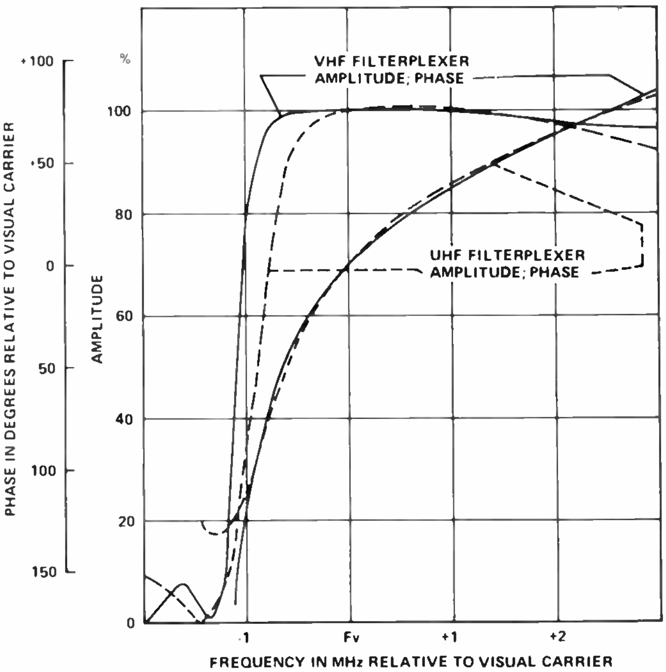


Figure 17 Attenuation and phase characteristics RCA VHF filterplexer MI-561702 and RCA UHF filterplexer MI-561543.

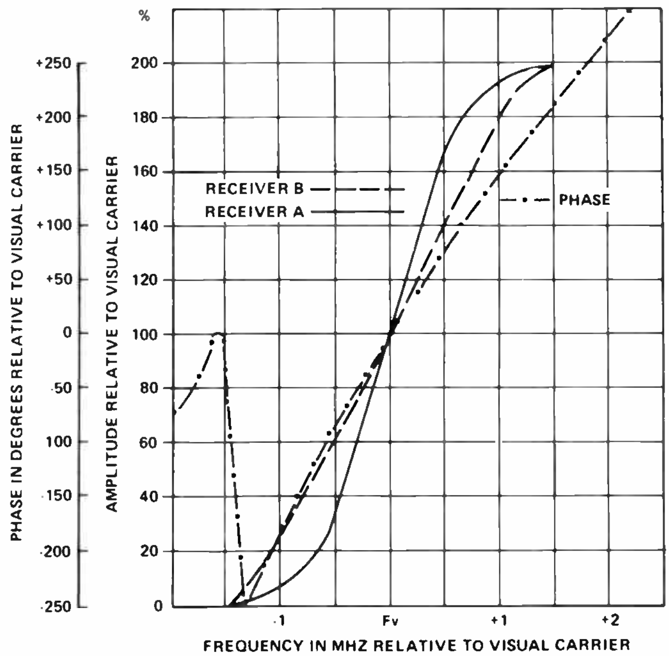


Figure 18 Attenuation and phase characteristics of representative receivers at extremes of lower sideband response.

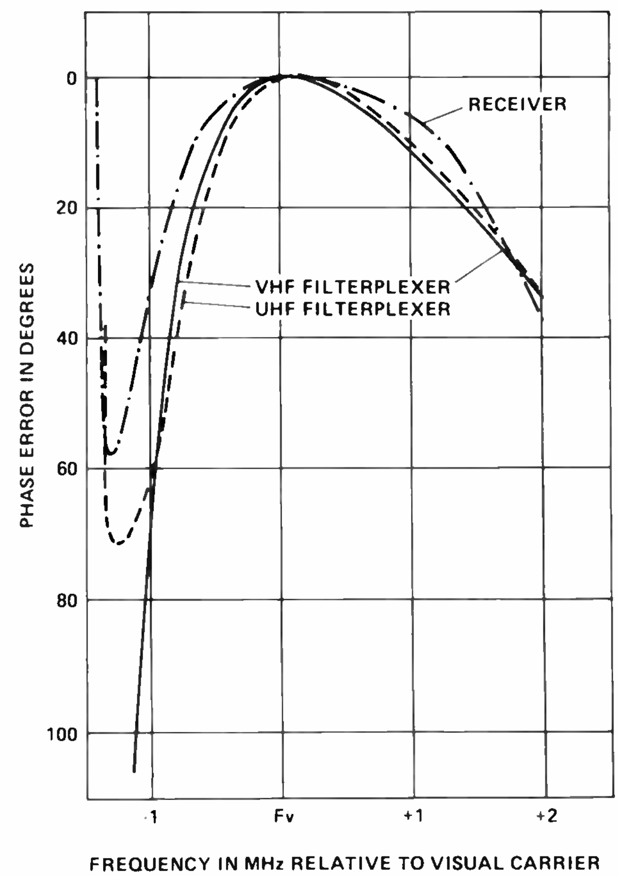


Figure 19 Transmitter (filterplexer) and receiver phase errors.

receivers. This is certainly not a proper assumption, but published receiver phase characteristics are very scarce, and it is impossible to say what phase response should be associated with each attenuation curve.

