CED

Communications Engineering & Design/The Magazine of Broadband Technology

February 1985

Commercial insertion, character generators

Heller: Interface issues
Ehman: Living with 21006
Dworkin: Converter security
Cooper: Broadband basics

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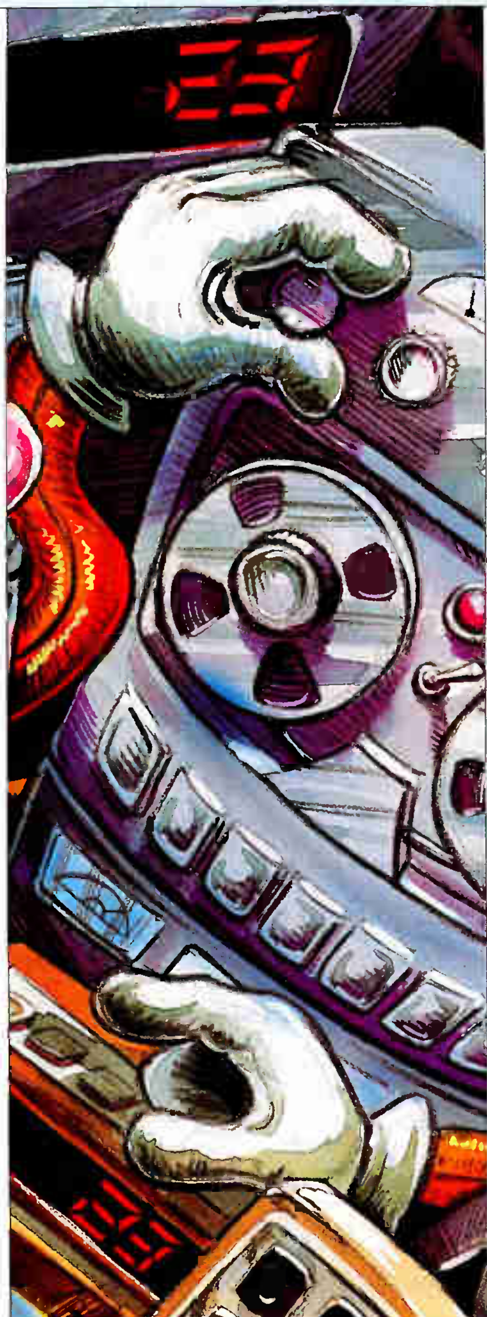
CED™

February 1985

DEPARTMENTS



About the cover
The cable/consumer electronics interface has grown complex in recent years, leading to increasing problems with device handshaking. Artist Malcolm Farley illustrates the concept for this month's cover.

CED. (USPS 300-510) (ISSN 0191-5428) is published monthly by International Thomson Communications Inc., 600 Grant St., Denver, CO 80203. © February 1985, Volume 11, Number 2. Subscriptions free to qualified industry readers. All other one-year subscriptions are $26, prepaid in U.S. funds only. Second-class postage paid at Denver, CO. *CED* is published on behalf of the cable television and broadband communications industries. POSTMASTER: Please send address changes to P.O. Box 5208 T.A., Denver, Colorado 80217. MEMBERS OF THE BPA. BPA

Ted Hartson

How did the president of the "Battle Creek Free TV Association," an organization devoted to keeping cable television *out* of Battle Creek, Mich., end up as Director of Engineering Services at Capital Cities Cable? Ted Hartson, the one-time cable antagonist, explained that it wasn't cable TV itself he was opposed to but, rather, the particular company that was attempting to take over his territory back in 1964. Hartson, who has worked in radio shops since his early teens, ran a TV and radio shop at the time, and the cable company that wanted to wire Battle Creek was planning to lease TVs to their customers as part of the deal. "I wasn't too happy about that because I wanted folks to buy a set from me," Hartson admitted.

Hartson was successful in his efforts to keep Battle Creek free from cable, but only temporarily. Two short years later, Time Life Broadcast had its eye on Battle Creek, but they weren't taking any chances. They offered Hartson a job, and he accepted. Hartson's first system was in his hometown of Battle Creek, and he was involved from the ground up.

Shortly thereafter, Time Life Broadcast started a group called Time Life Cable Communications. Hartson stayed with Time Life Cable Communications until the early 1970s when American Television & Communications Corp. (ATC) bought the company. At ATC, Hartson went from chief engineer for Michigan to the first regional engineer for the mid-states. Ten years later, he left ATC to join OMNICOM of Michigan, a system owned by Capital Cities Cable. At OMNICOM, Hartson built the first 400 MHz system in the country and learned how to write franchise proposals and prepare franchise presentations.

Soon after Capital Cities acquired the interests of Cable Com General, Hartson moved up to the corporate staff. There he remains, working on FCC compliance, product evaluations, providing engineering assistance to systems, training engineers and technicians, building microwave and developing ways to help cable engineers all over the United States.

The Average Leakage Index, well known in the industry, was conceived by Hartson several years ago. Prior to its development, there was no objective method for evaluating the performance of a system. "I've developed more sophisticated things, but the Average Leakage Index is definitely the most popular," Hartson claims. "Signal leakage is a fascinating area because in the past there has been more heat than light brought to the subject."

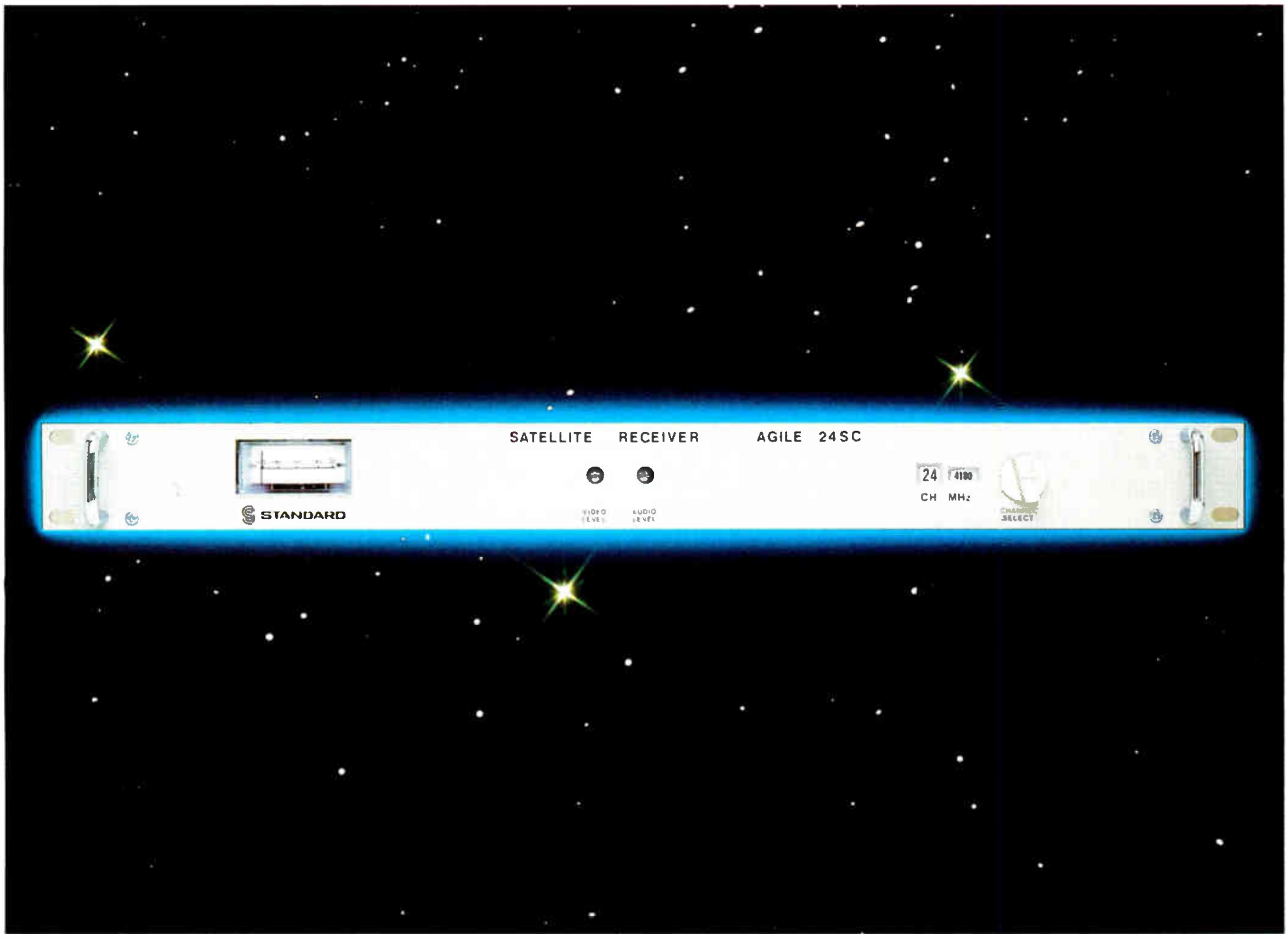
Bill Petty, founder of Empire Communications, was not alone in welcoming Hartson's development. "With Ted's Average Leakage Index, the cable operator has an actual measurement tool he can use to evaluate the relative performance of his plant," Petty said. "Too many engineers tend to be rather esoteric, but Ted always has a very good grasp of the real world and what is needed, as his creation of the ALI demonstrates."

Hartson views compatibility between cable and consumer electronics equipment as the next big challenge the cable industry must face. "We have to make CATV more user friendly in terms of home electronics," he states. "The way things stand now, the consumer is faced with such an unwieldy network of cords, boxes, switches, converters, etc. Frustration is inevitable."

The industry also needs to be more customer-service oriented, Hartson feels. "We've got to remember that we are refranchised once a month when the customer sits down to write his check. If he is unhappy, we're out," he warns. "I have never thought that I had 5,000 customers; I've always had one customer 5,000 times."

Like most successful people, Hartson truly loves his work. "I consider myself extremely lucky to have gotten into cable TV. When I was a kid, I used to wish that I was growing up in the 1920s when broadcast was just getting its start. I thought all the frontiers in electronics were over. Boy, was I wrong!"

—Lesley Dyson Camino



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Volume 11, No. 2

CED

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Bad press

"Ca-Bull' is the title a reviewer for *Video* magazine gave his January 1985 commentary. It was one of two blasts aimed at the cable industry in that issue, and it's not the first time the cable industry has taken a pounding on *Video*'s pages. Several negative commentaries also ran in 1984.

In the most recent pieces, the industry is blasted for failures in arenas ranging from signal quality to programming. Our "greed and arrogance" and "subscriber-be-damned" attitude are lambasted roundly.

It isn't the first, and won't be the last, time we get roasted by competitors. That has to be expected. What should be increasingly rare, though, is substance for the charges.

And that isn't to say there isn't room for complaint—of course there is. Technical standards can be much higher; and if our industry's leading engineers and managers get their way, things will get better. We're getting more sophisticated and experienced all the time. But we still have a ways to go, and the financial people can help by recognizing the importance of funding training and maintenance, for example.

Video blasts the industry for opposing must-carry MTS. They're entitled to their opinions, but the magazine's readers are ill-served by the broadside attack. To read *Video*'s commentary, you'd think the cable industry has no reason to be concerned. The authors claim knowledge of our best estimates of retrofit costs, but still insist this is a technical cop-out.

It isn't. The Society of Cable Television Engineers met in late January to discuss precisely the question of MTS, and it simply isn't fully understood yet. Cable operators, castigated as "all-but-ignorant" about MTS, should have a better handle on the technical as well as the cost considerations as a result of the SCTE meeting. Undoubtedly, the report on Viacom's Seattle system, which has two off-airs broadcasting in stereo, shed some light on the subject.

We've got to do our part at *CED* as well, and you'll be seeing our contributions soon.

Meanwhile, we can all pitch in and give our critics less to yell about. A little here and a little there will go a long way. In Showtime/TMC's case, a really long way. Their new uplink facilities and move to Galaxy, for example, have produced a 3-4 dB improvement in signal quality at the TVRO site. The new one-inch rather than two-inch tape machines also help. They're easier to maintain, more reliable, and provide better audio noise reduction. In addition, new S/N and C/N tests are available to affiliates. Most important, perhaps, is the ability affiliates now have to test for terrestrial interference with their received signals.

In the future, new tests will be possible: dropping signal power 2 dB at a time to check signal degradation and checking for interference when satellites are at two degree spacing (using a field strength meter).

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Gary Y. Kim

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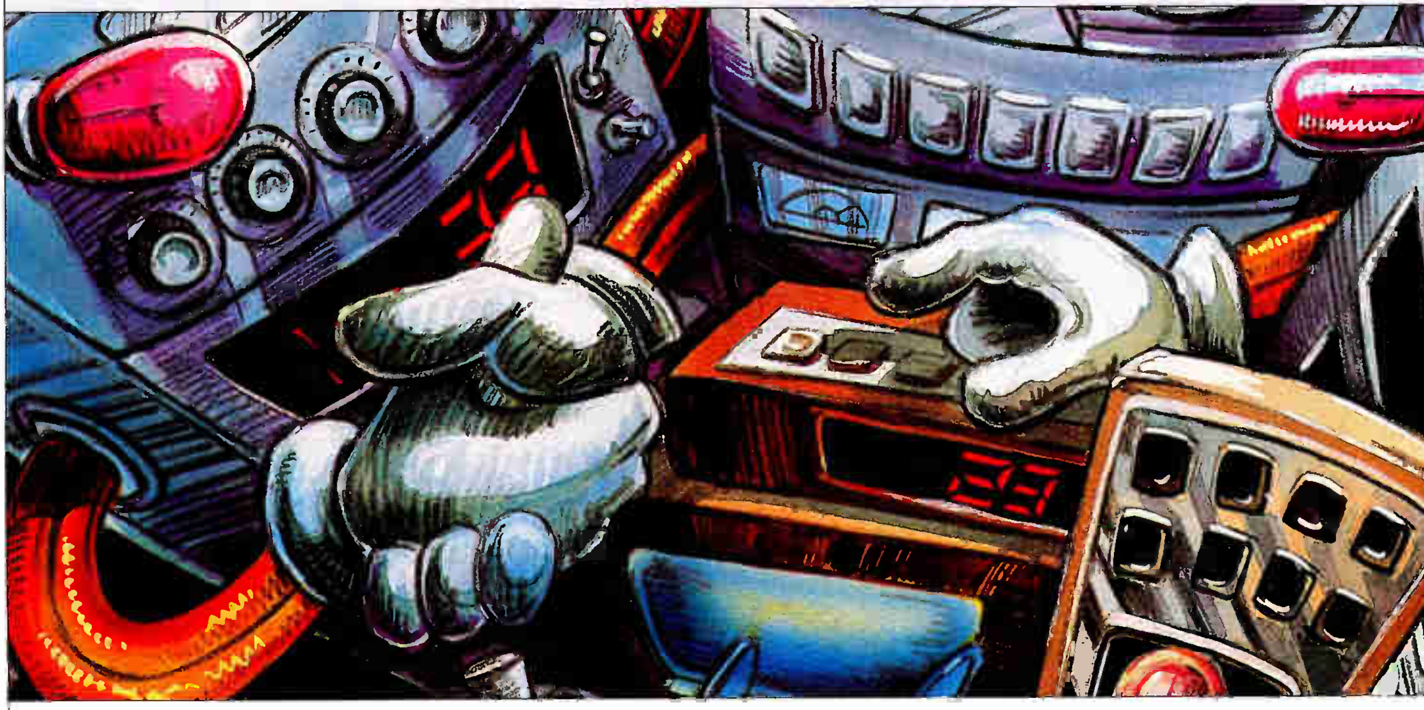

Cable/consumer interface issues

By Del Heller,
Director of Engineering,
Viacom Cablevision

The explosive growth of services and number of channels offered by the cable industry over the last six to eight years has been paralleled by a similar growth in the capabilities of consumer electronic devices such as television receivers and videocassette recorders.

