

APRIL 1987

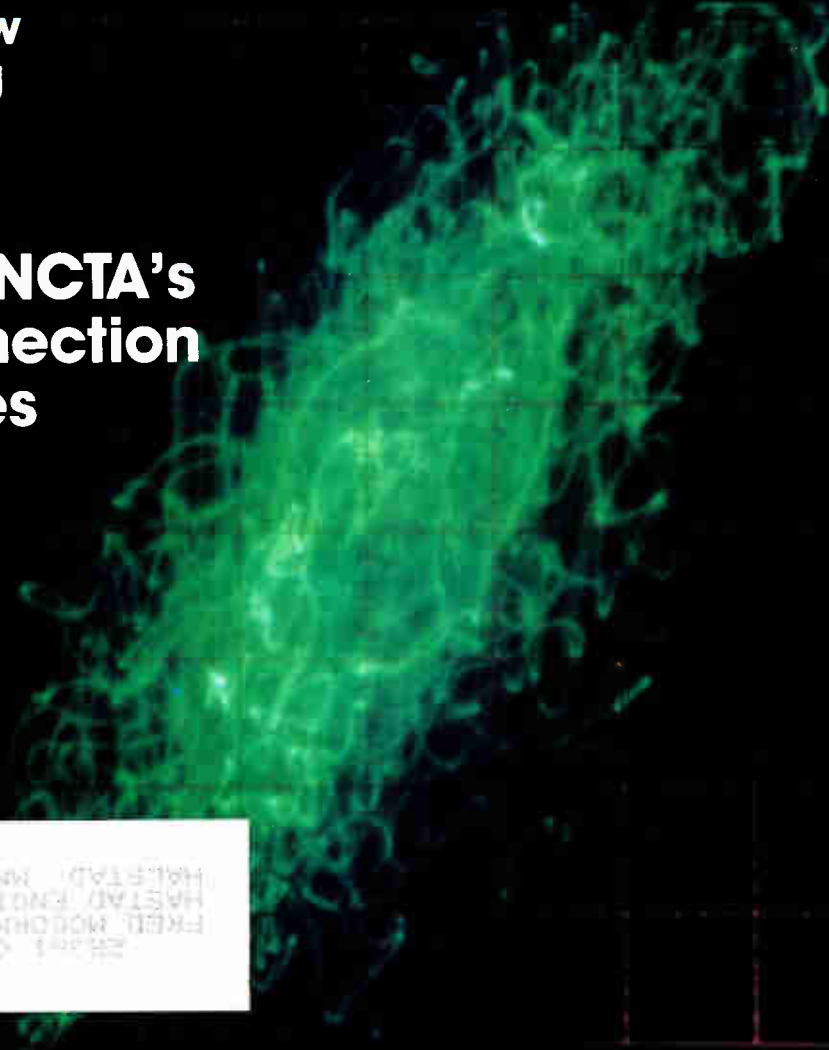
COMMUNICATIONS ENGINEERING AND DESIGN
THE MAGAZINE OF BROADBAND TECHNOLOGY

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**BTSC developing
in CATV after
slow start**

**CEBus: a new
and exciting
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**Part II of NCTA's
interconnection
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Delivering the best

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Cable's lackadaisical attitude toward keeping up technologically should cause the industry to look over its shoulder and watch for competition, says S-A's Jim Farmer.

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Service, service, service

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In this first column in a new monthly department by CED's own Wendell Bailey, Bailey talks about the importance of service, service, service.

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Transients in a CATV system

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This 1975 Classics article by Robert O'Hara deals with the cause and prevention of transients, a major problem for CATV system operators.

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After a slow start, stereo television is developing in the CATV industry; proper precautions are necessary, however.

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Part two of CED's exclusive reproduction of the NCTA document on consumer interconnection and customer owned equipment continues this month.