Figure 19 is a plot of transmitter and receiver "phase error," which here is defined as the phase difference between the acutal phase and a straight-line tangent to the phase curve at visual carrier.

Figures 20 and 21 show the amplitude and phase of the demodulated signal at the second detector of receivers having the characteristics selected for this study. We see that the amplitude response of both receivers driven by vestigal sideband transmitters shows some attenuation at 1 MHz compared to the same receivers driven by double sideband signal generators. The receiver with sharper lower sideband cutoff shows a negligible 2 percent dip at 1 MHz, but the receiver with more gradual cutoff has an 8 percent dip. Although this is less than the 12 percent dip observed on one station demodulator, it is not negligible.

The system delay errors shown in this slide are small for the receiver that cuts off sharply but significant on the receiver with more gradual cutoff. However, this is based on the indefensible assumption that the same phase curve applies to both receivers. The comparatively large delay ripples (30-70 ns) should not be interpreted as causing significant picture impairment. Since the delay ripple covers only a narrow frequency range, it represents only a small phase error.

The total 190 ns delay error is not important since it will normally be corrected at the transmitter. It is the spread between the curves that is important. The broken line suggests delay that could be subtracted by transmitter equalization. This correction includes low-frequency phase equalization for the transmitter plus receiver. Consequently, transient response observed on an R&S AMF demodulator, which includes its own IF delay equalization, might show some trailing over-

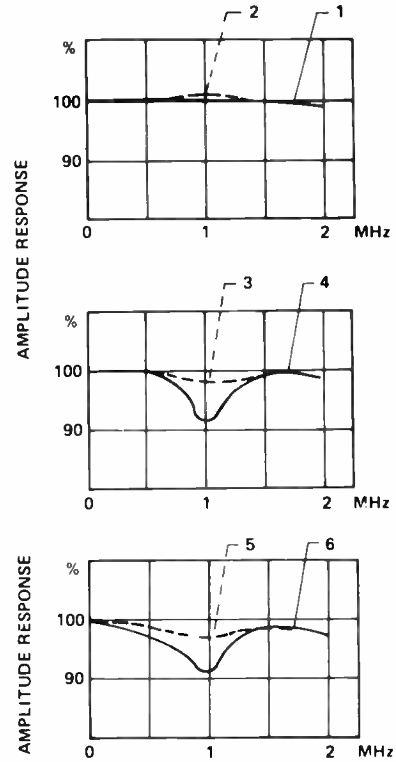


Figure 20 System amplitude versus frequency response for various combinations of receivers and filterplexers. 1—receiver *A* and double sideband transmitter; 2—receiver *B* and double sideband transmitter; 3—receiver *A* and VHF filterplexer; 4—receiver *B* and VHF filterplexer; 5—receiver *A* and UHF filterplexer; 5—receiver *B* and UHF filterplexer.

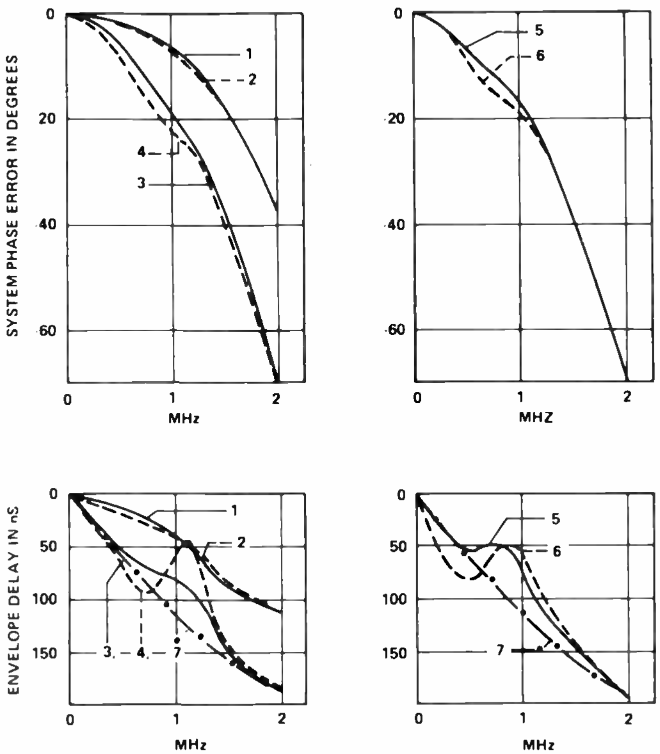


Figure 21 System phase and delay errors. Combinations of receivers and filterplexers. 1—receiver *A* and double sideband transmitter; 2—receiver *B* and double sideband transmitter; 3—receiver *A* and VHF filterplexer; 4—receiver *B* and VHF filterplexer; 5—receiver *A* and UHF filterplexer; 6—receiver *B* and UHF filterplexer; 7—appropriate transmitter delay equalization but invert slope.

shoot if the transmitter includes correction for receivers.