Unfortunately, however, the cable and consumer electronics industries remain more on parallel rather than converging paths.

When satellite-delivered programming became available in the late 1970s, it triggered new growth for the cable industry. Systems were able to offer uninterrupted movies, sporting events and a variety of other programming that couldn't be purchased elsewhere. To accommodate these new services, technological changes had to be made in plant operations. Some of these changes included expanded bandwidth amplifiers, set-top channel converters that could receive the mid-band and super-band channels and converter/descramblers that could descramble the security measures employed on movie services.

These new services drove the first wedge between the reception capabilities of subscribers' television receivers and the expanded channel capacity of cable delivery systems. The usefulness of popular receive remote controls was diminished. However, the excitement of having a whole new spectrum of entertainment services, combined with the limited tuning capabilities of the television receivers of the time, tended to minimize customer demands for an ancillary tuning device for receivers.

Receiver manufacturers in the late 1970s reacted to the expanded channel capacity of cable systems by introducing the first "cable-ready" television receivers, most of which included the addition of some, if not all, of the mid-band channels. Once again, cable subscribers could receive some expanded, non-scrambled channel offerings without using a set-top converter.

Channel tuning designations in most of these early receivers did not correspond to the alphanumeric channel identifiers used by the cable industry. Later versions of the early "cable-ready" sets had limited super-band coverage, but their channel number designations did not match cable's channel numbering scheme, causing even more confusion among cable subscribers.

The cable industry compounded the confusion even further by using alphabetical channel designations for mid-band and super-band channels on many set-top converter/descramblers. In addition, the channel program cards supplied subscribers usually listed the channel designation scheme utilized by converter/descramblers and not the channel numbering scheme used by "cable-ready" receivers.

Despite this confusion, cable's new and diverse programming choices continued to attract new customers. At the same time, cable-ready receivers were becoming more popular with cable subscribers, especially since they offered such conveniences as remote on/off, volume control, channel tuning and limited remote color adjustment.

Most of the converter/descramblers offered either non-remote units or cumbersome, cord-type remotes, neither of which offered remote on/off or volume control.

Another factor driving cable in the opposite direction of customer convenience was the need to scramble pay services to control the unauthorized reception of these services.

In the early 1980s, a second, more secure generation of converter/descramblers was offered by converter manufacturers to counter the rising theft of cable pay services. Most of these new descramblers offered such customer amenities as infrared remote control of volume, channel tuning, receiver on/off, favorite channel recall and channel scan, among other features. Although these features were attractive to many cable subscribers and an additional source of revenue for operators, they represented a duplication of cost to, We've created maximum signal security with the Magna 6400 Addressable Converter System. Maximum could be an understatement because our System possesses Encryptic Encoding™—an incredibly intelligent scrambling method combining advanced digital techniques with proven RF circuitry.

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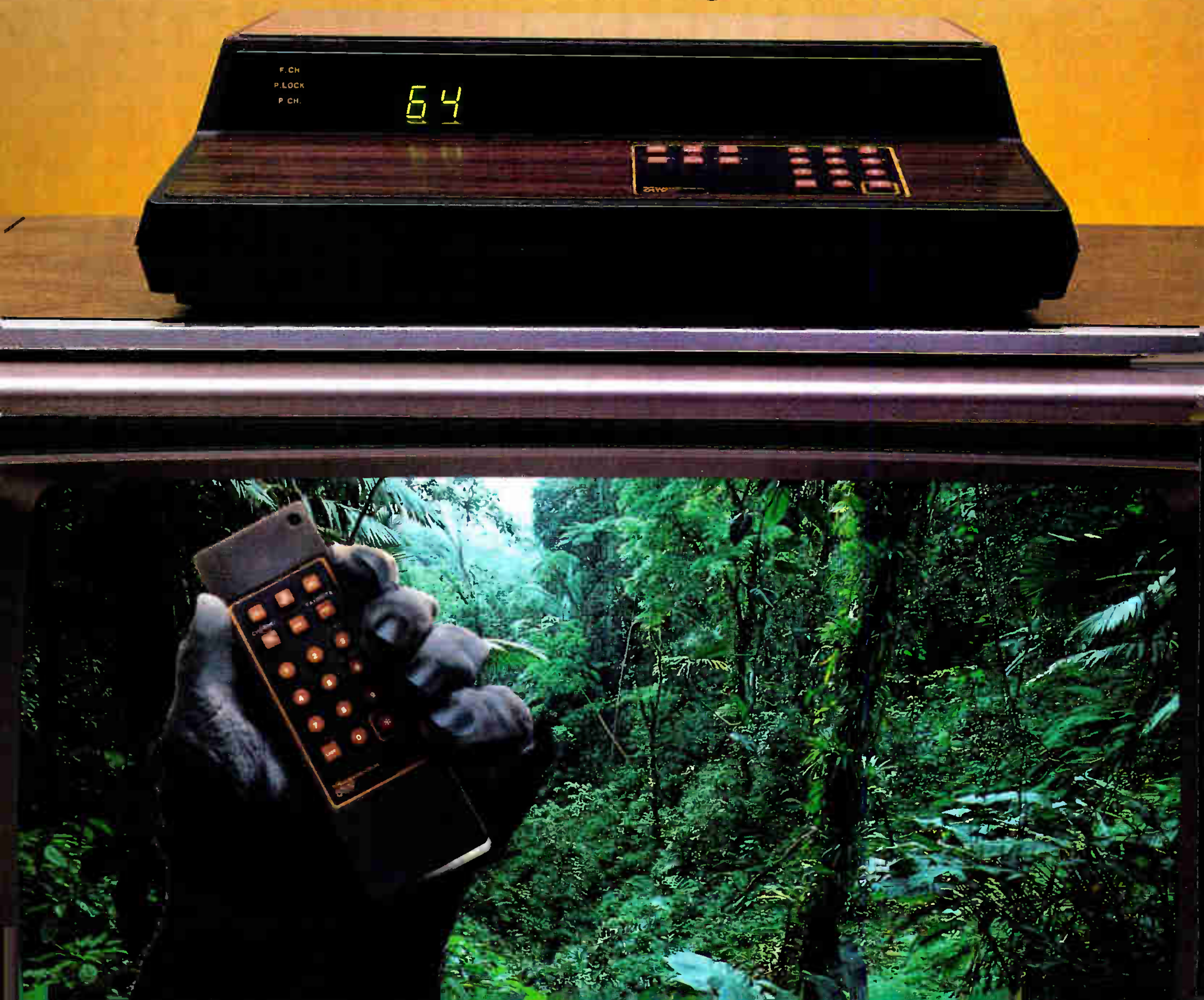

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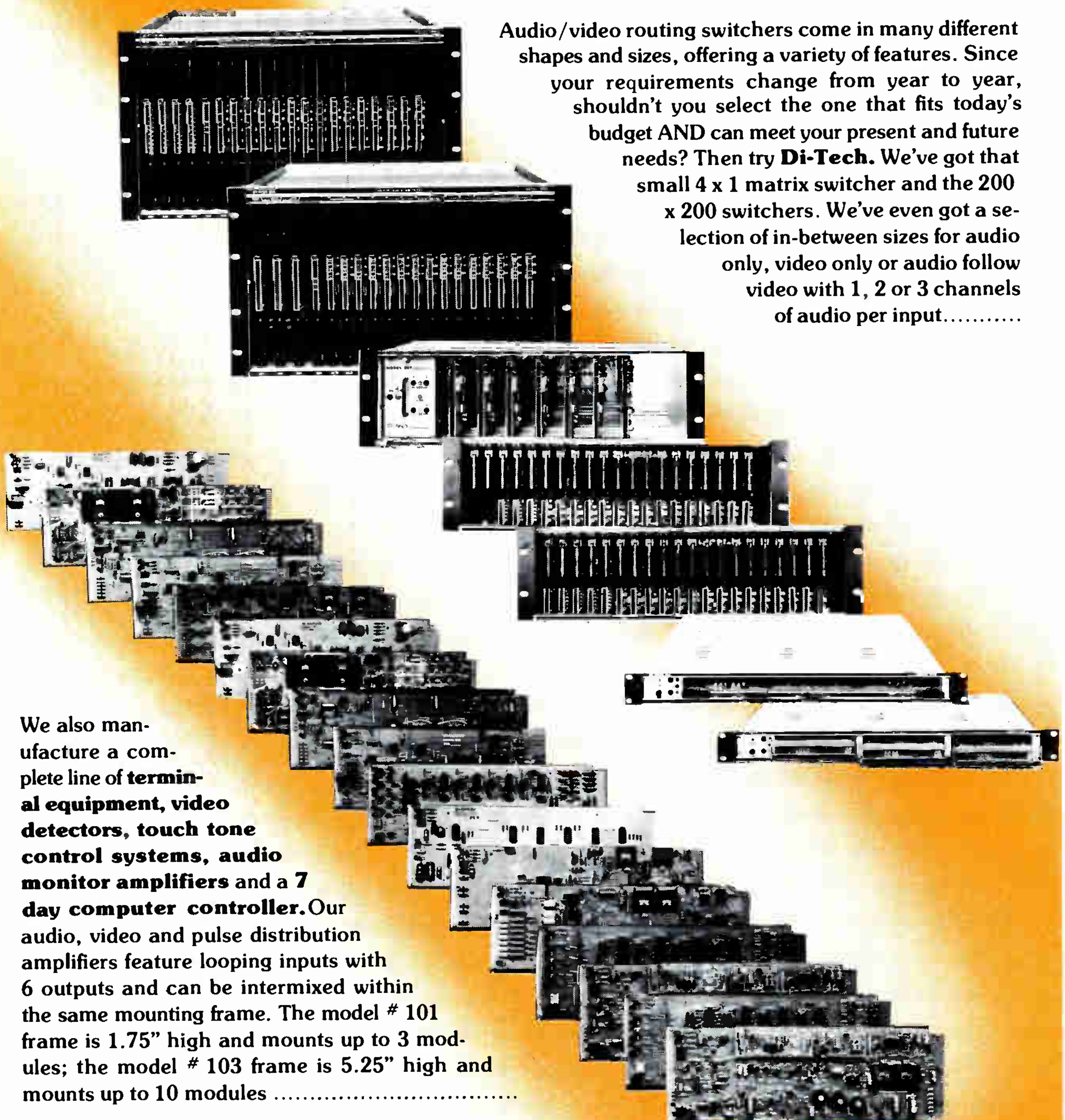

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and engendered confusion and resentment among, cable subscribers who had remote control "cable-ready" television receivers.

By early 1982, the consumer electronics industry was able to offer receivers that matched the technological capabilities of modern cable systems as far as channel tuning, but the consumer still could not utilize all the features of his remote control receiver if he wanted to subscribe to a cable or pay TV service.

The tiering structures of new cable marketing strategies now were requiring more and more channels to be scrambled. As a result, the incompatibility issue intensified. The television receiver and cable industries continued to diverge. No suitable marriage of the respective technologies was attempted.

Videocassette recorders pose other problems. As sophisticated as both cable and VCR technologies are, many incompatibilities exist. Stereo television represents yet another challenge to the cable industry.

Customer service has become a major industry focal point during the last year. One important element in this quest for greater customer satisfaction and customer retention is the willingness to address the issue of compatibility between cable technology and customers' entertainment equipment. With the mushrooming of VCR sales and the advent of stereo television, subscribers are making significant investments in sophisticated entertainment equipment. This equipment offers greater convenience and flexibility in entertainment choices; and if cable TV limits this flexibility, the subscriber is likely to spend his entertainment dollars elsewhere.

Collaborative efforts

An encouraging development in early 1982 was the Electronics Industries Association and the National Cable Television Association's decision to sponsor a joint engineering committee to explore the various incompatibilities between modern cable television systems and services and TV receivers, particularly the "cable-ready" type. Three working groups were formed to address channel tuning standards, RF interface standards and a cable decoder/television receiver interface.

In 1983, EIA Interim Standard (IS-7) was issued. It proposed a standard channelization and numbering plan to be used by consumer electronics manufacturers, cable equipment manufacturers and cable television systems.

The RF interface standard, which deals with such things as television receiver input levels, impedances, return loss, oscillator leakage, etc., has one more task to perform. Field tests have indicated that current cable-ready receivers have insufficient RF shielding protection against strong local broadcast television stations. Laboratory work currently being done will attempt to establish an acceptable specification on RF shielding integrity.

The decoder interface working group has developed a baseband video/audio interface. A preliminary field trial of this baseband interface will be conducted in early 1985. Participating in these trials will be a number of major television receiver and cable descrambler manufacturers.

The main premise of the interface is that it will support the use of a scrambled signal decoder module that will plug into a multi-pin connector on the back apron of a cable-compatible television receiver. All tuning, amplification and detection functions will be performed in the television receiver. The decoder module will provide the authorization recognition and descrambling functions necessary for scrambled or tiered services. Non-addressable and in-band or out-of-band addressable baseband scrambling systems could be supported by this interface. All present capabilities of baseband addressable converter systems would be preserved.

The decoder interface offers the following advantages:

To the subscriber:

- Full utilization of all receiver remote control functions
- Single remote control, even for pay services
- No monthly charge for a second remote control
- Potentially cleaner pictures due to the elimination of doubly processed signals when using an external converter/descrambler

To the cable operator:

- A possible 50 to 66 percent savings in decoder capital investments
- The long-term potential for eliminating all decoder investment costs
- Greater customer satisfaction
- Simpler maintenance and fewer service calls for decoder problems

The proposed receiver/decoder interface sits squarely between two diverse cable industry opinions. One says the ultimate location for the subscriber decoder should be off-premises so cable signal security can be controlled. The other argues that the decoder should remain in the home if secure video encryption techniques are being employed.

Neither position completely addresses issues that may be critical to the continued growth of the cable industry, such as greater recognition of customer desires and the reduction of capital expenditures and operating expenses.

Both on-premise and some off-premise systems have redundant tuning and processing functions, which leads to subscriber frustration. Other off-premise systems, such as the "switched trap" systems, do not have redundant tuning and processing functions, but have other drawbacks such as limited tiering capabilities.

The baseband decoder interface may offer a solution to both these problems. The elimination of the redundant tuning and processing of cable signals with the decoder interface is clearly evident. What may not be so evident is the potential for substantial long-term savings in capital investment and operating expenses.

Decoder interface benefits

If the decoder interface concept is married with a secure video/audio encryption system, it's possible for the subscriber to own and install the decoder himself. The cable operator could control the encryption key and download information to activate the decoder.

Even if the operator continued to own the decoder, its cost would be considerably less than a set-top model. Some adjustments would be necessary for the cable operator. Remote control revenues lost due to the decoder interface could possibly be recovered by charging a minimal rental fee for the decoder. This fee could possibly recover the complete capital investment in less than two to three years. Operator-owned decoder maintenance costs should be less than what is presently incurred because of its reduced parts count. Subscriber-owned decoders could be repaired or replaced by the cable operator for an appropriate fee. Decoders could possibly become a throw-away item if modern IC technology reduced decoder cost sufficiently.