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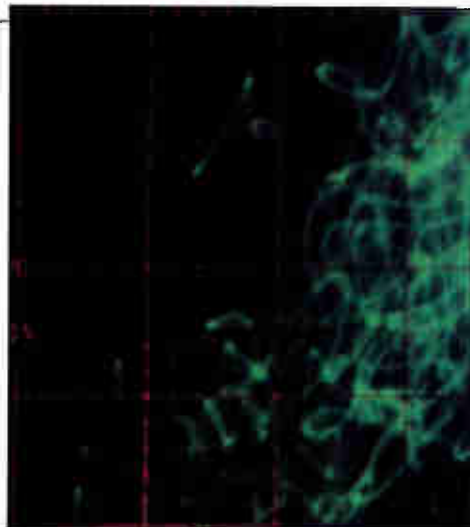
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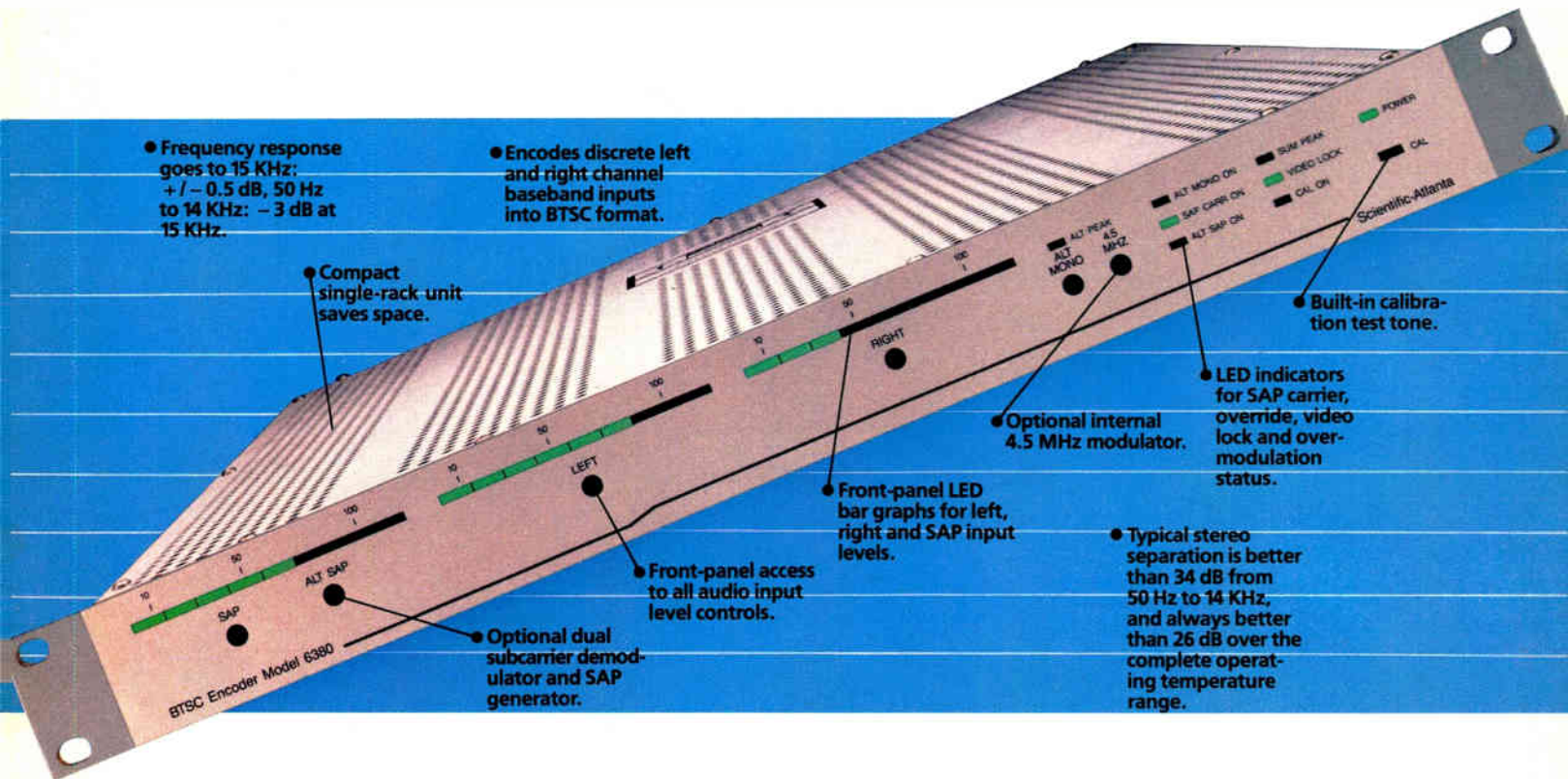
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About the cover

This simple pattern is used by FM broadcasters to continuously monitor their system using normal program material. Photo furnished by Scientific-Atlanta.



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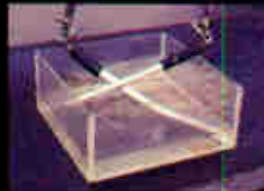
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**GENERAL
INSTRUMENT**



Jim Farmer

Cable is falling short technologically, says Farmer

If everyone cared as much about delivering their best efforts as Jim Farmer does, the cable industry would be so far ahead of everyone it wouldn't have to bother looking over its shoulder and wonder how much progress its competitors have made.

Unfortunately, not everyone cares that much, says Farmer, an 18-year veteran of Scientific-Atlanta's product development labs. That lackadaisical attitude does far more to undermine cable's potential than any other current competitor and may ultimately allow more players to enter the game and stake out their own territory and loyal customers.

"I worry about cable being able to meet its competitive threats (which predominately include VCRs and DBS), not because I think we have a less worthy medium, but because we're getting so wrapped up in tweaking profits and buying and selling systems we forget about the business we're running," says Farmer. "We're letting ourselves fall behind technologically."