Based on results with one color receiver, W.L. Behrend of RCA found 100 ns excess correction at the transmitter beneficial to receiver luminance transient response[8].

Conclusions and recommendations

Now, to recapitulate, picture edge transients and low-frequency ringing, although very faint, can be seen on high-contrast titles; and it would be desirable to be rid of them. However, the problem cannot be ascribed to transmitters alone. It depends on the combined attenuation characteristics of transmitter and receiver.

Transmitter visual demodulators, used with other test equipment, reveal many important performance characteristics of TV transmitters but cannot be relied upon completely to inform the transmitter engineer about edge transients on receivers in his viewing area. Based on limited observations, we have found that commonly used demodulators vary widely in presenting transmitter system transient response.

If the station engineer is striving for the best possible picture edge transitions on home receivers, it is not sufficient to optimize the usual transmitter performance parameters such as frequency response, envelope delay, differential gain and phase, etc. These adjustments should be made first and consistently maintained. Then the system performance should be warped a little to favor the average receiver. This can be done without going outside FCC performance tolerances.

A "black box" such as a time-domain equalizer could be provided, ahead of the transmitter, to adjust the system transient response to what the station chief engineer decides produces the best results. Such "mop-up" adjustments should be set below the value for full correction of an average receiver so as not to spoil the performance of good receivers or inhibit receiver design improvement.

As a closing remark, the analysis and conclusions stated in this report are based on scanty information and limited observations. It is hoped that others will investigate this subject more fully and report on any refined data or different conclusions that may be discovered.

Appendix

When typical demodulators or TV receivers are combined with typical transmitters, some waveform distortion is noted and a concommitant dip in the amplitude versus frequency response is observed at approximately 1 MHz. This dip in response was confirmed analytically by the vector product of transmitter and receiver response and the addition of upper and lower sidebands. It then was desired to find the associated time-domain response for a 2 *T* sine-squared pulse and bar. Such analysis is possible but hardly worthwhile in view of the many other assumptions in the problem and the rough data. Therefore, we used published data on the transient response to a unit step and assumed that roughly the same ringing would occur for 2 *T* sine-squared pulse or bar excitation. The rationale for this assumption includes the following three factors.

In the narrow frequency band of concern (1 ± 0.2 MHz), there is little difference in the spectrum level for a unit step, a 1 *T* bar and a 2 *T* sine-squared pulse. One source of an often-published curve on the spectrum of a sine-squared pulse and bar is included in a paper by Wolf. [9] The peak value of ringing is expected to be roughly the same for all three excitation waveforms and the period—determined by the 1 MHz resonance—also will be the same.

A second consideration is that the calculated ringing begins at time zero for a step function input signal. The peak occurs approximately 250 ns later. We elected, without proof, to let the error signal time zero be the *start* of the 2 *T* pulse (or bar). The peak of the transient then coincides with the peak of the 2 *T* pulse. This agrees with experimental results.

A third approximation is that a 1 dB dip in the demodulated video response caused by incorrect summation of upper and lower sidebands affects both amplitude and delay approximately as in the well-known relation for minimum phase networks. There is no theoretical reason to expect this; but, from experience, it has been observed that there is little or no anticipatory ringing which could be expected if phase and amplitude responses were independent. CED