A real boon to the implementation of this interface would be the adoption of a single video encryption standard. If this occurred, *standard* decoder modules could be produced by any number of untraditional decoder manufacturers. Subscribers could purchase their decoders from a television dealer or other electronics outlet, with the capital and maintenance costs becoming the sole responsibility of the subscriber.

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Reader Service Number 10

To encourage the purchase and rapid deployment of cable-ready receivers with the decoder interface, cable operators could offer either a rebate program in conjunction with receiver manufacturers or a discount on the subscriber's monthly cable bill.

The proposed receiver baseband interface also could support other consumer electronic devices and services capable of baseband video/audio inputs and outputs such as VCRs, videodisc players, teletext decoders, DBS receivers and stereo television broadcasts. Personal computers could be interfaced either through composite video or RGB connections.

Multiple interface devices such as a pay service decoder and a VCR interface module could be accommodated via a "piggy-back" arrangement in which one interface module plugs into the top of a previously installed module.

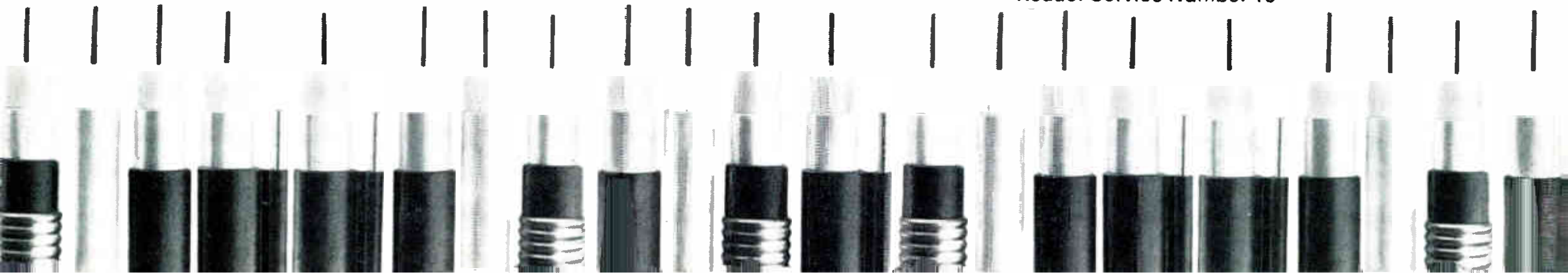
Arguments for cooperation

Other cable/consumer interfaces are faced with some of the same difficulties as television receivers. The full operational features of modern, programmable VCRs are negated by much of the existing cable converter/descrambler technology.

Converter enhancements such as programmable remote controls, which will turn on and tune the converter at pre-set times and intervals for unattended recording, will be helpful. But the subscriber will still be faced with programming both his converter remote control and his VCR for simultaneous operation.

The cable industry's plans for a viable pay-per-view or pay-on-demand service (to counter the impact of video tape rentals) should consider the possibility of a strong demand for either attended or unattended recording by the subscriber. If the cable/VCR interface is not simplified, some operators might have unpleasant conversations with subscribers who purchase a PPV event with the intent of recording it while away from home, only to find that cable/VCR interface incompatibility prevented the VCR from recording.

Consumer electronics manufacturers and the entire cable industry—manufacturers and operators alike—must begin to work more closely to meet the needs of our common customer. There are a number of existing committees jointly sponsored by the EIA and NCTA that are attempting to address the various incompatibilities that exist between the two technologies. These committees need your suggestions and help. CED



Living with 21006

By Roy O. Ehman
Director, Technical Services
Storer Cable Communications

Yes, folks, FCC Docket No. 21006 is going to change the way we do business. The interim signal leakage rules we've been operating under for the past few years have now become final regulations, although the NCTA and others have filed for reconsideration of the decision. Frequency offsets, peak power limits and routine monitoring provisions are key elements of the new rules.

Let's start by taking a closer look at the new offset requirements. We will be on a channelization plan that doesn't include the standard frequencies as we have known them such as XXX.250 MHz. But there is some flexibility and, assuming you meet the leakage requirements, you will never have to do those tedious computer runs or, worse yet, those "distance by trigonometry" calculations.

We must be offset 12.5 kHz from all FAA/government stations in the communications bands (118-136, 225-328.6 and 335.4-4-400 MHz) and 25 kHz in the navigation bands (108-118 and 328.6-335.4) with a frequency tolerance of ±5 kHz. The rule holds regardless of how far your system may be from any such station in the continental United States.

Expressed as a simple formula, our comb in the navigation bands is ± (2n + 1) × 25 kHz, and in the communication band it is ± (2n + 1) × 12.5 kHz (where n is any integer including zero). Let's take two examples. First, Channel A − 2 previously on 109.250 could now be on 109.175, 109.225, 109.275, 109.325, 109.375, etc. Taking Channel L in the communication band at 187.250, the new possibilities would be 187.2125 (n = 1 and —(2n + 1) × 12.5 = −37.5) or 187.2375, 187.2625, etc.

No deviation from these allocations is permitted, regardless of service volumes or whether the adjacent channels are vacant or not.

It has not been difficult for modulators to get crystals that will meet the requirement for about $25 each. Sometimes it has been necessary to "pull" the unit using the feedback trimpot or squeezing or expanding a coil or even adding L or C. The most you can move the output frequency and remain stable is about 300 kHz. When time is of the essence, three crystals of the same nominal frequency can be ordered at the same time with the assurance that at least one of them will be close. Once the crystal is in the "window," it seems to stay within a kHz at most.

Processors are another story. Due regard must be had for the offset, if any, of the transmitting station, but there is not too much you can do about a low-grade UHF station that waltzes all over the band. If it wandered right out of the window, consideration would have to be given to going demod-remod.

HRC systems will be able to squeak by with a rubidium comb driver on 6.0003 MHz ±1 Hertz at a one time cost of $5,000 to $7,000.

The popular old Sniffer frequency of 108.625 falls on our

The new FCC rules

1. We must be offset 12.5 kHz from all FAA/government stations in the communications bands (118-136, 225-328.6 and 335.4-400 MHz) and 25 kHz in the navigation bands (108-118 and 328.6-335.4)—both with frequency tolerance (T) of ±5 kHz and regardless of the distance our system may be from *any* such station in the United States.

2. Those systems that qualify under the new rules may run signals in the plant with a maximum peak power of 10^{-4} watts (+38 dBmV) in a 25 kHz bandwidth without application.

This means we can stop worrying about clearing audio subcarriers or having to run them "reduced." It also takes the heat off FM modulated supertrunks and most data, converter and control carriers. Note, however, that in the absence of any time constant in the language, peak power means *instantaneous* peak power and, as such, it forbids signals from a high level sweep system from passing through the aeronautical bands.

3. We must set up a routine monitoring system so that the *entire* plant is covered every three months. Leaks in excess of 20 uV/Meter are to be repaired "within a reasonable period of time." The logs covering leaks found, probable cause and date repaired are, as always, to be retained for a period of two years and made available to any FCC personnel on demand.

4. In order to come under the foregoing new rules, systems must meet the cumulative leak index criteria on existing and on new plant (before it is put into service) and formally once every 12 months. This could be tough on large (1000+ miles) systems since no allowance is made for size.

5. Those systems not ready to meet the new requirements are automatically grandfathered until Jan. 1, 1990. These systems will *not* have to meet CLI nor do they have to monitor the entire system every three months, but they must continue to do "routine" monitoring which is just good engineering practice in any case. They also must be properly offset from FAA stations within 111 Km (as before, but in terms of the new reduced spacing requirement applicable to grandfathered systems). But if a new FAA "drop-in" station were licensed in the area, and absent a waiver, the system would lose its grandfathered status for the channel and might have to shut it down. There also are some interesting rule changes for grandfathered systems.

When does all this happen? The official publication date was Dec. 17, 1984, but further word is expected from the FCC before actual processing starts. But one thing is certain: Those systems than can and do come under the new rules will obviously have met CLI and, since they also will be properly offset from all FAA frequencies, it will be impossible for them to interfere with aircraft.

Those systems that do elect to stay grandfathered for protracted periods of time are going to be the object of close scrutiny by the FCC under their greatly stepped-up 1985 inspection budget.

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comb and is, therefore, good under the new rules. But if data, converter or control carriers are to be run at levels in excess of 10^{-4} watts (+38.75 dBmV peak) anywhere in the system, they will have to be moved into the relevant comb slot.

Under the new rules (and assuming you qualify on the other counts), it is merely necessary to "notify" the FCC of the aeronautical channels to be used and the offsets. You may immediately use these frequencies and, if you have done your homework properly, there will be no further response from the FCC. But make darn sure you do meet all the requirements, as a few will undoubtedly be "spot-checked" shortly after filing.

It also will be necessary to notify the FCC of all signals carried in the aeronautical bands and note the type of emission. "The timely filing of FCC Form 325, Schedule 2, will meet this requirement." Do remember to include all non-TV signals such as leakage pilots and control carriers. They are apt to be missed by the program-oriented personnel who are often responsible for making up the 325.

While discussing notification, let's clear some of the confusion surrounding the dual standards we will be looking at.

1. If you use *any* frequency in the aeronautical bands for *any* purpose, at *peak* power levels above 10^{-5} watts (+28.75 dBmV in 75 ohms), in 25 kHz of bandwidth anywhere in the system, you are obliged to monitor, log and repair leaks in excess of 20 uV/Meter. Suppression of "harmful" interference still applies to all systems under all rules. Note that your normal signal level meter is very close to peak reading but may need to be corrected from its nominal 4 MHz bandwidth to 25 kHz, depending on the type of signal being used to monitor.

2. Grandfathered systems operating under the "old" rules need only notify the FCC of the use of any frequency in the aeronatuical bands in excess of 10^{-5} watts (+28.75 dBmV) and up to, but not exceeding, 10^{-4} watts (38.75 dBmV).

3. Grandfathered systems in operation before Jan. 1, 1985, that carry aeronautical signals in excess of 10^{-5} (28.75 dBmV) must be offset from any FAA/government station within 60 nautical miles (111 Km), but it need only be by "45 kHz plus the frequency tolerance of the cable signal or signal component," instead of the old 50 + T and 100 + T.

4. Frequencies up to a power level of 10^{-4} watts (+38.75 dBmV peak) can be used without notification.

If you can't meet the new relaxed standards that now apply to grandfathered systems, and you can't meet CLI, you may eventually have to abandon some channels.

Cumulative leak index

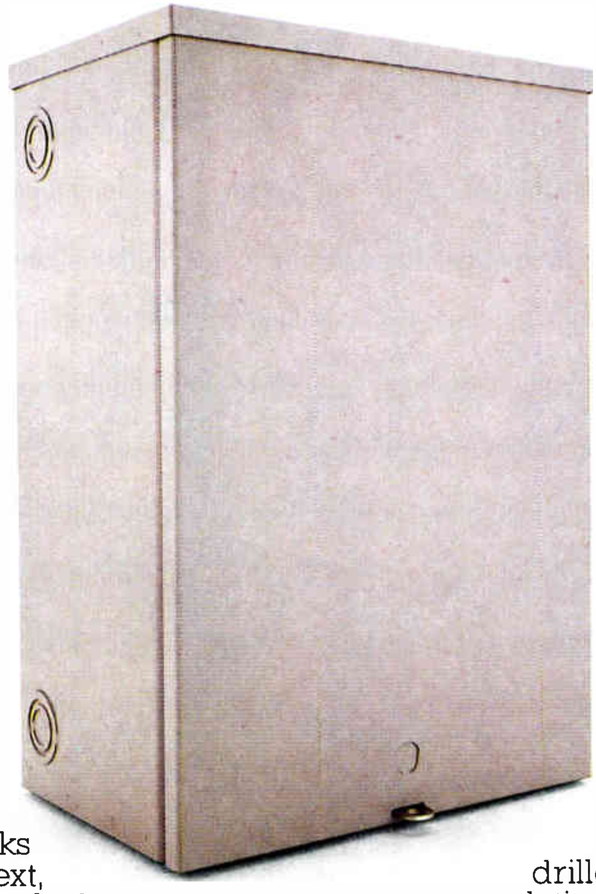
This is a measure of cable systems leakage penetrating up into the airspace of aircraft in the vicinity. The measurement technique has been around for some years, and more and more systems are using it.

The CLI is quite a different animal from single leak intensities or "leaks per mile." Since it is a very valuable tool for assessing airspace leakage, we need to be aware of the two fundamental properties that set it apart:

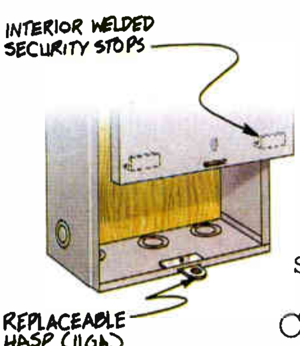
1. There is no allowance or factorization of mileage. It's just the absolute, raw number of leaks times the square of their values. This means that as far as CLI is concerned, the little systems (± 100 miles) are laughing, while the big ones (± 1000) may not be. The miles part of the calculation involves simply extrapolating the results of a partial drive-out over the entire plant.

2. There is a square law factor involved. You will observe this in the formula below where you can see that the value of "leaks found" is squared. This means that it only takes a

Details Enclosed



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



For example, CWY's all-welded enclosures are constructed of heavy 16-gauge aluminized steel—shown to outlast unpainted galvanized steel *at least five-to-one*.

For added security, CWY enclosures feature security stops welded inside the front cover...a hingeless, secure cover removal system...knockouts for optional cam locks...and extra heavy-duty plated 11-gauge *replaceable* hasps.

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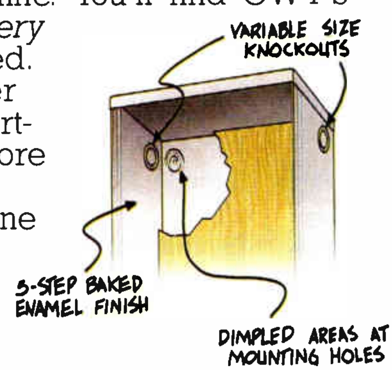
And while you're looking at detail, don't forget the bottom line. You'll find CWY's enclosures to be *very* competitively priced.

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



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handful of the bigger leaks to do you in. Let's take a look at a hypothetical example of a 1000 mile system:

Drove 750 miles.
Found 300 leaks = 50 uV/M
Found 30 leaks = 150 uV/M
Found 3 leaks = 450 uV/M

$$\text{CLI} = 10 \times \text{LOG} \frac{\text{(plant miles)}}{\text{(plant-mls driven)}} \times \text{(sum of each leak)}$$

Sum of each leak squared

$$= (300 \times 50 \times 50) + (30 \times 150 \times 150) + (3 \times 450 \times 450)$$
$$= 750{,}000 + 675{,}000 + 607{,}500$$
$$= 2{,}032{,}500$$

$$\text{CLI} = 10 \times \text{LOG}\,(1.33 \times 2032500)$$
$$= 10\ \text{LOG}\,(2710000)$$
$$= 64.33\ \text{(LOG to BASE 10)}$$

This exceeds the legal limit of CLI = 64. Note the contribution from the 3 big leaks. Without them the CLI would have been 62.79, which is most acceptable. This clearly indicates that as far as CLI is concerned, we must never let up on routine patrolling and repair and that the big leaks should be repaired immediately.