Perhaps Farmer's vision of technology's role in cable is somewhat blue-sky, but that wouldn't be surprising, given that as a graduate student

at the University of South Florida he toiled in the lab on a star-tracking control system for the astronomy department. But he must have been able to keep his head out of the clouds during his interview with S-A, which hired Farmer right out of school.

Farmer went into S-A doing servo compensations and interfaces with customer equipment for antenna positioning systems. After being transferred into a group developing a special-purpose receiver for a German satellite experiment, Farmer's curiosity over RF circuits drove him to transfer into the CATV division in 1972.

At the time, the unit was a fledgling one headed up by Alex Best. Farmer began by designing headend equipment. "I spent my days designing equipment and convincing Alex how much I knew about it," recalls Farmer. "I spent my nights going home and studying like a fiend to stay one step ahead of where I was at the office because, in fact, I didn't have any idea what I was doing. But I must've pulled the wool over someone's eyes because I'm still here."

Everyone should have such modesty. His first project was developing phase-lock for the Model 6300 modulator, for which he presented his first NCTA paper in 1973 (which was published as a "Classic" in *CED* in January 1987). He followed that up by designing phase-lock for the Model 6150 processor and then turned to designing demodulators, modulators and receivers. During that time, Farmer accomplished what he still considers his greatest feat—the Model 6350 modulator. "It had many novel features," says Farmer, and utilized SAW filters, a first for the industry.

From there it was on to project management where Farmer had to swallow his pride and admit to the Model 6700 set-top converter, S-A's first. "It was not a success, but we learned a lot," says Farmer of that 1979 box. And apparently they did, because in 1981 the still-active 8500 converter line was developed.

Today, Farmer's role is geared more toward engineering consulting, concentrating on subscriber and headend equipment (for which he has several patents pending), which allows him to get his hands on several projects at

once, including the biggest research effort currently underway—a better positive trap for use by TCI for the MSO's "on-premise" concept.

The results of that project, which Farmer said was "real strong on 'R' as well as 'D'," still doesn't quite meet Farmer's goal, but it is at least twice as good as any previous positive trap technology, which was one of TCI's requirements.

Working on the leading edge of technology fascinates Farmer, but it admittedly "scares the daylights" out of him when his back is against the wall in terms of time and funding. But without the presence of a customer waiting for a finished product on a fixed budget, the natural tendency is to give up or accept something short of the goal, Farmer says.

The fact that this project is so different from most others—because of the amount of research needed to develop the new trap—is distressing to Farmer, who feels the industry is moving "slow" technologically. He envisions the day when cable and VCRs can live together, much as radio and records have for years, but can't predict whether the ultimate solution is through the Multiport or an off-premise technology.

"Eventually, one (technology) will be chosen over the other, but I'm telling our people we need to look at both because we can't confidently predict the outcome at this time." Farmer believes the MSOs have the power to decide, but he's distressed over their lack of commitment. "I am chagrined that many operators take a very passive role" in product development, he says. Although some MSOs are beginning to take more of an active part, Farmer says participation needs to be even more widespread. "Nobody understands this business as well as the operator," he says.

Farmer carries that thinking into his personal life, where he's just as committed to his family as he is to his professional endeavors. He's been involved in his community tennis and swimming associations, spends time gardening and doing home fix-up, and teaches Sunday School. If his life and his profession don't live up to expectation, it won't be because he didn't try.

—Roger Brown

HOW TO TAKE THE RECALL OUT OF THE INSTALL



Belden's drop cable with DUOBOND PLUS™ shield helps you prevent costly call-backs. It's also the most shield-effective drop cable in the CATV industry.

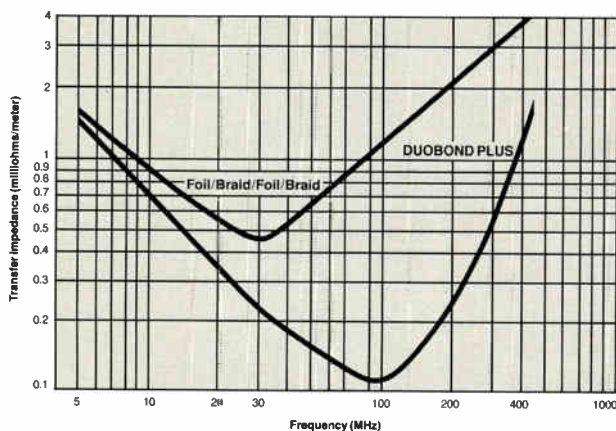
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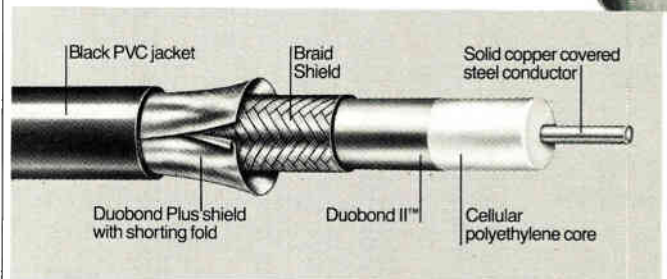
The added benefit is easier termination. This means less chance for error, resulting in greater shielding integrity and reliability. It also means fewer