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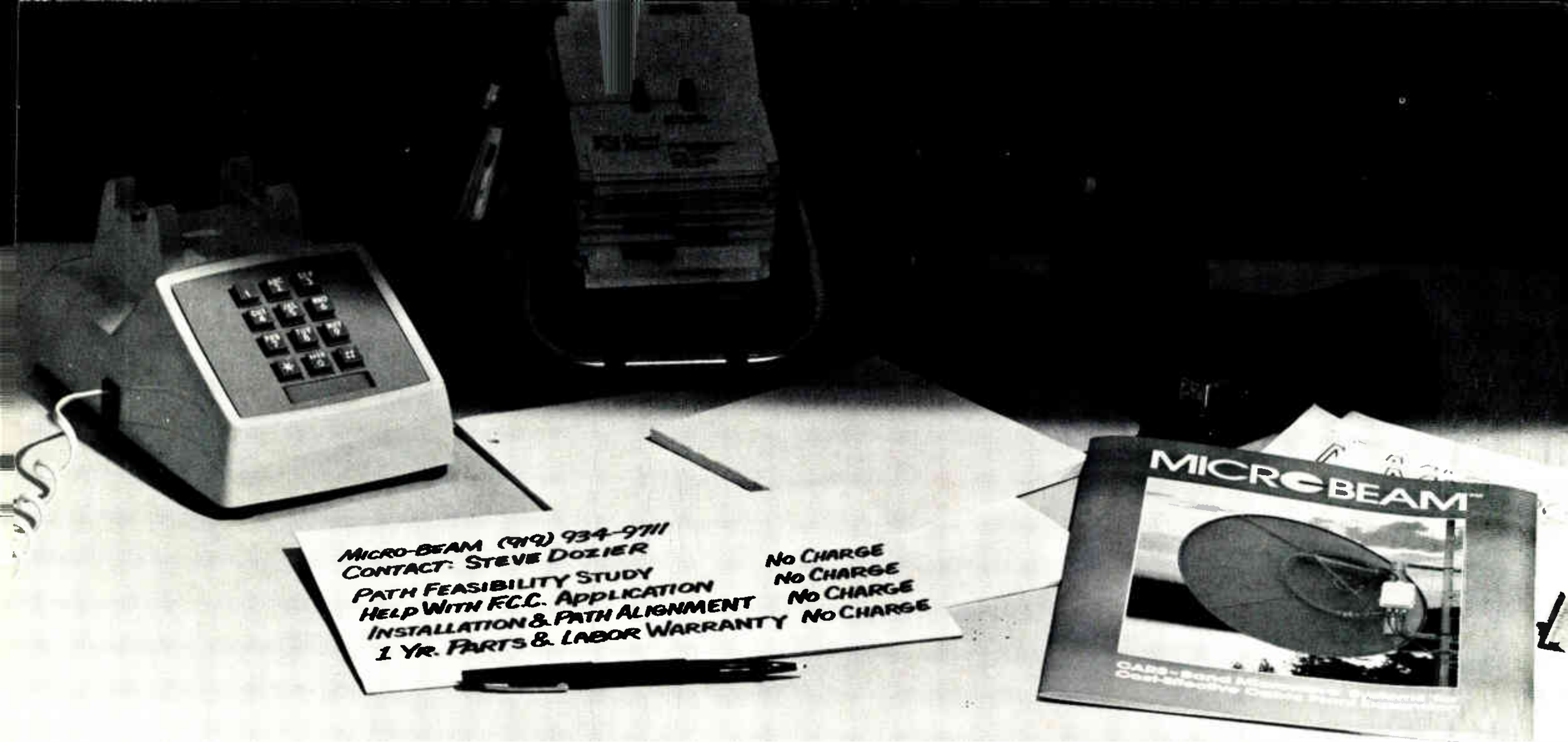

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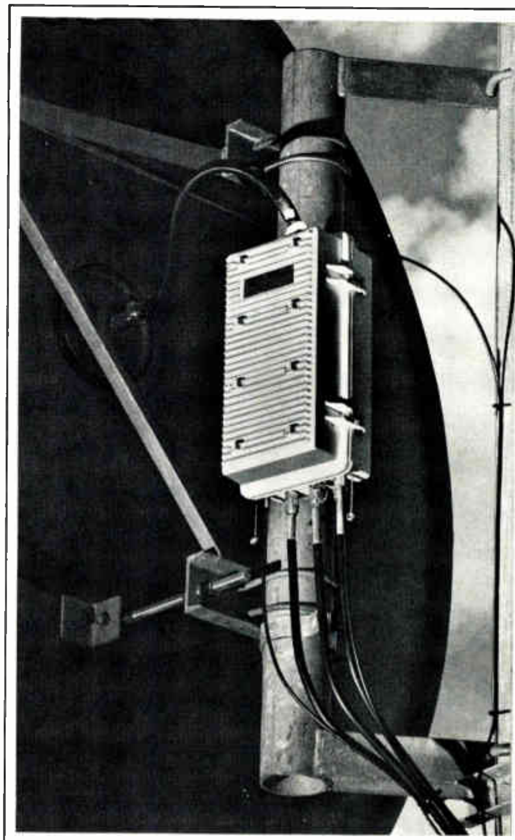

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"Because ya gotta. . ."

How to upgrade is fairly straightforward. But when to upgrade isn't as clear cut.

Sometimes the decision to upgrade a cable system is made for you. Especially if you're running a 12-channel system, are facing refranchising and other systems in your area already have 35 channels. But upgrading "because ya gotta" is less the rule these days.

As 35-channel systems become the norm, rate of return considerations are more important. Increased signal security and reduced maintenance costs also are factors in some cases. And some systems weigh the potential pay-per-view revenue stream.

How to upgrade, in a technical sense, is fairly straightforward. But when to upgrade isn't as clear cut. While some systems still drive upgrade decisions by franchising calendars alone, others use more formal planning methods. Warner-Amex, for example, begins with system business plans.