In order to help you get the feel of how CLI stacks up, here is a program that will run under almost any BASIC with minor changes.

```
100 PRINT TAB(-1,0)                                          'Clear the Screen
110 PRINT TAB(02,45)"CLI.BAS 841202 by Roy Ehman"            'Subst. your name etc
120 PRINT TAB(05,00);                                        'Skip 2 lines
130 PRINT "      TOTAL NUMBER   SIZE  IN       CUMULATIVE"
140 PRINT "      PLANT  LEAKS   MICROVOLTS     LEAK INDEX"
160 DIM S(3)                                                 'Cute little array


200                                                          'RERUN entry point
210 PRINT TAB(7,0)TAB(-1,10)                                 'Clear to end of screen
220 PRINT TAB(20,30)"Zero Microvolts also ends input"
230 FOR I=1 TO 3 :LET S(I)=0 :NEXT I                         'Set Leaks Squared=0
240 LET ROW=8     :LET I=1


300                                                          'NEXT LINE entry point
310 LET NN=0 :LET MV=0                                       'Reset input variables
320 PRINT TAB(ROW,07); :INPUT:NN                             'Use your own protocols
330 PRINT TAB(ROW,22); :INPUT:MV                             'to position cursor
340 S(I)=(NN*MV*MV)                                          'under correct columns
350 CLI=10*LOG10(S(I)+1)                                     'Calc single value CLI
360 PRINT TAB(ROW,35)CLI                                     'Print it
370 ROW=ROW+1   :I=I+1                                       'Increment line & subsc.
380 IF MV <> 0 AND I < 4 THEN GOTO 300                       'Return if not ended


400                                                          'END sequence
410 CLI=10*LOG10(S(1)+S(2)+S(3)+1)                           'Calc summation CLI
420 PRINT TAB(ROW+1,07)"CLI - ALL  LEAKS  COMBINED ":
430 PRINT TAB(ROW+1,35);CLI                                  'Print it
440 IF CLI>64 THEN PRINT TAB(ROW+1,42)"  (There's work to be done!)"
450 PRINT TAB(20,30)"RETurn to Continue any letter to stop . . . ";
460 INPUT;ANS$
470 IF ANS$=""  THEN  GOTO  200
480 END
```

The TAB, ROW and COLUMN calls position the cursor. Use the equivalent for your version of BASIC. To get a printing version, just write duplicate print statements to file and spool, or send me an SAE for a listing.

Here is an example from the above program to consider. The number of leaks is the total plant leaks as extrapolated from drive-outs, which should always include your most leaky plant.

NUMBER OF LEAKS	SIZE IN MICROVOLTS	CUMULATIVE LEAK INDEX
100	75	57.50
200	75	60.51
500	75	64.49
1000	75	67.50
50	150	60.51
100	150	63.52
200	150	66.53
5	500	60.97
10	500	63.98
20	500	66.99
1	1000	60.00
2	1000	63.01
5	1000	66.99
1	1000	60.00
1	1250	61.94
1	1500	63.52
1	1750	64.86

It is important to note that 50 uV/meter is the threshold level for inclusion of leaks in the CLI calculation. This is clearly stated in Docket 21006, Second Report and Order Appendix A, Paragraph 3, (a), (1), and could easily be overlooked in a cursory reading.

Quarterly and annual ride-out

Under 21006 we must institute a monitoring, logging and repair operation such that our entire plant is covered every three months. Additionally, one of the four coverages must be an accurate CLI patrol embracing at least 75 percent of the plant and including any parts that may tend to low integrity. The result must be CLI = 64 or less. A similar CLI also needs to be done *before* we can come under the new rules. Also, any new plant, when calculated in with the rest of the plant, must meet CLI = 64 before it is put into service. For this purpose *any* test frequency will be acceptable, but if it's an aeronautical, it must have one of the standard offsets.

For monitoring under 21006, the pilot carrier used must be unmodulated (or you must be able to show how a modulated carrier equates to the modulated one with the equipment you use), and it must be in the VHF aeronautical band at a level equal to the highest level aeronautical carried on the system. This means that you may end up loading the system with an additional, heavily square-wave-modulated carrier 3-5 dB higher than surrounding picture carriers.

We are to measure the leak level at 3 meters from the cable for any or all frequencies, and this rule applies to *all* systems that use the aeronauticals. This is new for existing and grandfathered systems. To do a proper CLI you would need to classify your leaks into at least three catagories. You would have to stop your vehicle, get out, set up an RD-1 or similar, get to the right distance and orientate the antenna as prescribed for maximum reading.

At first this may appear unreasonably tough, especially if there is no access to rear-lot cable plant. The rules go on to say that larger systems with such access problems might do the measurements by fly-over. This also is costly and involves a properly calibrated crossed-dipole antenna, a recorder (analog or digital) and the aircraft itself. The level at 450 meters above average system terrain is not to exceed 10 uV/meter. Some MSOs figure that if they measured every leak with a calibrated dipole in the prescribed manner, they would have to immediately hire and train 25 techicians for that sole purpose. Fortunately, the exclusion of under 50 uV readings from the calculations is a big help here, although such leaks also must be logged and repaired.

Although the 3 meter reading is the benchmark, we are allowed to use other methods at other distances provided we can justify the procedure by showing the relationship to a proper standard. This should be on file at the FCC. Levels at greater distances can be factored back to the level at 3 meters by formula. This opens the door to readings from the street done on equipment with secondaray calibration.

We need to clearly differentiate between three kinds of monitoring:

1. First, there is what the FCC calls routine monitoring and what many in the industry refer to as "random" (as opposed to structured) patrol or monitoring. If you have enough technicians and vehicles equipped and in use, this meets the requirement. But it must be monitored closely as it tends to fall into disuse. Routine or random monitoring continues to be required of *all* systems under new and old regulations. Logs showing leaks found, probable cause and date fixed must be available for inspection for two years.

2. Next is the quarterly patrol. This is an extension of the routine monitoring with the assurance that the entire system was covered during the three month period.

3. The annual CLI is what we might call a structured patrol. Leaks found need to be measured with a fair degree of accuracy by one of the acceptable methods and graded into four categories as such:

a. Under 50 uV/M. Does not go into the CLI calculation but logged for normal attention.

b. 50 to 100 uV/M. Average = 75 for repair and calculation.

c. 100 to 200 uV/M. Average = 150 for urgent repair and the calculation.

d. Over 200 uV/M. These, should be repaired immediately and not go into the calculation at all.

One can do no better than quote the actual words of the FCC: "The basic annual signal leakage performance requirements are intended to provide periodic assessment of a system; whereas regular and routine monitoring requirements are intended to assure that a cable operator undertakes responsible steps and appropriate procedures to detect and correct signal leakage sources throughout the year."

If you have never done a CLI before and don't have enough accurate level readings on hand, but do have the total system leaks based on a recent ride-out, you may have to start by making some suppositions.

EXAMPLE: 500 mile plant.
500 leaks found.

Just to get some idea, let's say:
95% of the leaks were at 60 uV/M
5% of the leaks were at 150 uV/M
1% of the leaks were at 350 uV/M
for a composite CLI of 61.8

This is hardly a scientific approach, but it's a start. You could use this yard stick to compare systems. It's also easy to get the CLI program to do it that way automatically in the interim.

For the quarterly patrol, some systems have had a fair amount of success using a small ($55) hand-held dictation ma-

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chine and driving at about 15 to 20 miles per hour. The tape is then turned in at the office, and a typed log for scheduling repairs and filing is made available. It is possible to cover 50 miles per day quite adequately in this manner.

The foregoing is by no means complete, but it will have served to whet the appetite for a strongly recommended reading of the actual Report and Order where additional interesting details may be found.

And here's a parting thought. If you can keep *all* your leaks under 50 uV/M @ 3 meters, you need never do a CLI! CED

Editor's note:

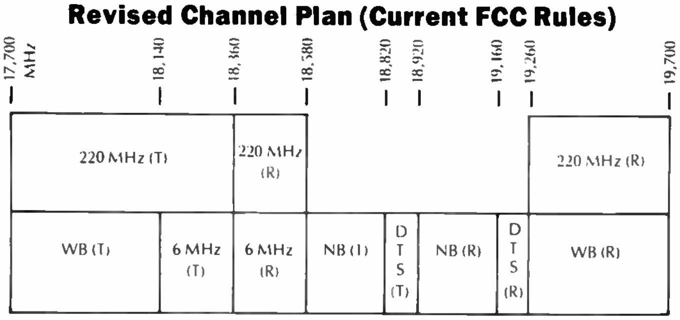
The information and results put forward in this article have been carefully researched and are believed to be accurate and current. They are, however, the views of the author, and obviously "no warranty is expressed or implied" on behalf of any party (specifically including the FCC, NTIS and Storer Communications).

Correction:

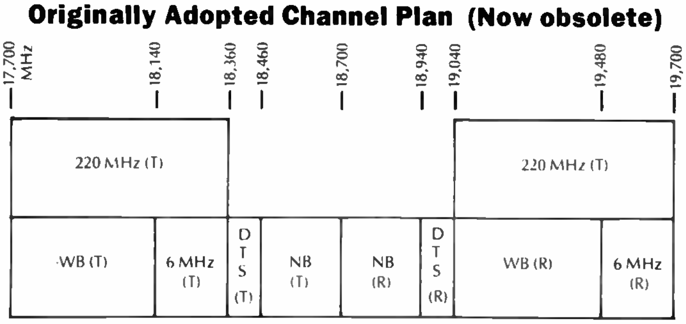
In the January issue of CED, the diagrams that appeared in Figure 2 on page 36 were, unfortunately, transposed. Our staff wishes to apologize for any confusion or inconvenience this error may have caused you. The figure, as it should appear, is shown below.

18 GHz Channel Plans

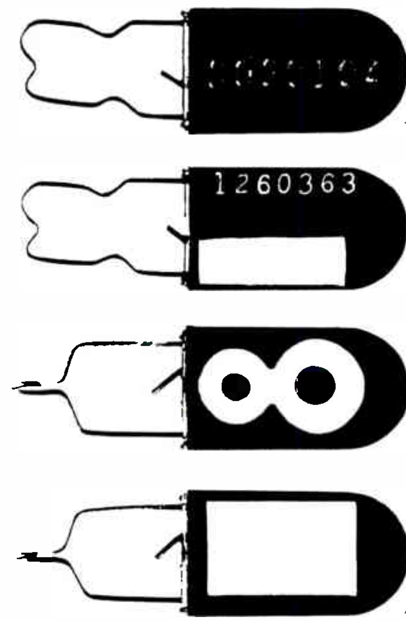
Revised Channel Plan (Current FCC Rules)



Originally Adopted Channel Plan (Now obsolete)



Key:
DTS = Digital Termination Systems
220 MHz = 220 MHz channels
WB = 10, 20, 40 & 80 MHz channels
NB = 5, 10 & 20 MHz channels
6 MHz = 6 MHz channels
(T) = Transmit frequencies
(R) = Receive frequencies



February

1: The Texas Cable Show sponsored by the **Texas Cable Television Association** will be held at the convention center in San Antonio, Texas. Contact Bill Arnold, (512) 474-2082.
5-6: The **Arizona Cable Television Association**'s 1985 Annual Meeting will be held at the Phoenix Hilton Hotel in Phoenix, Ariz. Contact (602) 257-9338.
6-8, 11-13: Magnavox CATV Training Seminar will be in San Jose, Calif. Contact Laurie Mancini, (800) 448-5171 or (800) 522-7464.
11-15: Knowledge Industry Publications will hold Video Expo at the San Francisco Civic Auditorium. Contact Sheila Alper, (914) 328-9157.
12-14: Len Ecker Technical Seminar, Orlando, Fla., sponsored by the **Jerrold Division** of the General Instrument Corp. Contact Ann Pliscof, (800) 523-6678.
13-15: Georgia Cable Television Association Annual Convention, Atlanta Hilton, Atlanta. Contact Nancy Horne, (404) 252-4371.
17-18: The **Idaho Cable TV Association** will hold its annual convention at the Red Lion Riverside in Boise. Contact Jean Westin, (206) 336-9121 or Bruce Frickelton, (206) 627-6981.
19-21: C-COR technical seminar, Columbus, Ohio. Contact, (814) 238-2461.
20: A seminar on system design sponsored by the **Delaware Valley Chapter of the Society of Cable Television Engineers** will be held at the George Washington Motor Lodge in Willow Grove, Penn. Contact John Kurpinski, (717) 323-8518.
26-28: William Grant, author of *Cable Television*, will conduct a CATV Technical Training Seminar at the Harley Hotel, Atlanta, Ga. Contact Howard Plattner, (703) 823-6522.

March

4-6: Cable-Tec Expo, Sheraton Hotel, Washington, D.C. Contact: Society of Cable Television Engineers. (215) 692-7870.
11-12: Waters Information Services Inc. will sponsor "The Conference on Stereo Television" at the Hyatt Islandia Hotel, San Diego, Calif. Contact Dennis Waters or Merrill Oliver, (607) 770-1945.
11-13: A short course in fiberoptic communications will be offered by the **Arizona State University** in Tempe, Ariz. Contact Joseph Greenburg, (602) 965-1740.
12-14: Len Ecker Technical Seminar, St. Louis, Mo., sponsored by the **Jerrold Division** of the General Instrument Corp. Contact Ann Pliscof, (800) 523-6678.
13-15, 18-20: Magnavox CATV Training Seminar, San Antonio, Texas. Contact Laurie Mancini, (800) 448-5171 or (800) 522-7464.
19-21: C-COR Electronics technical seminar, Chicago. Contact Deb Cree, (800) 233-2267.

Looking ahead

April 10-12, 16-18: Magnavox CATV Training Seminar, Denver, Colo. Contact Laurie Mancini (800) 448-5171 or (800) 522-7464.
April 15-17: "Communications Satellite Systems-The Earth Station," San Diego, Calif., offered by The George Washington University. Contact Darold Aldridge, (202) 676-8518.
April 30-May 2: CATV Management, Engineering and Operating Principles workshop, offered by abc TeleTraining in Chicago. Contact (800) ABC-4123.
June 2-5: National Cable Television Association convention, Las Vegas Convention Center, Las Vegas. Contact (202) 775-3550.
June 17-19: Community Antenna Television Association Annual Convention, Nashville. Contact CATA, (202) 691-8875.
July 9-11: CABLE 85, The Brighton Metropole, U.K. Contact, 01-868 4466.
July 29-August 2: "Satellite Communications Networks," Washington, D.C., offered by The George Washington University. Contact Darold Aldridge, (202) 676-8518.
August 25-27: Eastern Cable Show, Congress World Center, Atlanta. Contact Convention & Show Management, (404) 252-2454.
September 18-20: Atlantic Show, Atlantic City. Contact (609) 848-1000.
September 25-27: Great Lakes Expo, Convention Center, Indianapolis. Contact IL/IN Association (618) 243-6263.
December 5-7: Western Cable Show, Convention Center, Anaheim, Calif. Contact California Cable Television Association (415) 428-2225.