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Service is key to cable's success

In the highly competitive and complex business world that we are all familiar with, there are many reasons why individuals, companies and whole industries arise, compete and either flourish or fail. It should be clear to anyone who thinks back over the history of a business that the overall reason for success is heavily related to what is known as its price/value ratio. Just as a boss will be pleased with and perhaps promote a worker who provides more value for the company at his or her salary than their co-workers, so, too, do consumers rate goods and services which they receive on a price/value ratio.

When one buys a name brand appliance today they find that they get a lot of value for a reasonable price. And, most amazing of all, it is likely to work flawlessly in your home, barring unseemly accidents, for 10 to 12 years.

In the telecommunications industry, however, and in particular in telephone

and cable TV, we are pure service industries. We do not have a hard appliance that we sell to our consumers. We, in fact, connect them up to our service provision network and allow them to see, for a fee, the programming which we gather and deliver to them. While this is a satisfactory arrangement for all concerned (consumers get a good price/value ratio, program suppliers get a good price/value ratio from cable operators, etc.) we cannot, like those discounters who sell major appliances, forget about the customer once he has taken "delivery" of the unit. The only thing we have to sell the customer is our ability to provide service on a continuing uninterrupted basis, and in those cases where there is a need for a subscriber to contact the cable company for service, the ability to provide it to the consumer on a prompt, friendly and helpful basis.

This short column is not meant to be a complaint or a diatribe against the state of service in the cable television industry. But the fact remains that we have nothing to offer our customers but our service.

What can we do about improving our service and why should we have to improve it? Let's start with why. In case you haven't noticed, we have a lot of competitors for our subscribers' discretionary income. We make a living out of the fact that people like to be entertained and are willing to pay a fee for that entertainment. The fact that we've been a successful industry has not been lost on people who would share in the attractive business that has been created by us. Our competitors are capable of examining this industry and determining what we do well and what we do poorly. If in that examination they determine that we deliver good programming but we lack attention to our customers' well-being, it's possible that we may begin to find an erosion of our customers' loyalties.

There are major efforts underway in the cable industry to tell the cable story; to let everyone know that cable is good, that cable offers a lot of entertainment for the dollar and that cable employs people and resources in every community where it exists and is an integral part of the fabric of our national economy. Those of us in the direct service end of the industry would

not like to be the ones who, by our inattention to customers' needs or inability to service them as they feel they need to be, persuade customers and non-customers alike that this message and perception is false. The only way that non-subscribers will get a perception about what service is like on a cable system will be to listen to friends and neighbors who are subscribers. The only way those people will give us a good rating when their neighbors ask what the cable company is like is if we have given them prompt, friendly and helpful service every time they've asked.

A big part of the service issue is in the front office, the telephone contact room or what your system chooses to call it. While technicians and engineers who work on the system can't do a lot to change what goes on in that room, perhaps we can do something by setting an example of what good service should be. The people who read this magazine and other magazines like it are, for the most part, front-line people. They are the people who go into customers' homes, the ones who customers see in trucks on the highway, climbing a pole, digging a trench or putting the cover back on a pedestal. Service, reliability and friendliness from this group of people will work its way back up the chain to the office. If we as a group can't fix service in other parts of our company, let's at least be sure that that part of service which we are responsible for lives up to the reputation and feeling that so many other people in the cable industry are striving so hard to impart.

Nothing but good can come from a major effort on behalf of SCTE, NCTA and other groups on how to provide good service. The surest way to keep our rightful share of the market from all those who imitate us and wish to compete with us is to have satisfied customers. If service deteriorates on our behalf, we will have let down that major effort. I hope that in the future it is not said that we knew how to invent, build and implement a system but we did not know how to provide the service necessary to make it whole.

This is the first column in a new monthly department written by Wendell Bailey, chairman of CED's consulting board of engineers.

Wendell H. Bailey, NCTA, vice president, Science and Technology

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Transient considerations for CATV systems

This paper deals with the damage and outages caused by both natural and man generated transients which are a major, very costly problem for CATV system operators. The paper is divided into three categories:

- The nature of transients
- Source of transients
- The prevention of damage and outages from transients

The emphasis in the paper involves an analysis of how transients get into the cable systems. These are categorized in such a manner as to enable analysis and preventative measures to be taken.