Each year, as capital budgets are reviewed, the company looks for potential upgrade candidates. "We'd normally be looking at systems with one or two pays, limited channel capacity and standard converters," says Ewan Mirylees, company director of sales and marketing administration.

In a typical year, about 12 to 15 upgrades and new system launches occur. Of course, there will be fewer in upcoming years as the traditional systems are upgraded. "A fair rate of return on the money we're putting in is our main criteria," Mirylees adds.

Times Mirror, on the other hand, is an MSO that prefers to look at upgrades when refranchising is coming up. "If we're within two to three years of a renewal, we'll generally hold off on upgrades until the franchise is actually renewed," says Kathy Flanagan, company director of corporate affairs.

The presumption is that a 12-channel system will be upgraded because "it's unrealistic to think you can get away with less," Flanagan says. "One of the things we look at is the size of the subscriber base and the rates that base can support. There's no rule of thumb on channel capacity."

And while there's no question economic, marketing and technical concerns are growing, the refranchising situation still is pivotal.

"We look at what it'll cost to upgrade versus rebuild—consider the age of the system and how many channels we need—but the number one factor is still refranchising," says Rollins Vice President Joe Cline.

Armstrong Utilities Plant Manager Dean Busatto agrees. "We look at each franchising situation on a case-by-case basis. We certainly wouldn't take any chances rebuilding before renewal if we were facing a hostile authority. In other cases we might use the upgrade

High churn, low reliability or failing converters also can trigger an upgrade.

as a goodwill gesture and leverage for renewal."

In most cases, some mixture of political and strict marketing concerns is evident. "We look at what our competition is doing, review the demographics and whether we can go with an electronic upgrade with minimal cable replacement," says Carol Applebee, vice president at Televents.

Likewise, a mix of engineering and marketing judgements is called for. "We look at our rate of return basis over five to ten years compared to the up-front capital expenditure and capitalize our marketing costs," adds McCaw Corporate Engineer John Allen.

For some MSOs, additional pay units are the attraction; for others, expanded basic.

Customer service costs also count. Addressability, for example, is marketing-driven, says Jones Intercable Vice President of Engineering Al Kernes. "We look at addressability when a system has high pay churn, potential for PPV or when the cost of addressability versus other schemes of security is about the same—say, when we are moving from a non-converter to a converter market anyway."

"A six-pay market might be a good candidate—a two-pay market might not require it," Kernes says.

Reduced maintenance costs also are a factor in some upgrades. "We made an economic decision to make all of our systems one-way addressable," says Colony Communications' Bruce Clark. "We had older converters failing at a high rate, and we knew we'd have to replace them anyway. We also thought we could save truck rolls."

Usually, the condition of the plant doesn't drive the decision, says Viacom's Pete Petrovich.

But "if we're investing significant dollars to maintain a system, we'll often reach a trade-off point where the incremental costs of the upgrade compare favorably with our existing costs," says Donald Smith, vice president, Metrovision.

Upgrades also are easier to justify when electronics can do the job, says Colony's Mike Angi, director of engineering. And it makes sense to space the electronics for higher bandwidths than you need immediately. "In most cases, proper picking and location of equipment will work for us," says McDonald Group Vice President of Operations Frank Leiter. "Most of the older systems were short-spaced, so even with higher output levels, a lot of systems fall into place without a redesign."

Leiter says a three-step planning process is followed. The first step is to estimate whether subscribers will sign up for new service packages and, if so, at what rates. "Then we look at whether we can do it with electronics," he says. "Finally, we evaluate the cable itself."

And although the company begins with marketing, "our rebuilds are driven from a technical standpoint," Leiter says. "If we're running three to four service calls a day, that usually requires an extra person or two. In that case, we look at the upgrade from the standpoint of greater reliability and better signal quality. This usually comes even before our market analysis."

So, when are systems upgrading? Although things have changed, refranchising still plays a pivotal role. They're also upgrading when market studies show consumers want, and will pay for, additional programming.

High churn, low reliability or failing converters also can trigger an upgrade. Greater need for signal security counts too.

Still, the political imperative—"because the franchise authority says we have to"—remains critical.

—Gary Kim
—Research by Sandi Benke

Doing it right

Speaking to 300 or so municipal franchising officers, FCC Mass Media Bureau Chief James McKinney recently came under heavy fire for proposing deregulation of cable technical rules. Challenged to defend his position that operators would maintain and improve signal quality standards even without rules, he pointed to Media General Cable of Fairfax County, Va.

It's clearly a system that is technically sound. It's also a system that is atypical. It's what people mean when they say "state-of-the-art." It has more operational channels than any other single system in the United States: 80. It also has capacity for 128 channels. All active channels are digitally frame synchronized and everything is baseband patched.

It has the biggest antenna array you've ever seen at a cable headend—one array for each of Media General's two headends. One headend feeds the A cable; the second headend, the B cable.