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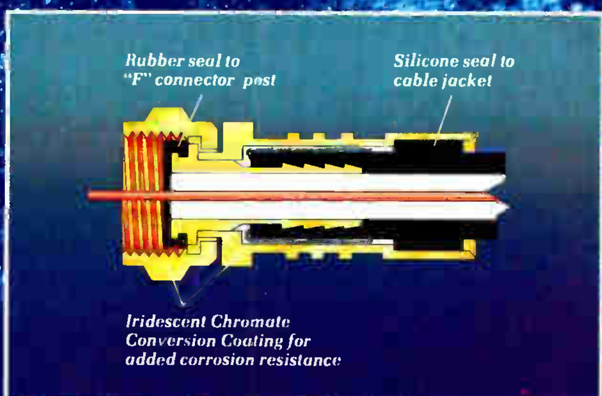

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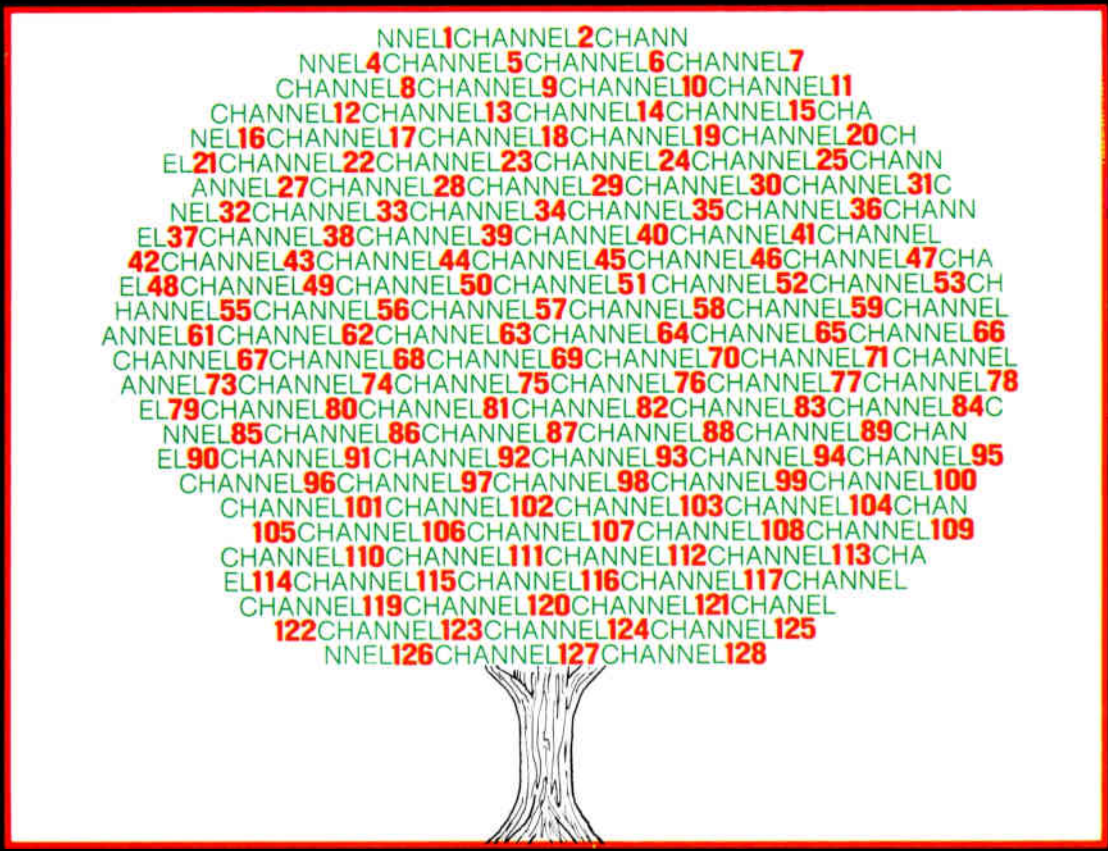
128 ways to Cherry-Pick



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Reader Service Number 24

FEATURE

Two-way converter security

By Donald Dworkin, Group Director, Engineering, NYT CableTV

Mention "converter security" to a group of "N" cable people, and you will get "N + 1" opinions back. Somebody changed his mind!

The Sprucer converter, marketed by Kanematsu-Gosho (USA) Inc., is an in-home model with an infrared hand-held remote control unit. NYT CableTV began installing Sprucers in January 1984 in a 4,000-subscriber section of its Cherry Hill, N.J., system.

Previously, NYT used the usual type of converter with a PROM chip and corded remote control unit. NYT's "missing" rate, system wide, for those units was approximately 0.21 percent per month. In addition, we have estimated that between 5 to 15 percent of NYT subscribers were "non-pay" pays due to tampered, missing or drifting traps. With the new two-way Sprucer converters, our total missing rate among those 4,000 subscribers has been 0.013 percent per month.

The key to good security lies in each subscriber's carefully educated understanding that the new two-way converter uses no traps, is completely controlled by the headend computer and would be useless if stolen. Part of each salesperson's explanation to the new subscriber (or that of the customer service representative to the self-installed subscriber) includes a description of how the converter is continually addressed and responds at certain intervals.

A subscriber can actually see this concept in action when his converter is installed. Initially, it is authorized for all channels, but after one day's viewing of all premium services, a channel authorization command is sent to the converter, shutting off all services except those which the subscriber has agreed to purchase.

Later, if the subscriber fails to pay his bill in a reasonable time, the converter will be soft disconnected or force-tuned to a "barker" channel programmed by the cable system. This will be the only channel available to the subscriber until the bill is paid or the converter is removed. Homes with a cable-ready set or an old converter may see only standard off-air channels or "unimportant" channels which NYT does not bother to scramble.

The two-way system monitoring affords other protection. If power cords are unplugged, the Sprucer system computer will print out a list of all converters that do not respond to the address. The subscriber then may receive a call from the cable office to determine the status of the Sprucer converter. This would be a favor to the honest subscriber and a discouragement to the not-so-honest one who may have been thinking about "removing" his converter.

Sprucer converters also have physical security features, with the usual security screws, seals which must be destroyed before tampering can begin, and a disabling switch that opens when the cover is removed. This switch will shut down the microprocessor until the system reactivates it.

Most important, Sprucer's security

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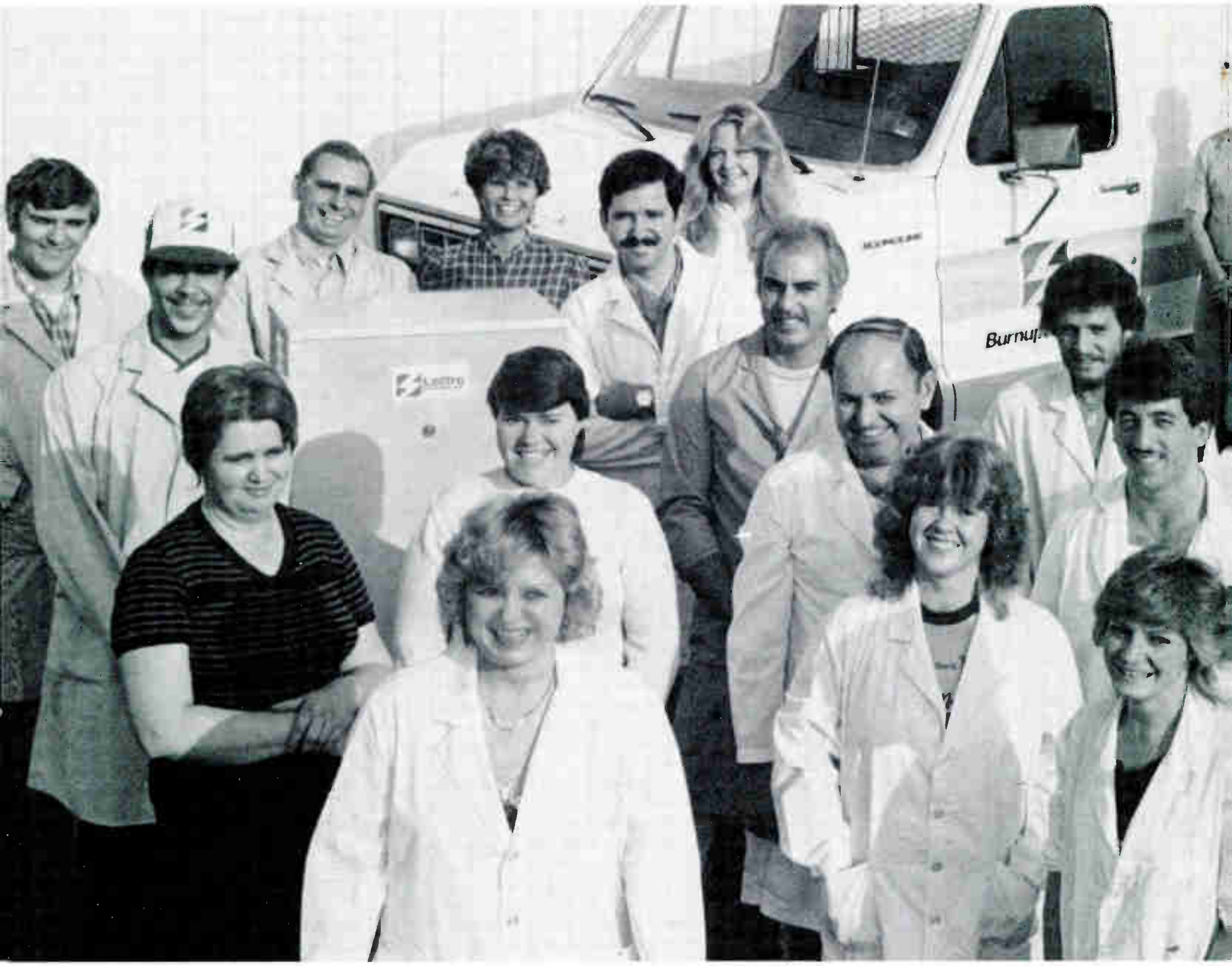

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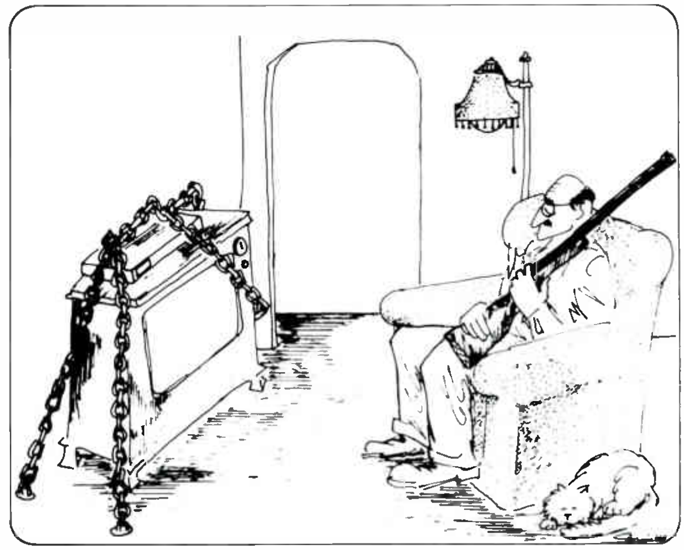

The key to converter security does not rely upon armor plating the converter. . .

also includes sophisticated scrambling modes, consisting of 16 different modes of random video signal inversion for every field. It also utilizes two level shifts of vertical and horizontal synchronous signals, producing 32 modes of scrambling. These modes also can be changed on a daily or random basis to nullify any possible descrambling.

An illustrative case occurred when a teenager stole a Sprucer converter from a home. NYT promptly deactivated the converter since we knew its "address" number from our customer records. Much to the boy's frustration, the converter would not operate, so he broke into a second home and substituted it for the converter there. The second home owner was about to move and, not knowing its history, turned in converter #1 to our office. However, we knew its history as soon as we compared address numbers, so we promptly deactivated the second converter. The completely frustrated culprit was quickly apprehended, together with the second converter. The resulting headlines in the local newspapers served to educate the entire community.

Kanematsu-Gosho is continuing to develop new software to further improve system security and reduce errors. Eventually, the Sprucer computer will poll every converter and reauthorize only those channels it is supposed to receive. If a converter does not answer its authorization command, the computer will place its number in a special file. When the converter does answer its next normal polling, the full authorization command will be sent. The converter's answer, as always, will be checked against the command. Any discrepancies on either normal polling or the special polling will create an error message which will be printed out.

The key to converter security does not rely upon armor plating the converter or placing it where the subscriber cannot get his hands on it, but rather, in educating the subscriber to the futility of converter tampering. This appeal to good sense, coupled with the knowledge that the system has the converter under minute-by-minute scrutiny, has worked so well to date that NYT Cable has begun re-equipping the rest of its 119,115 subscribers with the new Sprucer two-way converter. CED

Communications Engineering & Design

TECH II

CED's feature supplement and Product Profile

February 1985

- **Broadband basics**
- **Product Profiles: character generators, commercial insertion equipment**

Vidifont Graphics V from Thomson-CSF.

Control Video's Saber Spot Assembler.

Broadband basics

By Edward Cooper
Manager, Cable Design & Consulting, Sytek

With this installment, Edward Cooper begins a series on the fundamentals of broadband network design, based on his recent book, Broadband Network Technology.

The arrangement of a broadband network often is described in two ways.

- Its physical topology: where the components are located.
- Its logical topology (architecture): how the components are connected to each other by the network.

The placement of the headend and the distribution network determines the physical topology of the system. From the local network point of view, the logical topology or architecture of the broadband network could be a ring, star or bus. This level of organization is distinct from the physical topology, and depends on the LAN interface devices connected to the broadband network.

A single broadband network can support several different types of local networks, each with a different logical topology.

In a bus network, all interface devices may have equal access to the network's resources. This structure requires a method to regulate transmissions and to prevent one device from monopolizing the network. Data communication networks have used such methods, called channel protocols, for many years.

In a token-passing ring network, each interface device has permission to transmit when it receives a unique pattern of data over the network called the token. This station then transfers its data to the network and passes the token along, when finished, to the next station in the ring.

In a polled star network, a master controlling device grants permission to transmit to each connected station, one at a time. All communications traffic passes from the source device, to the central controller, and then to the destination device.

Other combinations of topologies and operating rules, or protocols, can be used on a broadband network. These communication protocols are provided by the interface devices attached to the network, and not by the backbone network itself. As long as interface devices can successfully get signals on and off the cable, they can send any kind of data using any kind of protocols.

Once the basic topology is determined, the distribution network can be designed to supply proper signal levels to each connection.

Decibels

Calculating signal levels throughout an entire system can be time-consuming, especially when several channels and amplifiers are involved. This task is made easier by expressing signal levels in logarithmic units.