Protective devices are discussed in some detail including the characteristics and limitations of these devices. The major solution discussed in regard to preventing transient damage is the grounding system as used conventionally and as it might be used to improve the grounding action. The solutions discussed in the paper have been based on experience of systems as observed over the past two years.

Introduction

Damage and outages caused by transients are a major and very costly problem for CATV systems, especially for those located in areas of high transient activity.

The problems created include those caused by any system outage; the main ones being customer complaints and dissatisfaction; and the added time and expense of maintenance crews.

In addition, a considerable amount of equipment damage can occur. RF transistors by their nature are very susceptible to damage. To a lesser extent, power supplies, splitters, directional couplers, filters and power chokes can be damaged by transients.

For purposes of discussion, we can separate the subject into the following categories:

- Nature of transients
- Source of transients
- The prevention of damage and

Preventative steps can be taken to help control damage caused by transients.

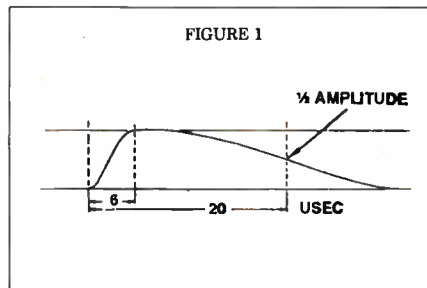
outages from transients

The nature of transients

The damage caused by transients can be appreciated if we look at the nature of transients, i.e., rise time, duration and particularly the magnitude of the currents and voltages.

Direct lightning strikes have had the following record:

Current, 10,000 amps avg. to 260,000 amps maximum; Rise time, 12,000 V/usec; Voltage, 72,000 v; Waveform, 6x20 is standard; Definition: for typical lightning strikes:



The first number is the rise time, the second is the time to decay to 1/2 amplitude.

Power line surges resulting from load switching transients can range from one usec to the larger part of a second. Currents of 2,000 amps and voltage of 15,000 volts are not uncommon.

Higher and lower values for transients can be cited, however, when compared to the 24 volt transistors we use, the magnitudes are formidable.

The source of transients

We can classify transients into two types. See Figure 2.

A. Those which enter the system via the 60 Hz pole mounted A.C. power supplies. These transients are present on the power line and enter through

the 115 volt primary. These power surges are usually present where heavy industrial loads are being switched. Automatic reclosure of power company circuit breakers also create transients to the power supply. Lightning can also be a cause. It is interesting to note that power interruption for less than five seconds is not classified as an outage by many power companies. In a typical power company, there may be 2,500 per year of these short duration non-classified outages which cause transients.

Ferro-resonant type power supplies due to their nature can cause a transient as high as three times rated output voltage when turned on.

Protection for these transmitted type transients can be provided by several types of devices.

B. The other type transients are those which are inductively coupled into the strand or coaxial sheath of the CATV system. These may be caused by power line faults, load switching, lightning and atmospheric effects. Inductive coupling shown in figure 3 occurs due to current in a conductor (such as the power strand) creating a magnetic field which cuts (or couples) another conductor (in this case the CATV strand). A voltage is generated in the CATV strand which will cause a current to flow. These currents in

Cable Classics

Do you know how lightning induces voltage transients in trunk and distribution cable? Did you know that lightning-induced currents can run into the thousands of amps? Do you know what other sources of transients can occur in cable plant? What categories of transient protection devices are available and where are they used?

These questions (and their answers) are part of the initiation and training of all cable engineers and technicians.

This early paper by Robert O'Hara (first published in the 1975 NCTA Convention Record) answers some of these questions—and should stimulate further thinking and reading.

Graham S. Stubbs
Engineering Consultant

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Robert N. O'Hara, President, Westec Communications

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Reader Service Number 7

Protection for those transients entering from an A.C. power supply is relatively simple.

both the power and CATV strand flow to the best ground point or points.

Both transients and steady state voltages can be inductively coupled when neutral (strand) or unbalanced currents flow in parallel conductors.

The most important consideration for system protection from this type of transient is a good grounding system.

Theory is interesting but most im-

portant, what are the practical methods a system operator can use to protect his system against transient outages.