Of the three earth stations at each headend, one is a Simulsat, so Media General can look at five or six satellites simultaneously.

Each of the 12 hub sites is linked by microwave and fully redundant cable, as well. In fact, between 22 and 26 cables run out of each hub. Altogether, the system uses 60 microwave channels—and 64 HPAs—at each headend. About four to five active devices for each channel—almost 700 in all—operate in the system's headends.

That's not all. The technical staff watches over 10,000 fuses, 1,300 power supplies, 4,000 batteries, 5,000 trunk amps and between 4,400 and 5,000 LEs.

Media General certainly isn't a place for the lazy. Technical operations run seven days a week. Service calls normally are answered within 24 hours, and an awful lot of work is done between 2 a.m. and 6 a.m. Plus, the typical dual-cable install takes about 27 extra fittings.

About 50 percent of subs have second sets. So an installer is lucky to get five to six jobs done in a day's time. Still, the company is averaging about 1,000 installs a week.

Media General's local origination facilities are more than "near-broadcast quality." The gear could easily be shipped out to Media General's TV stations without a hitch. Digital effects units, mixers, digitizing cameras, ¾-inch VTRs and graphics generators, slow-motion and captioning equipment, for example.

The system is fully two-way active and makes money at pay-per-view. The company's I-net is a dual cable, 410 MHz system offering digital communications services to clients like Boeing and SBS.

Media General has all the bells and whistles you could ask for. But it also features some nice little touches you wouldn't expect—like lighting for the earth stations so you can work on them at night.

Altogether, the company has put in about $4 million worth of hardware so far.

A 2,000 square foot repair facility is going up now, and Bob Dattner, Media General's vice president and director of technical operations, says he plans to repair 95 percent of all system equipment in-house.

It's a complex system serving affluent, articulate and influential clients. And it needs a technical staff to match. So Media General emphasizes customer service, exacting technical standards, heavy PM and training, training, training.

Extensive cross-training is a must. All PM technicians, for example, have to make customer calls one day a week. And CSRs spend time out in the field with installers. Marketing and customer service are emphasized from the start. "Fix the customer, not just the problem," Dattner says.

Company CSRs get 5,000 to 7,000 calls a week, for example. But they manage to solve most problems on the phone. So only 1,200 to 1,300 truck rolls are generated by all those calls.

And if any single subscriber has trouble twice in one month, a supervisor goes out on the call. So, although Media General gets its share of letters from customers, half of them are "thank-you's."

People are rotated every six months through construction, customer service and installs—even the construction staff is expected to be service-oriented.

The company also believes in PM. "Every time we have to pull the PM crews off to work on outages, our service calls shoot straight up a week later," says Mile Nelson, operations manager.

It helps to be owned by a corporate parent with deep pockets and a commitment to live up to its franchise promises. That isn't to say another system like this one would be bid or built again. Perhaps not. But there's no mistaking the dedication to doing it right.

Media General also happens to be a place where technical talent can rise quickly. "Some of the guys who've been with us for two years are now chief techs," Dattner says.

It's as challenging a system as a cable technician or engineer would ever encounter. And what's being built there isn't just a cable system—it's a cable company.

Dattner has about 31 line and service technicians now, but he's about 20 short. "We're using almost 100 contract installers and would like to do more in-house," Dattner emphasizes.

The company also believes in training and is willing to pay for it. "Everybody gets a shot at being a technician, and everybody gets supervisory training, experience in service calls and plant turn-on—even if they just want to stay in installation," Dattner points out.

Media General is about half-way through its three-year newbuild, and about 10,000 new units are added to the housing stock every year. And despite the dramatic growth in subscribers since initial turn-on, one statistic tells the story about successful system maintenance.

The company was getting 1,200 to 1,300 service calls a week when it had 6,900 subscribers. It now has 75,300 subscribers but still gets the same number of weekly service calls.

Dattner wants to hang on to that record. And he's got at least one good idea about how to do it. He's hiring.

—Gary Kim

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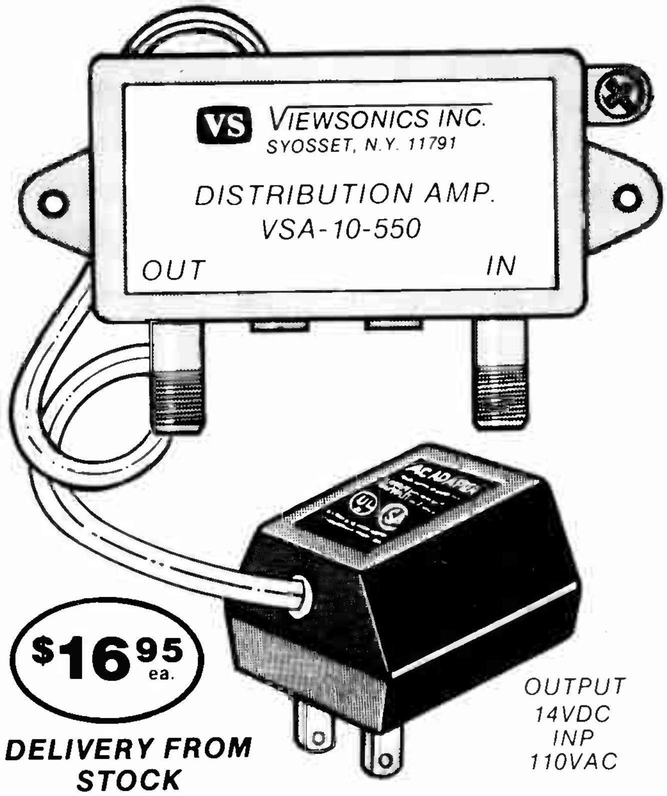