The decibel is a unit that expresses

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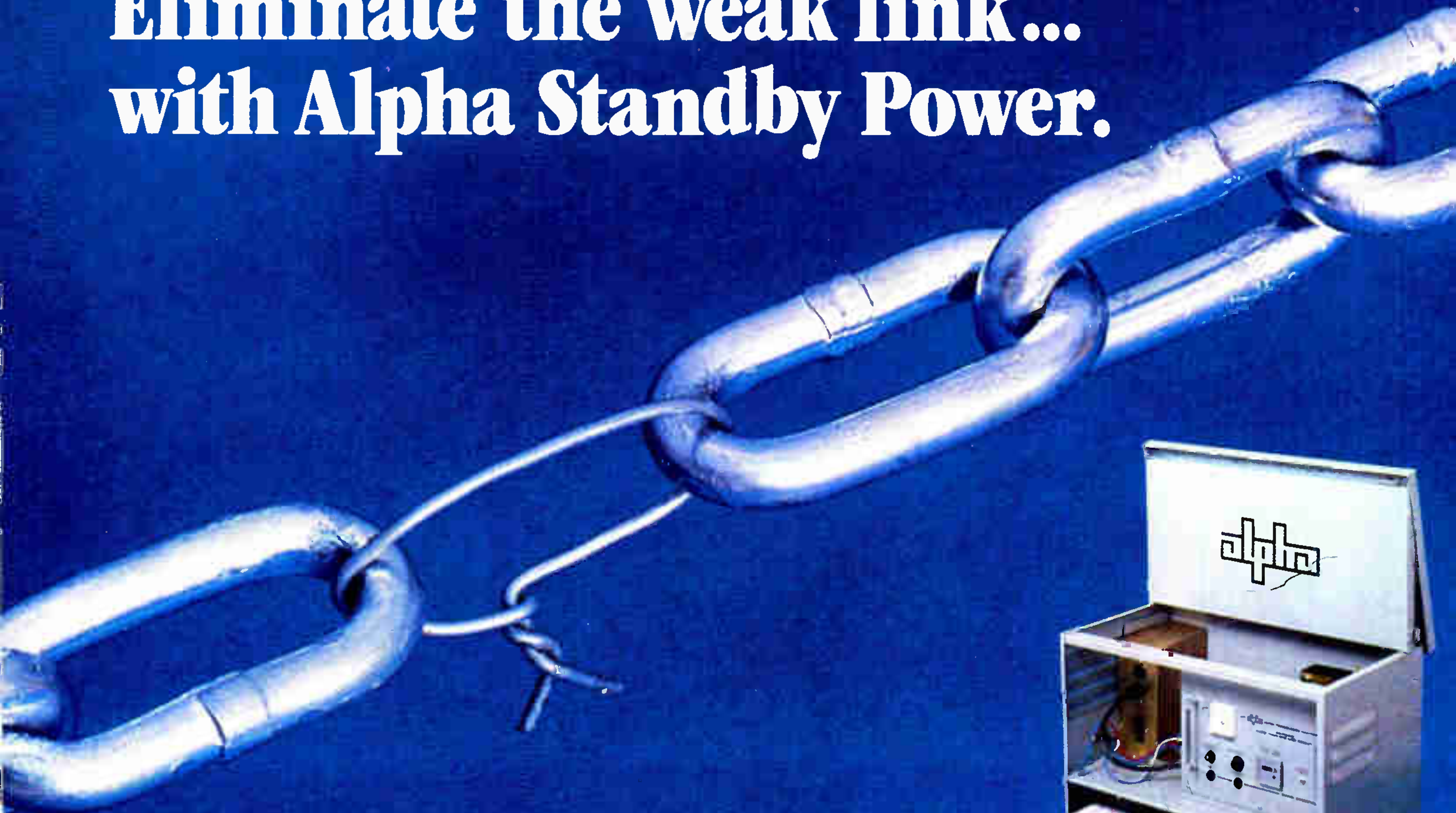

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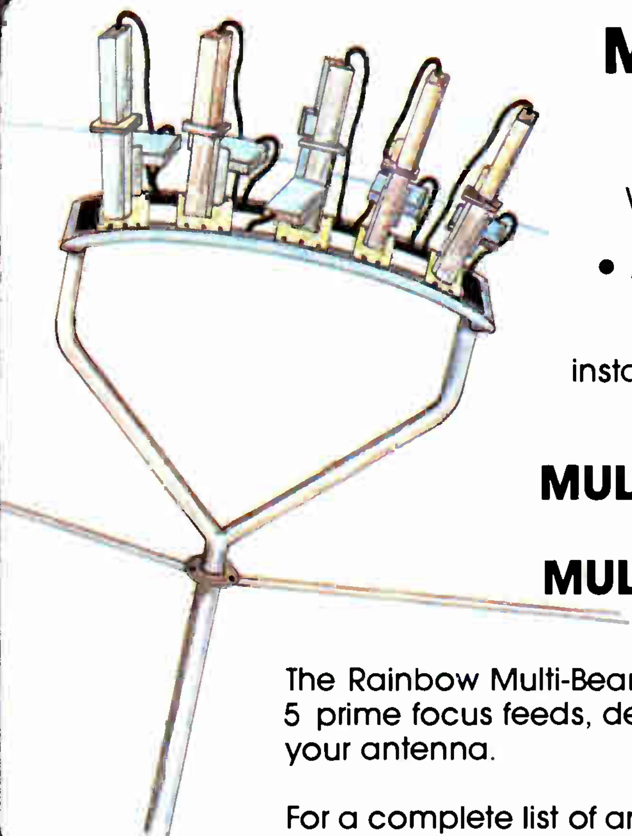
5 Star General



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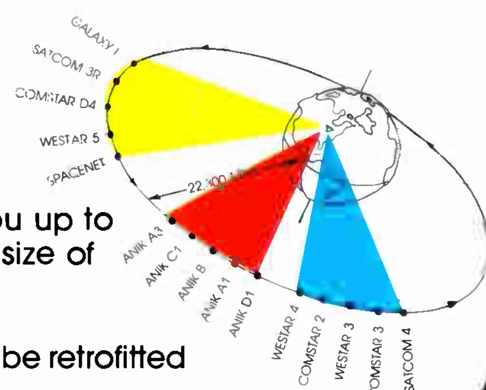

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the ratio of two levels of power. It also can be used to express the ratio of two voltage or current values, if they are measured at points of similar impedance. For example, many network components have an input and output connection. The ratio of the signal levels at these two points can be expressed in decibels, such as an attenuator with 3 dB of loss, or an amplifier with 20 dB of gain from input to output.

$$\text{Number of dB} = 10\log(P_1/P_2) = 20\log(V_1/V_2)$$

where P_1,P_2 are power levels
V_1,V_2 are voltage levels
log is the base ten logarithm

A standard unit used in the CATV industry to express signal amplitude is the decibel, referred to one millivolt (dBmV).

$$\text{Number of dBmV} = 20\log(V_1/1\text{mV})$$

where V_1 = the measured voltage level
$0\ \text{dBmV} = 1\ \text{mV} = 1000\ \mu V$ across a 75-ohm load

Using absolute voltage levels instead of decibels to calculate signal levels requires calculations that become more complex as more components and channels are added to a system. Using dBmV to calculate signal levels allows easier manipulation of those values. The gain or loss, in decibels, of a component is added to or subtracted from its input signal level to obtain its output signal level. Also, fractional values can be avoided, since any number between zero and one is represented by a negative number of decibels. For example,

- A 40-dB amplifier increases its input signal voltage level by 100 times;
- A 6-dB coupler decreases its input signal level by one-half;
- A video signal level of 10 dBmV for a specific channel at any given outlet is 3,200 μV.

Because decibels are easy to use, all relevant equipment specifications and signal requirements are expressed in dBmV or dB. The difference between two dBmV values is expressed in dB. For example, a typical carrier-to-noise ratio is 43 dB and can be obtained by subtracting the measured noise floor (in dBmV) from the input signal level of an amplifier (in dBmV). Both the input level and the noise floor are expressed in dBmV, but the mathematical result is expressed in dB. Thus, dB is a ratio while dBmV is an expression of signal amplitude.

Table 1 provides a short conversion chart for translating between dBmV and voltage. Note that all levels below 1000μV (0 dBmV) are negative values.

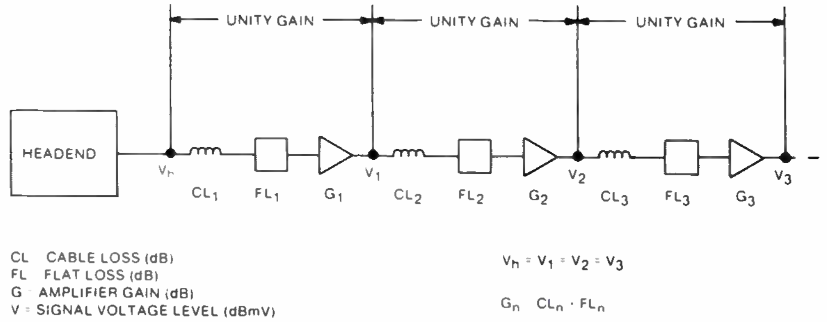


Figure 1 Unity gain in a system

Table 1

dBmV	Voltage
80	10.0 Volts
70	3.2
60	1.0
50	320,000 μV
40	100,000
30	32,000
20	10,000
10	3,200
0	1,000
−10	320
−20	100
−30	32
−40	10

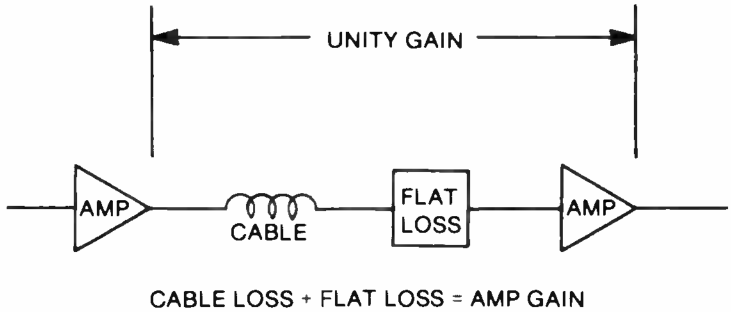
Unity gain trunk design

When designing the trunk portion of the distribution system, the unity gain criterion should be followed.

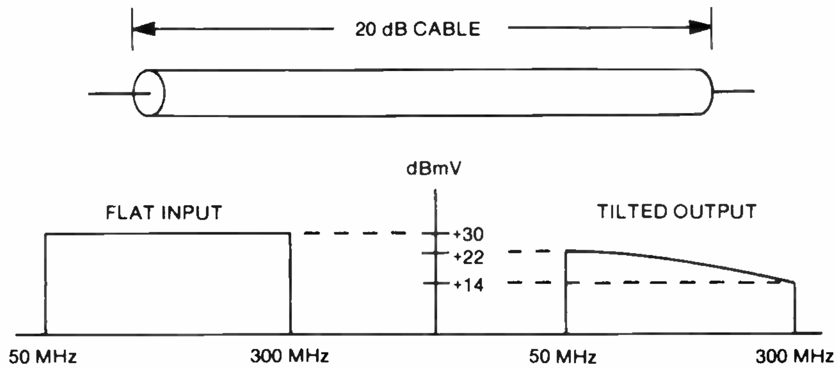
Unity Gain Criterion

1. All trunk amplifiers are identical (with respect to noise figure, gain and equalization).
2. All trunk amplifiers are separated by an identical length of cable.
3. Flat Loss + Cable Loss = Amplifier Gain.

Result: All trunk amplifier output levels are identical.



(a) Unity gain



(b) Cable attenuation

Figure 2 Unity gain of one stage

Designing the trunk to this standard provides these advantages:

- The system is easy to design by consistently following this rule.
- The system is easy to align and maintain, since the output levels of all amplifiers are identical.

This rule requires that either each trunk amplifier be adjusted to compensate for the losses between its input point and the previous amplifier's output point (see Figure 1); or that each trunk amplifier be adjusted to compensate for the losses between output point and the following amplifier's input point. Thus, each amplifier in the system has the same output signal level, and the system has unity gain throughout (no increase or decrease in signal level from one amplifier's output to the next).

System losses

The distribution system's losses can be divided into two main categories, flat loss and cable loss.

- Flat loss, or passive loss, is the attenuation through all the passive components in the network (not including the cable). The value of this loss is constant across the entire frequency spectrum.
- Cable loss is the attenuation of the coaxial cable. This loss increases with frequency, a characteristic called cable tilt.

To achieve the same amplitude for all signals at all frequencies of interest, it is necessary to compensate for both flat loss and cable loss. This is accomplished with equalizers and amplifiers.

An equalizer has an attenuation characteristic that is the inverse of the cable tilt with respect to frequency. It attenuates low frequency signals more than high frequency signals. Ideally, the combined cable and equalizer losses produce constant attenuation across the system's entire bandwidth.

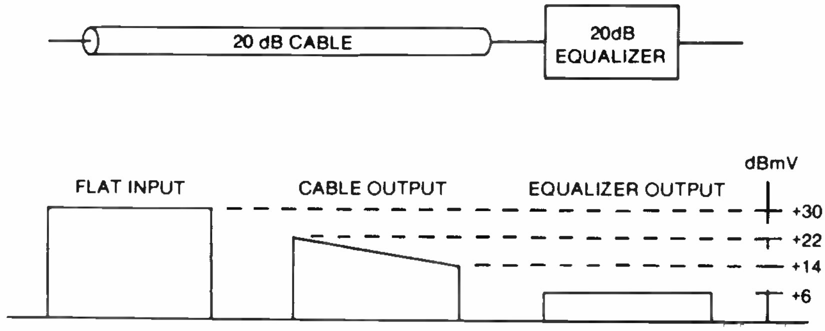
A flat gain amplifier following the equalizer increases signal levels across the spectrum. Figure 2 demonstrates unity gain and shows how one state of a network compensates for cable tilt.

Single cable systems

Two-way communications can be implemented on a single coaxial cable by dividing the available frequency spectrum on the cable into two bands.

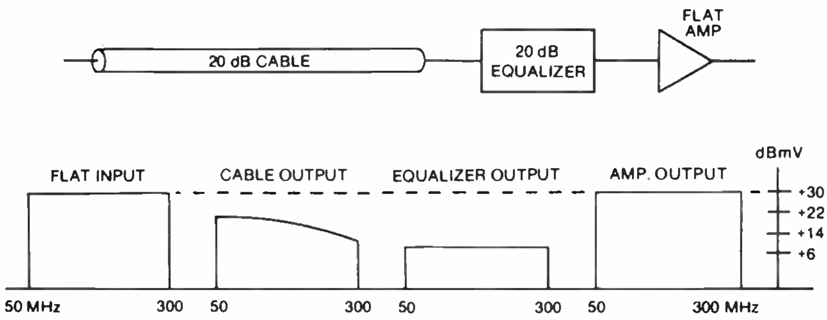
Most CATV two-way cable systems now in service use the subsplit format:

- Forward band 54-400 MHz
- Reverse band 5-30 MHz
- Total usage bandwidth 371 MHz



(c) Cable and equalizer

Figure 2 Unity gain of one stage



(d) Cable, equalizer and flat gain amplifier

Figure 2 Unity gain of one stage

This system has been popular with CATV system operators because it offers the easiest method to upgrade existing one-way cable systems to two-way operation. It allows transmission of all 12 VHF television channels on their normal broadcast frequency assignments, which eliminates the need for special converters at each customer's site.

However, when more than 12 channels are to be distributed over a single cable system, separate converters are necessary anyway, eliminating this advantage for many systems.

The subsplit format has limited utility when information originates from locations other than the headend. Since only 25 MHz is available in the return direction, only four television signals or their bandwidth equivalent can be transported to the headend at one time. The impact of this limitation depends on the type of equipment used in the network. Microprocessor-based packet communication units available today permit data networks with thousands of users to operate on a single 6-MHz channel.

Midsplit systems are used in many data communication networks.

- Forward band 168 to 400 MHz
- Reverse band 5 to 116 MHz
- Total usable bandwidth 343 MHz

Midsplit is more popular than subsplit for local area networks, because of its greater return direction bandwidth. It can handle high volume two-way interactive communications including data (both low- and high-speed) and video. The IEEE-802 specification (a standard currently being developed for local area networks) endorses this format.

A midsplit system's greater bandwidth can be used by one or more services. For example, when using a modem with a bandwidth efficiency of 2 bits per Hertz, a T1 channel (which conveys digital data at 1.544 Mbits/s) occupies only 772 kHz. A midsplit system can provide over 140 such channels in its return path.

Figure 3 shows block diagrams of trunk amplifiers for subsplit and midsplit systems.

This is the newest system of the three:

- Forward band 232-400 MHz
- Reverse band 5-174 MHz
- Total usable bandwidth 337 MHz

A highsplit system fulfills the need for high return path bandwidth that some large systems might have. Some amplifiers are now available in the highsplit format, but standardization among vendors of these units has not yet been achieved.