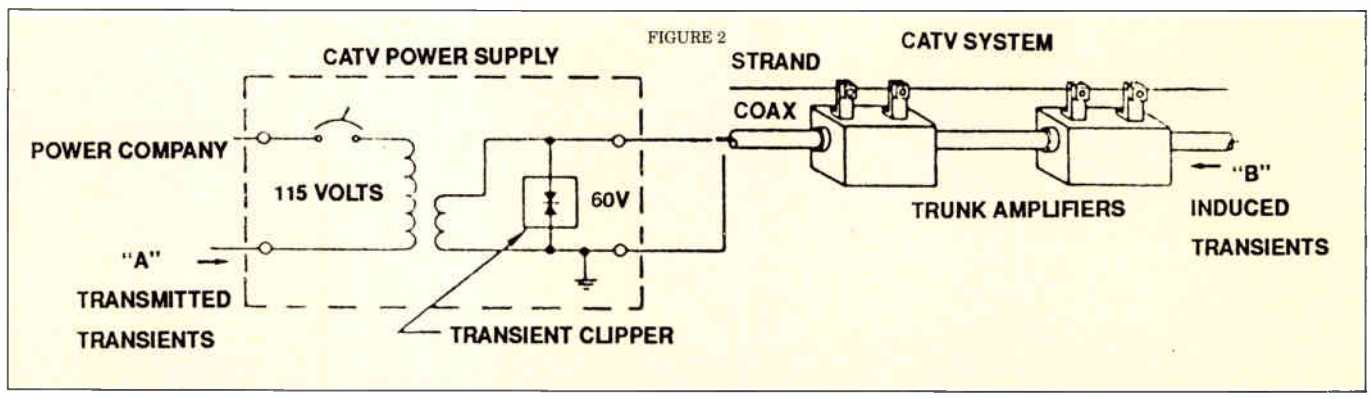
Prevention of damages and outages

Protection for those transients entering from the A.C. power supply is relatively simple. The Transient Clip-

per, used and field tested by Theta-Com, has proven to be quite effective.

Let us look at how the Transient Clipper protects the system from transients which enter through the power supply.

The typical waveform from a ferro-resonant supply is shown in figure 4. The peak value is 62 to 72 volts at full load and no load respectively. The



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- 70/140 MHz I.F. Converter

The most important element for protection is a good grounding system.

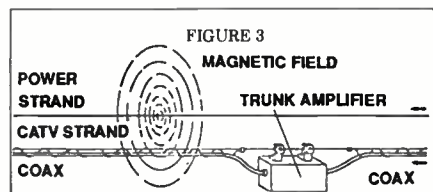
Transient Clipper is connected across the 60 volt (RMS) terminals and will conduct when the peak voltage exceeds 91 ± 10 percent in either a positive or negative direction. This is done by a network of avalanche (zener) diodes. The voltage and current characteristics of the Transient Clipper and three other devices are shown in figure 5.

Characteristics of The Transient Clipper

The sharp curve (zener characteristic) allows the breakdown voltage to be set reasonably close (130 percent) to the operating voltage. Other devices used start at 200 percent and some go to 400 percent voltage before complete breakdown. When the Transient Clipper conducts, it clips above 91 volts but does not present a low impedance or short circuit as does the spark gap device. The turn on and off time is very fast at 10^{-12} seconds (one millionth of one microsecond). It has a peak pulse

power dissipation rating of 15,000 watts and a peak pulse current rating of 300 amps. The small size of the Transient Clipper allows it to be easily mounted in the power supply housing.

Ferro-resonant type power supplies (which are used by the majority of



CATV systems) produce a voltage transient of two to three times rated voltages when turned on. This will decay to normal in two or three cycles of the 60 Hz frequency. The Transient Clipper will clamp these at a lower voltage than the spark gap type devices. The spark gap units at times would not turn off due to the power supply short circuit current. When they

do not turn off, they will destroy themselves by melting solder joints into the associated circuitry. The Transient Clipper does not have this problem as it turns off at approximately 91 volts peak.

The basic circuit device in the Transient Clipper has been used in airborne electronics equipment to protect voltage sensitive components from large voltage transients. The device was tested in the Theta-Com Engineering laboratory and subsequently installed in several systems that were experiencing severe transient problems.

The resulting reduction in transient damage and outages has been dramatic in most cases.

Time delay relays which allow time for transients to pass before connecting power to the cable system have been used with good results. The Transient Clipper will perform the same function and operates much faster.

Protective devices such as fuses,

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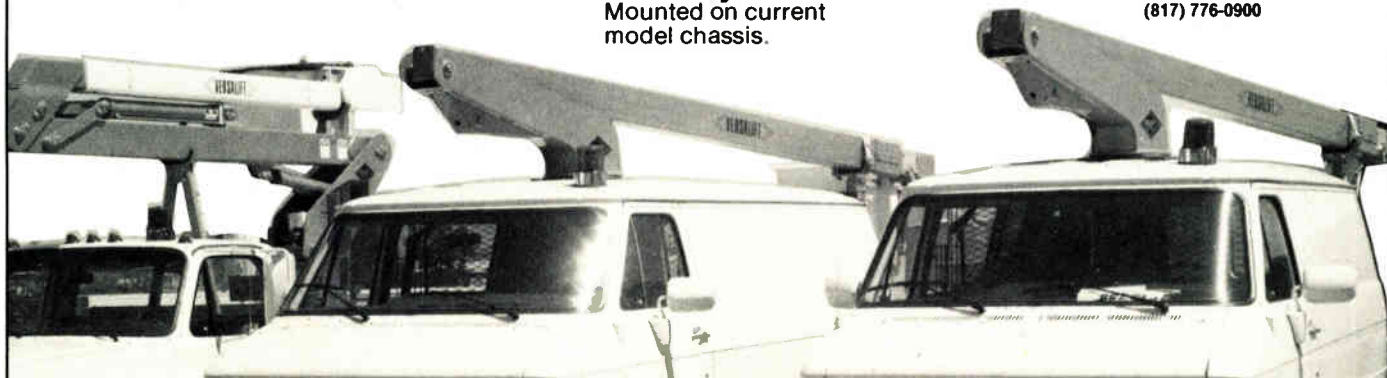