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Output Match 14db
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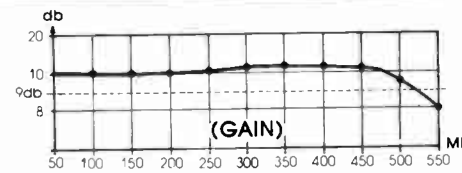
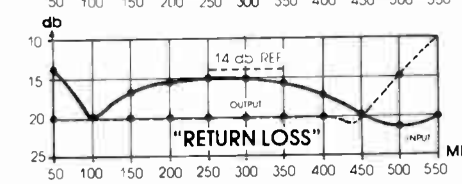
(Composite Triple Beat)

2nd Order Distortion @ +20 DBMV .... -70db

71 Channel X Modulation .... -70db
Typical Inp. Level 10db





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VSA-20-550	20db GAIN	$24.50 ea.
VSA-20-5502W	20db GAIN 2 WAY CAPABILITY	$29.50 ea.
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Reader Service Number 38

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Needed to manage technical department for a 700 plus mile system in central New Jersey location. 5 years experience required. Strong supervisory and people management skills are necessary. Send resume to:

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The City of Cerritos, CA with a population of 55,220 announces it will except applications for construction and, or operation, and, or maintenance of a telecommunications/cable communication system to serve the City's residents and institutions. Applications must be submitted by November 15, 1985. A formal Request for Proposal has been issued, copies of which may be obtained by contacting;

Mr. John H. Saunders
Director of Internal Affairs
Civic Center, Bloomfield Ave.
at 183rd Street
P.O. Box 306
Cerritos, CA 90701

INSTITUTIONAL NETWORK ENGINEER

Colony Communications is seeking an applications engineer to work in its Institutional Network department. The following skills are desired: First Class Radio License; Associates Degree in Electronics Technology or equivalent field training; 5 years on the job experience in such occupations as computer field maintenance, mobile radio maintenance, or telephone engineering (inside plant); working knowledge of digital techniques, data communications, and RF applications in the cable TV field; ability to assume project management responsibilities; ability to integrate with all levels of company staff. Some travel may be required. Competitive salary and benefits package. Interested applicants should send resume to:

D.V. Donohue
Colony Communications
169 Weybosset St.
Providence, RI 02901
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using one-piece construction with a hex crimp.

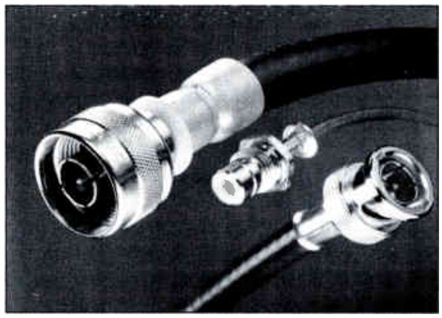
For more information, contact Kenneth Wood, (607) 739-3844.

Augat/RDI has announced the availability of two new products, the 2M and 2S Series terminal blocks. Using the 2S Series, placing the solid or standard wire (16 through 24 AWG) into the opening and pushing the lever gives a connection without the use of tools. The 2M Series is subminiature with 0.500" high wire connectors. The 0.200" center spacing fits worldwide standards.

For more information, contact Herbert Naylor or Joseph Glomp, (312) 682-4100.

Available from Regency Cable Products is the restyled 66-channel addressable RC32 converter. The converter features downloadable, non-volatile memory technology. Advanced parental control and diagnostic features. The Regency downloadable RC32 line consists of a family of one-way addressable converters with dual-mode random scrambling, optional audio scrambling and a new optional full-feature hand-held wireless remote control.

For more information, contact Regency Cable Products, P.O. Box 116, E. Syracuse, N.Y. 13057-0116, (315) 437-4405.



AMP Inc. introduced new cable-, panel- and bulk-head-mounted 75-ohm BNC, SNB and N-Series coaxial connectors for network applications up to 2 GHz. The connectors exhibit a VSWR of less than 1.3 and RF leakage less than -55 dB (-90 dB for N-Series). Hand tools or automatic machines may be used to apply the connectors.