The following factors should be considered when converting an existing one-way network into a two-way midsplit network:

- Use of individual frequency converters at each user device.
- Expandability of present amplifiers to bidirectional use.
- Redefinition of system frequency allocations.
- Modification of existing services and their frequency allocations.
- Selection of passive components that pass all the required frequencies
- Inspection of existing coaxial cables. Inspect them to ensure signal ingress will not cause problems.

It is not necessary to disrupt service while upgrading a system to support two-way traffic. Modular amplifier units allow easy installation of return amplifiers, equalizers and distribution legs in the field.

One study from the cable industry estimates that existing one-way networks can be upgraded to two-way subsplit networks at a cost of around $300 per mile.

Dual cable systems

Two-way dual cable systems use two coaxial cables laid side-by-side. One cable provides the inbound (return) path signals to the headend. The second cable provides the outbound (forward) path signals from the headend to the attached devices.

- Outbound band 40-400 MHz
- Inbound band 40-400 MHz
- Total usable bandwidth 360 MHz

Not all dual cable networks use this same spectrum. For example, Wang Laboratories' network uses non-standard amplifiers with the bandpass of 10 to 350 MHz.

Each outlet in a dual cable system must have two connections that clearly identify the inbound and outbound paths. In addition, twice as many amplifier units are required to implement a dual cable network, compared to a single cable network.

The term amplifier unit refers to the module that contains the gain block, power supply, equalizers, and any associated circuitry. Currently, one vendor supplies all the necessary circuitry for both paths of a dual cable system inside a single module. Shielding and isolation requirements dictated against placing circuitry for both directions inside the same enclosure for many years, until improved isolation methods were perfected.

Dual cable system amplifiers are used in the unidirectional mode with a bandpass of 54 to 400 MHz. Figure 4 shows the block diagram of a dual cable amplifier.

Dual cable systems have no interaction between inbound and outbound signals except when devices are incorrectly connected to the network. No special filters are required in amplifiers to provide frequency separation. As a result, amplitude and phase distortion in a dual cable network are less than in a single cable network.

The two-way dual cable systems described in the preceding section are not the same as CATV dual trunk systems. CATV dual trunk systems are composed of two one-way trunks laid side-by-side to each subscriber's location. The subscriber selects signals from only one trunk at a time with an A/B switch. This technique was a simple way for early CATV systems to double their signal bandwidth. The A/B switch directs the signals from one trunk to the television receiver and isolates the signals on

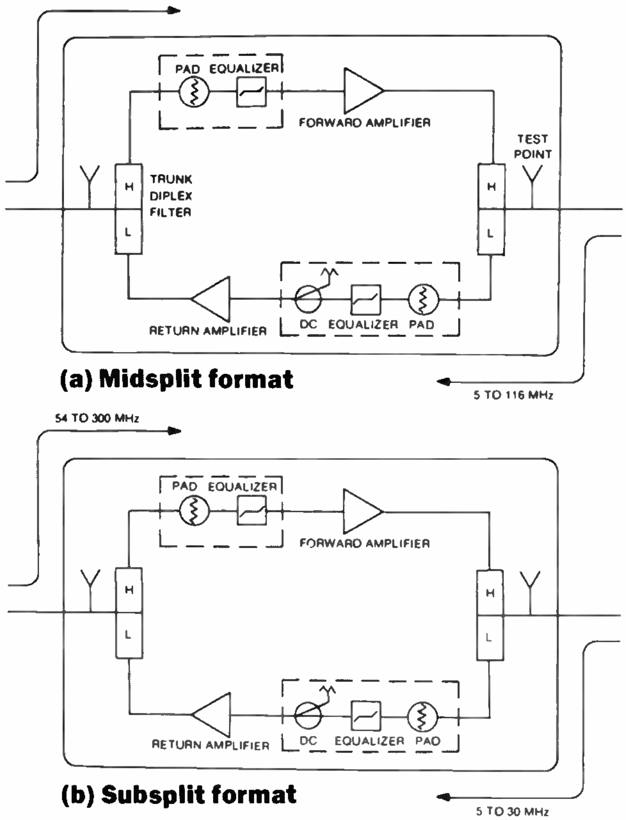


Figure 3 Typical two-way cable trunk amplifiers

the other trunk from the receiver. Some CATV operators have converted one of these trunks into a two-way system. When the proper trunk is selected by the user, two-way operation is possible.

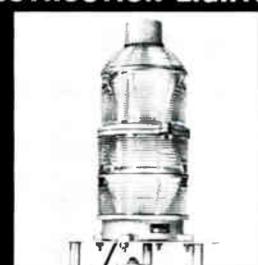
Comparing single and dual cable systems

Although it is difficult to generalize for all networks, 60 MHz of bandwidth in each direction has proven adequate for many applications. Several systems use only about 35 percent of the total bandwidth available. Where wide bandwidth is necessary, there are two alternatives:

- A dual cable system can be implemented.
- Two separate single cable systems, each carrying different services, can be implemented side-by-side.

Two single cable systems provide all the advantages of the single cable method including simpler design, maintenance, and installation, in addition to increased bandwidth and system redundancy. The disadvantages of this approach are cable identification, trunk switching, and more complicated documentation requirements.

When applications require more than about 100 MHz in the return path, it is



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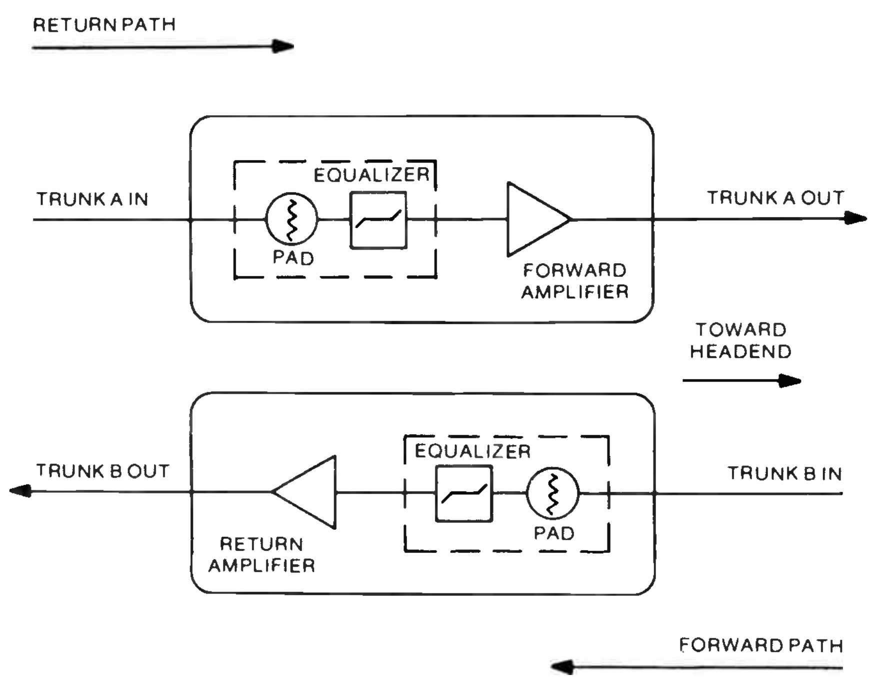


Figure 4 Dual cable system amplifier

more cost effective to install two mid-split cables instead of one dual cable system. This provides 222 MHz in the return path and 464 MHz in the forward path.

One alternative to a large cable system throughout a facility is to build several distinct and complete systems that serve various subdivisions of that facility. At first glance, this scheme might seem to offer several advantages over either a dual cable or two single cables where large bandwidth is required in the entire facility. However, it has some serious drawbacks:

- Confusing layout
- Redundant cabling and equipment
- Duplication of resources
- Diffused responsibility for maintenance

A better solution is to have an intraplant cable trunk that provides the backbone for shared services throughout the entire complex. Connected to this trunk are branches that feed each building. Inside each building, one cable network provides the necessary services. This approach is simpler to design, easier to maintain, and allows better management of system noise. CED

Character generators

Manufacturer/ Model	No. of Type Styles	Character Resolution in Nanoseconds	Characters Per Line, Max.	Lines Per Page, Max.	Proportional Spacing	Italics	Flash	Auto Line Centering	Auto Page Centering
Beston									
Marquee CG-800	1	140	32	16	No	No	Yes	Yes	No
Cable Graphic Sciences									
System 1500	8	n/a	40	Variable	No	No	Yes	Yes	Yes
Chyron									
VP-2	6 from 45	35	62	24	Yes	Yes	Yes	Yes	Yes
Chyron IV	6 from 45	27	62	24	Yes	Yes	Yes	Yes	Yes
D.E.L. Compu-Cable									
Spectraview	1	n/a	20	24	No	No	No	Yes	Yes
Dubner									
TEXTA	100	37	80	30	Yes	Yes	Yes	Yes	Yes
FOR-A									
VTW-210	1	52	32	8	No	No	Yes	Yes	No
VTW-400	2	50	26	8	Yes	Yes	Yes	Yes	Yes
Knox Video									
K-60	1	7x9 dot matrix	32	16	No	No	Yes	No	No
K-100	1	57	Variable	Variable	Yes	Yes	Yes	Yes	No
Laird									
7200	21	35	Variable	Variable	Yes	Yes	Yes	Yes	n/a
MCI/Quantel									
Cypher	6 from 1500	n/a	Variable	Variable	Yes	Yes	Yes	Yes	Yes
MPB Technologies									
Vista 80	4	35-40	Variable	Variable	Yes	n/a	Yes	Yes	Yes
Vista 90	7 from 14	35	140	64	Yes	Yes	Yes	Yes	Yes
Mycro-Tek									
Ernie	2	70	32	12	Yes	No	Yes	Yes	Yes
Supra	12	40	32	12	Yes	No	Yes	Yes	Yes
Portac									
KBD-2	1	n/a	32	8	No	No	Yes	Yes	No
SRP Electronics									
45/7	1	30	22	18	No	No	No	Yes	No
Teledac									
T-1300	2	n/a	28	13	No	No	Yes	Yes	Yes
Telpar									
CTI-180	2	70	32	16	Yes	No	Yes	Yes	Yes
Texscan									
CDD-45	1, 8 op.	70	40	26	Yes	No	Yes	Yes	Yes
SpectraGen 4	1, 2 op.	35	40	26	Yes	No	Yes	Yes	Yes
Thompson-CSF									
Vidifont V	8	48	Variable	Variable	Yes	Yes	Yes	Yes	Yes
3-M									
D-1000	1	70	22	20	Yes	No	Yes	Yes	No
D-5000	8 from 100 +	35	80	16	Yes	Yes	Yes	Yes	Yes
Video Data Systems									
CG-1000	1	70	22	10	No	No	Yes	Yes	Yes
Vidstar	2, 8 op.	30	Variable	Variable	Yes	Yes	n/a	Yes	Yes

Background Colors	Character Colors	Horizontal Crawl/Speeds	Vertical Roll/Speeds	Channels Controlled by Basic System	Wire/Weather Station Interface	Keyer	Resident Storage	Graphics
4	1	Yes/3	No	2	Optional	Optional	1K	No
128	128	Yes/1	No	1	Optional	No	70 pg.	5 graphic fonts, animation, library
512 512	512 512	n/a Yes/5	Yes/4 Yes/5	1 program, 1 preview 2	No Optional	Yes Yes	400,000 char. 2,400 lines	Palette animation 3/D animation
256	256	Yes/3	Yes/9	1	No	No	25-75 pg.	Touch tablet
4,096	4,096	Yes/9	Yes/9	1 or 2	Optional	Yes	20 MB	Full graphics/ animation
1, 8 op. 64	1, 8 op. 64	Yes/4 Yes/4	Yes/4 Yes/4	1 program, 1 preview 1 program, 1 preview	Yes Yes	No Yes	4 pg. 8 pg.	No No
1, 8 op. 512	1, 8 op. 512	No Yes/multi	No Yes/multi	1 program, 1 preview 1 program, 1 preview	n/a Yes	Yes Yes	4 pg. 64 pg.	No No
32	32	Yes/9	Yes/9	1	n/a	Yes	10 pg.	Animation
Infinite	Infinite	Yes/multi	Yes/multi	1 program, preview	n/a	Yes	n/a	3/D animation
8 62	8 62	Yes/4 Yes/5	Yes/4 Yes/20	1 program, 1 preview 1 program, 1 preview	n/a Optional	No Yes	40-2000 pg. 1 pg.	Character graphics Yes
8 12	8 12	Yes/3 Yes/3	Yes/3 Yes/3	2 2	Yes Yes	Yes Yes	120 pg. 240 pg.	Graphics font Graphics font, custom logos
6	2	Yes/multi	No	1	No	No	56 pg.	No
8	8	No	No	1	No	No	45 pg.	Yes
5	1	Wipe	No	1-8	Yes	No	40-230 pg.	Limited
8	8	Option/1	Option/10	1	Yes	No	16-64 pp.	Optional characters
32 32	32 32	Yes/3 Yes/3	Yes/3 Yes/3	1 1 program, 1 preview	Yes Yes	Yes Yes	150 pg. 150 pg.	32 character graphics/ animation (both)
4000	4000	Yes/7	Yes/7	2	Yes	Yes	440 pg.	Full graphics/animation
8 512	8 512	Yes/2 Yes/9	Yes/2 Yes/9	1 program, 1 preview 1 program, 1 preview	No Yes	Yes Yes	36 pg. 100 pg.	32 char. graphics/ logos/separator (both)
512 512	512 512	Yes/9 No	Yes/9 No	1 program, 1 preview 1	No No	Yes Yes	36 pg. 2 pg.	26 graphic symbols 3-D/graphic windows

kHz spacing, with levels adjustable from +25 dBmV to +52 dBmV.

For more information, contact Radyne Corp., 170 Wilbur Place, Bohemia, N.Y. 11716, (516) 567-8484.

IEEE-802.4 products

Concord Data Systems has released products for IEEE-802.4 spec local area networks. The Token/Net controller components are available as a 3-board set with system soft- and firmware, allowing system integrators and OEMs to implement 802.4 token passing protocols on a variety of system and host computer configurations. The set includes an access unit, RF modem and control unit, compatible with Multibus systems.

Also available is an 802.4-compatible headend remodulator. The HR 105 provides up-conversion of low frequency reverse channels. Unlike analog frequency translators that use a 128-bit preamble, the HR 105 uses a 32-bit preamble, improving token rotation rates and network response times.

For more information, contact Concord Data Systems, 303 Bear Hill Road, Waltham, Mass. 02154, (617) 890-1394.

Stereo generator for Linkabit

Leaming Industries has developed the FMT615C stereo generator for cable systems using M/A-COM's Linkabit Videocipher system.

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

Pico modulator series

Pico Satellite Inc., a wholly owned subsidiary of Pico Products Inc., has introduced three new modulator series. The PCM audio-video modulators for multiple dwelling and private cable systems are crystal controlled for adjacent channel operation and are available in a 35 dBmV output (PCM-35) and a 55 dBmV (PCM-55) output series. Both are available on any single VHF (2-13) or midband (A-I) channel. Each has separate modulation and level controls for audio and video. Power supplies for each are fused and regulated.

Pico's new M45 series are low profile (1¾ inch) rack-mount modulators for cable TV application. The series features frequency agility with plug-in filters and crystals. The saw filtered, monolithic channel passband filter never requires maintenance or calibration. The M45 models are available in all channels from 2-W.

For more information, contact Pico Satellite Inc., 415 Gator Dr., Latana, Fla., (305) 588-7356; (800) 321-6351.