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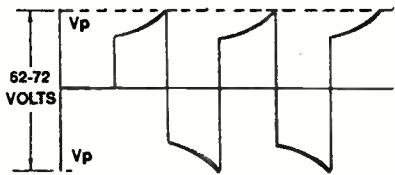
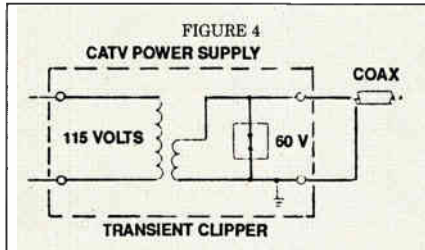
Ground resistance on the order of 5 ohms are desirable. Good grounds in dry climates may be impossible to establish.

surge suppressors, transient clippers, over-voltage circuits are necessary and useful to protect equipment, but, they many times create a secondary problem by causing a system outage in the process.

Protection against type B (see figure 2) transients which enter from the strand is more difficult. The most important element for protection is a good grounding system. The grounding system should minimize the magnitude of the transients before they reach the equipment and protective devices. This will reduce the fuse type outages to a necessary minimum.

General ground system considerations

The resistance should be as low as possible. Wetter soil and higher clay content will have lower resistance. OSHA requires eight-foot ground rods. Multiple ground rods can be used to provide a lower resistance.



In addition to resistance, the inductance of the ground lead is a factor. A high inductance will produce a high transient voltage. Lower inductance can be provided by multiple leads; woven copper straps are also quite effective.

Antenna site

1. The mast should be higher (preferably 10 feet) than the antenna.

2. Heavy copper conductors should run from the top of the mast to the ground system instead of depending upon the mast for conduction.

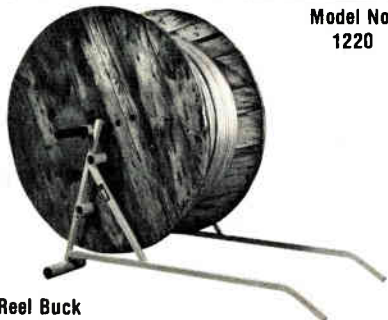
In extremely dry soil, a good ground is difficult to establish. Methods that have been used are: Several buried radial 100- to 200-foot copper conductors, large masses of scrap metal such as car radiators have been buried four to six feet deep to provide a ground.

Cable distribution system

The generally recommended considerations for good grounding should be followed.

Ground resistances on the order of 5 ohms are desirable. Good grounds in dry climates may be impossible to establish.