For more information, contact AMP Inc., Harrisburg, PA 17105-3608. (717) 564-0100.

R.L. Drake Co. has introduced two products—the Drake ESR2240 Earth Station Receiver and the Drake VM2410 Video Modulator. The ESR2240 is a broadcast-grade block downconversion receiver. Features include an auxiliary subcarrier output and descrambler compatibility. The Drake VM2410 is a fully agile modulator offering a range of 60 channels from 50 to 400 MHz.

For more information, contact Steve Ford, R.L. Drake Co., P.O. Box 112, Miamisburg, Ohio 45342, (513) 866-2421.

Panduit Corp. has introduced a new cable tie mount designed for use with switch installations in electrical control panels. Available with two hole diameters (7/8" and 1-13/64"), the mount is compatible with most panel switch designs.

Panduit also announced custom stamping of cable ties and marker plates to provide permanent identification. Both 1/8" and 1/4" high characters are available.

For more information, contact Manager, Inside Sales Dept., Panduit Corp., 17301 Ridgeland Ave., Tinley Park, Ill. 60477-0981, (312) 532-1800.

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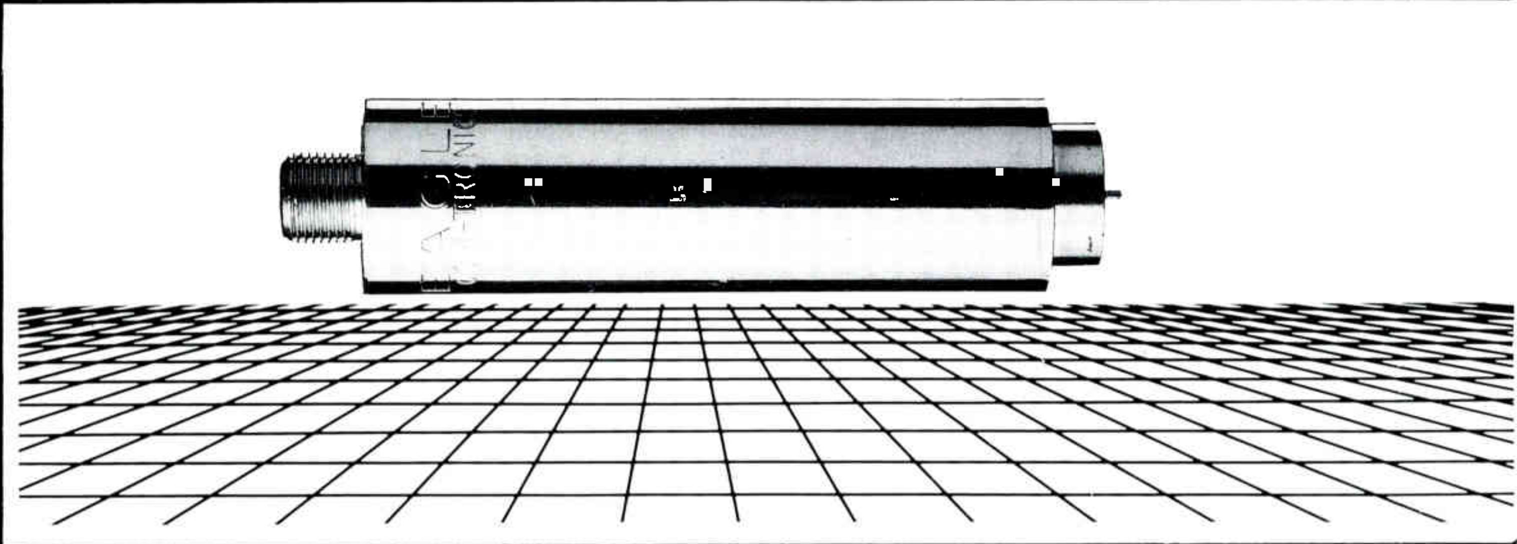
TRAPS VS. DESCRAMBLERS



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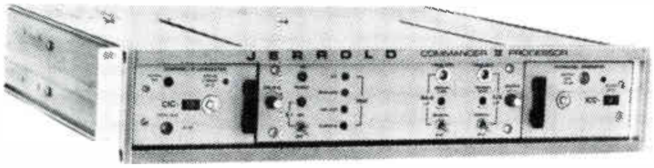

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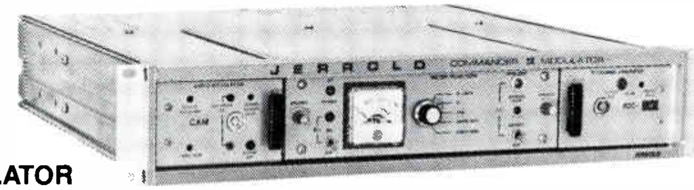

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