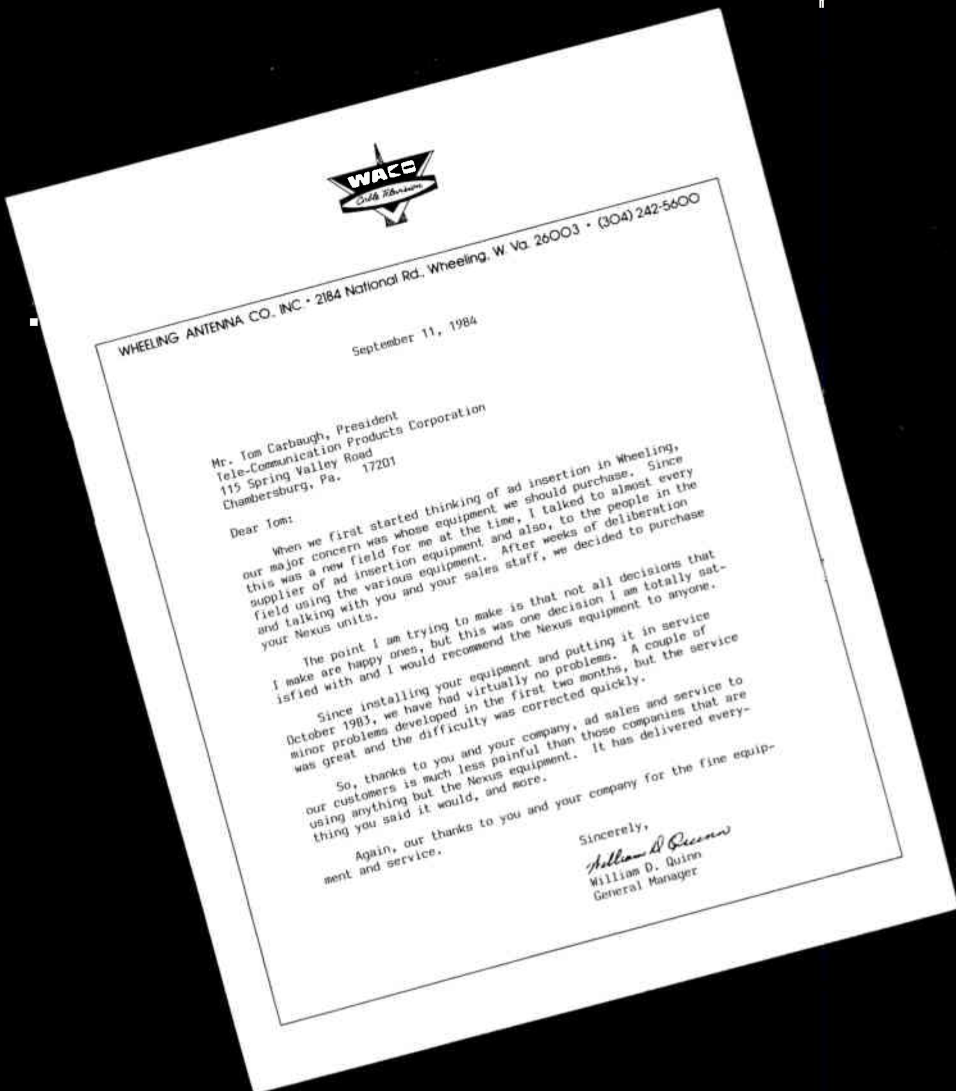
Hughes microwave line extender

Hughes Aircraft Co.'s microwave products division has created a microwave line extender designed to extend the range of a cable TV system where natural barriers, size of amplifier cascades or cost of cable would otherwise be prohibitive.

The new unit is a broadband multichannel transmitter using block upconversion techniques to distribute one to 60 channels of programming to small or specialized subscriber pockets. It accepts VHF inputs in the 54 to 440 MHz range and provides microwave output for distribution to cable hub sites.

For more information, contact Hughes Microwave Communications Products, P.O. Box 2940, Torrance, Calif. 90509-2940.

"STATE OF THE ART" In Commercial Insertion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September 11, 1984

Mr. Tom Carbaugh, President
Tele-Communication Products Corporation
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Dear Tom:

When we first started thinking of ad insertion in Wheeling, our major concern was whose equipment we should purchase. Since this was a new field for me at the time, I talked to almost every supplier of ad insertion equipment and also, to the people in the field using the various equipment. After weeks of deliberation and talking with you and your sales staff, we decided to purchase your Nexus units.

The point I am trying to make is that not all decisions that I make are happy ones, but this was one decision I am totally satisfied with and I would recommend the Nexus equipment to anyone.

Since installing your equipment and putting it in service October 1983, we have had virtually no problems. A couple of minor problems developed in the first two months, but the service was great and the difficulty was corrected quickly.

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Sincerely,

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Reader Service Number 46

Commercial insertion equipment

Company name	Model	Mode of operation	Number of channels	Number of VTRs	Events/ entries
Adams-Russell Video Information System Division	ARVIS 7200/7500	random access	standard: up to 4; 2 or more, optional	6 Sony 3/4-inch VP-5000s	115 different 30 second spots
Beston Electronics	Marquee CG-800A, System 1	ROS	1	alphanumeric generated messages & graphics	16 pps of 8 lines (32 characters per line), 64 events
same as above	Marquee CG-800A, System II	ROS, can skip spots	1	same as above	100 pps of 12 lines
Cable Graphic Sciences	System 1500	ROS	1 LO channel 3 satellite channels	VCR control optional	70 pages, 960 characters per page
Channelmatic	Spotmatic	random access	up to 32	up to four per channel	100 commercials per tape
same as above	Spotmatic Jr.	multiple spot mode, spot sequential mode	1	1	N/A
Control Video	Sequencer with ASSI	random access	4	2, expandable to 30	140, expandable to 1500
Falcone International	Autoserter 1	upgradable to random access	1, expand-able to 4	N/A	N/A
same as above	RAMS 5000	random access	N/A	N/A	N/A
Lake Systems	La-Kart	random access	N/A	expandable to 30 ½-, ¾- or 1-inch VCRs	more than 1,000 different individual events
Microtime	C-150	N/A	N/A	up to 4	N/A
Monroe Electronics	3000R-14F	ROS	2	1 per channel	N/A
(H.A.) Solutec	SOL-6800	can mix VTR formats, with one spot on one cassette	multichannel	8	100 events/ day/channel

Tone decoder	Programmable pre-roll	Video	Audio	Memory	Other Features
cue tone, can interface with customer-supplied subcarrier detection	yes	(in/out) BNC type (x8) 1.0 ± 2 Vp-p, 75 ohms, NTSC, compatible EIA-RS 170A	audio level controls-limiter/ compressor, 50-15,000 Hz frequency optional stereo	hard and floppy disc stored for 7 days of unattended operation	remote communications diagnostic capability, automated traffic and billing, sales management and accounting reports
built-in tone decoder, contact closure	N/A	outputs: 2-1 V p-p into 75 ohms	N/A	ROM 16 lines of 3 characters title line memory, 1K RAM page display memory; RAM crawl line memory	4-color background, automatic centering
same as above	same as above	same as above	same as above	same as above, digital tape for message storage	see above
cue tone decoder/video switcher	N/A	single channel NTSC compatible. 1 Vp-p into 75 ohms	N/A	nonvolatile floppy disk storage	128 colors offered, nonvolatile floppy disk storage and five graphic fonts
DTMF tone decoder module	programmable pre-roll delay	N/A	N/A	N/A	automatic logging optional remote communications, sales management, preview and automatic bypass
microcomputerized satellite tone decoder, secondary tone decoding	yes	1 V p-p, 75 ohm for both input and output (output source terminated)	0 dBM nom., 600 ohms balanced	N/A	logging and verification print-out, vertical interval switching and automatic return to satellite for VCR failure
satellite tone, contact closure	yes	N/A	N/A	N/A	commercial verification, VTR backup and CRT
digital decoder	N/A	input; 0.2-5 Vpp, 1 VPK—PK normal; output: 1.4pp adjustable NTSC type video 1v normal	input: 100 mv-5v pp, 0 dB output, 600 ohm 0 dB normal level	N/A	automatic bypass, machine control card, and optional preview switcher
programmable digital decoder	N/A	N/A	N/A	64 K random access memory;	power supply, real time clock scheduling menu printout, spot verification
N/A	external pre-roll, touch sensitive screen	N/A	N/A	N/A	redundancy, monitoring status of each segment
satellite tone decoder, can select multiple network tone decode sequences	adjustable pre-roll cues	input: 1 Vp-p into 75 ohms, reference: 1Vp-p looping	input: 10K ohms, unbalanced; output impedance: 600 ohms, unbalanced	N/A	audio-video bypass default system, automatic TBC interface, logging interface connector and operational safeguards
cue tone decoder, contact closure	yes	integral AB switching	integral AB switching, 600 ohms, balanced	N/A	data logger, external printer, diagnostic self-test mode, remote override of program source cues
cue tone presence detector LEDS	N/A	inputs: 12 max.; outputs: 2 of 75 ohms	input; 12 max., output: 2 balanced + 4 or +8 dB, 600 ohms w/transformer	N/A	system status monitoring; real time and multiprogrammed; alphanumerical document "descripter" data base, optional automatic logging system

Commercial insertion equipment

Company name	Model	Mode of operation	Number of channels	Number of VTRs	Events/ entries
Sony Broadcast	BVC-10	random access	1-3, user selectable	40 cassettes loaded in bins and transferred by elevator to 4 VTRs	300 events/sequence, 112 sequences/disk
T.R. Pitts Co.	Ad-Vantage	run-of-schedule automatic insertion	1 specific, 1 selectable	one 60-minute tape	120 per cassette, sync switching
Telecommunication Products Corp.	NEXUS	random access to spot 30 second	2 channels per chassis	3 per channel	255 per channel, four 30-second spots each
Tele-Engineering	Ad Cue 84	random access; ROS, fixed position or combination	2	2 VCRs, 1 extra video source	198 commercial blocks
same as above	Ad Cue 100	random access	12	24	200 commercial blocks per channel
Texscan	CSR-92	random access	1-8	up to two per channel	more than 2,000
TV Watch	Stationmaster	linear access	unlimited	one per channel	2400 per channel
same as above	Stationmaster	random access I	same as above	same as above	same as above
same as above	Stationmaster	random access II	same as above	up to 4 VCRs with 1 channel	unlimited
Videodisc Broadcasting	Ad Mint	random access	2	2 VCRs per channel	200 time program entries per week
Video Media	Q Star	sequence switching	N/A, upgradable to multichannel	6 VTRs	N/A
same as above	VMC-200	random access	up to 63	N/A	N/A

Tone decoder	Programmable pre-roll	Video	Audio	Memory	Other features
No, time code cuing	user specified or instant start	see manu-facturer	see manu-facturer	memory save mode	management and control system, event override, local or remote VTR writer, crash protection
satellite tone decoder	adjustable delay for commercial starts	input: 75 ohm; output: 75 ohm	input: TVRO, 600 ohm, balanced, VTR, Hi Z unbalanced; output 600 ohm balanced	N/A	override switch, manual insertion button, timing control, automatic bypass to network in case of power failure, internal black level, computer interface
built-in tones (contact, closure or manual)	yes	input and output: BNC type NTSC standard video format	input: selectable 600 ohm balanced or high impedance unbalanced; output: 600 ohm balanced	32 K, C-MOS, RAM/ROM	3 levels of commercial verification, 5-hour memory backup, automatic bypass to network in case of VTR failure, vertical interval switching
PROM memory can be programmed to receive 3 different cue tones	field-selectable pre-roll	N/A	N/A	10K ROM, 4K RAM time program memory, 16K RAM log memory	commercial verification; automated billing interface; remote log retrieval, programming and verification; video presence monitoring and automatic return to network
digital tone decoder with AGC	N/A	N/A	balanced, 600 ohm with VCR level adjustment	can store 7 days worth of programming	verification printout, log memory capable of retaining 3,200 spots, remote programming, programming verification, standby power supply, vertical interval switching
can program as many as 10 DTMF tone sequences per channel	automatic pre-roll averaging	input: all 1Vp-p, terminated in 75 ohms; output program video to modulator to transmitter (1Vp-p, 75 ohms)	input: all 600 ohm single-ended; output: program audio to modulator or transmitter (stereo or monaural, 600 ohm open ended)	96K, protected by fail safe power supply and batteries	programmable cue tones, vertical interval switching, stereo audio, operator override, hard copy printouts, internal monitoring, bypass in case of system malfunction and remote control of VTRs
digital tone recording system	yes, VTRs prerolled from stop mode	automatically balanced from network to commercial	balances the program audio line from VCR output imped-ance to 600 ohm	32K	verifier logging device, 12 hour summary and battery backup, remote verification avail.
digital tone decoding	same as above	same as above	same as above	can program/ store one month	remote verification, remote programming, error checking and Epson printer, controller/ user friendly
same as above	same as above	same as above	same as above	64K, expandable to 256K	verification all channels, ITT Qume display terminal, remote programming, Epson printer, can insert multiple networks at same time
DTMF decoding, separate input and contact closure	digital sequence and pre-roll timing	N/A	N/A	12K ROM, 4K RAM, 16K RAM log memory	remote log retrieval, video presence monitoring electronic clock and calendar and vertical blanking switching
DTMF decoder	N/A	N/A	N/A	8 event memory	remote control of 43 devices, event-by-event comment entry, manual override and printer output
N/A	N/A	N/A	N/A	N/A	manual override and control; vertical interval switching; auto-logging and billing options

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Advertisers' Index

Dean Ericson

Panayes Gatseos

American Television and Communications Corp. has named four new vice presidents. They are **Donald Carroll**, president of the company's Oceanic division headquartered in Honolulu; **Dean Ericson**, vice president of new business development; **Panayes Gatseos**, vice president of consumer research and planning; and **Thomas Rackerby**, president of ATC's San Diego division.

Tom Saldi was named president and chief operating officer of AM Cable TV Industries Inc. Saldi will report to Maqbool Qurashi, chairman of the board and CEO. Saldi formerly served as president and chief operating officer for C-Cor Electronics.

Joseph Preschutti was appointed vice president and general manager of the E-COM Products division of AM Cable TV Industries Inc. Preschutti most recently held the position of vice president, engineering, at C-Cor Electronics.

Times Fiber Communications Inc. announced the appointment of **Albert Potter** as vice president, sales and marketing, for the CATV division and **Richard Kearns** as vice president, marketing, for the Communications Systems division. Formerly, Potter was president of General Instrument's RF Systems division and Kearns, director of network planning for the DunsNet subsidiary of Dun & Bradstreet.

Stacey Pandeloglou was named national sales manager of AM Computer Services Corp. His duties include introducing the "Cable Manager" subscriber billing and management system for AM's Cable Services division.

Gary Boot has joined Tele-Engineering Corp. as director of business development in charge of marketing engineering and construction services for the CATV industry. Boot previously was director of construction for Cablevision's Boston system.

The Institute of Electrical and Electronics Engineers (IEEE) has elected **Dr. Bruno Weinschel**, president and chief engineer of Weinschel Engineering Co., its 1985 president-elect and **Merlin Smith**, technical assistant to the vice president of logic and memory at the IBM T.J. Watson Research Center, its executive vice president.

Michael Shaughnessy was promoted to vice president and general manager of Oak Communications' CATV division. Shaughnessy assumes responsibility for the design, development and marketing of Oak's subscriber control systems. In addition, **Rj Smith** has been promoted to vice president, sales/marketing, and **Anthony Wechselberger**, to vice president, systems engineering.

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