The commonly used practice of obtain-



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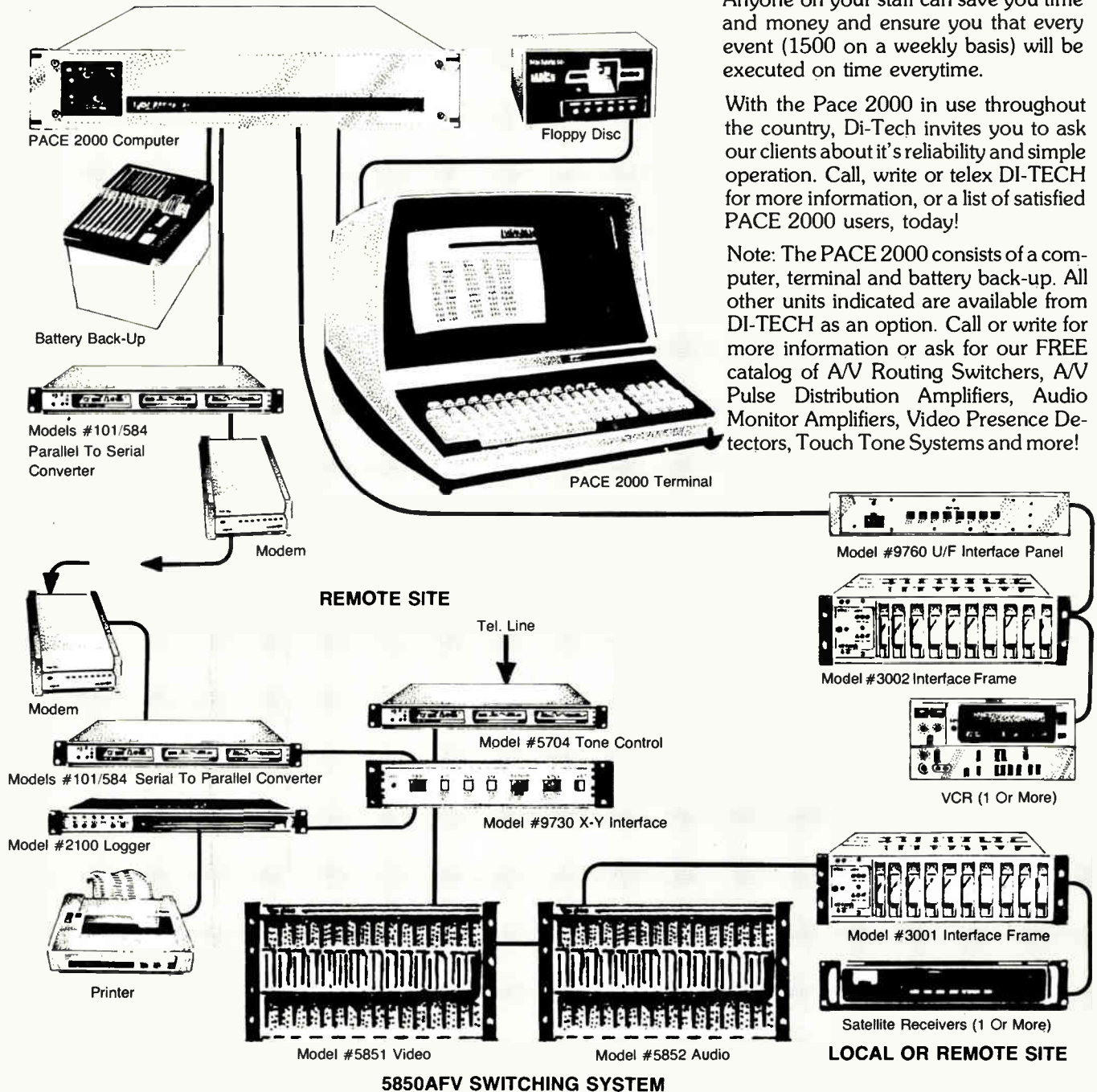
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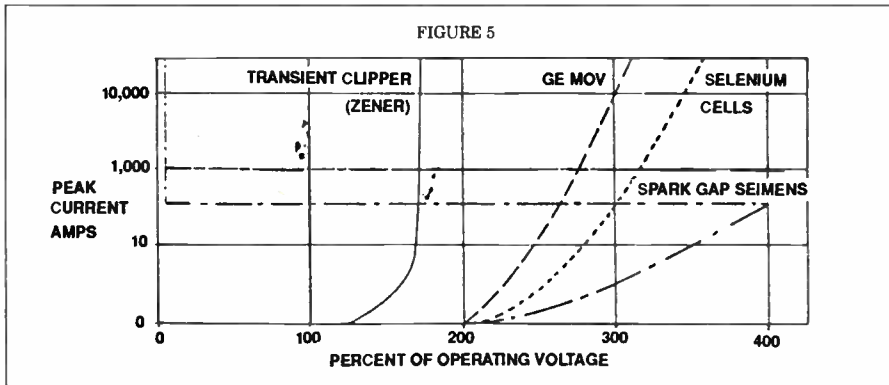


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Some systems having consistent transient problems were able to cure them only by removing the strap.



ing a ground by "strapping" the CATV strand to the telephone or power company strands has in many cases created transient problems for the CATV system.

There are three grounding situations shown in the case studies (see page 22) which are significant. In all three situations it has been assumed that the surge current in the power strand is

5,000 amps and a surge of 1,000 amps has been inductively coupled in the CATV strand and coax sheath. A ground resistance of 5 ohms has also been assumed.

In case A, the CATV strand is "strapped" to the power strand and the sum of 5,000 and 1,000 amps flow through the common ground resistance of 5 ohms, producing a voltage at the

amplifier case of 30,000 volts.

In case B, a separate ground load and rod have been installed on the CATV strand which is still strapped to the power strand. The total surge current of 6,000 amps divides equally between the two grounds and produces 16,000 volts (3,000 amps x 5 ohms) at the amplifier housing. This is a 2 to 1 improvement over case A.

In case C, the strap has been removed from the power strand, allowing the surge current in each strand to follow the separate grounds installed on each system. The 1,000 amps in the CATV strand will produce 5,000 volts (1,000 amps x 5 ohms) at the amplifier housing. This is a 6 to 1 improvement over case A.

The above is intended to illustrate the problems that can be encountered in grounding systems and the importance of low ground resistance. There are requirements, in many instances, to be strapped to power grounds. How-

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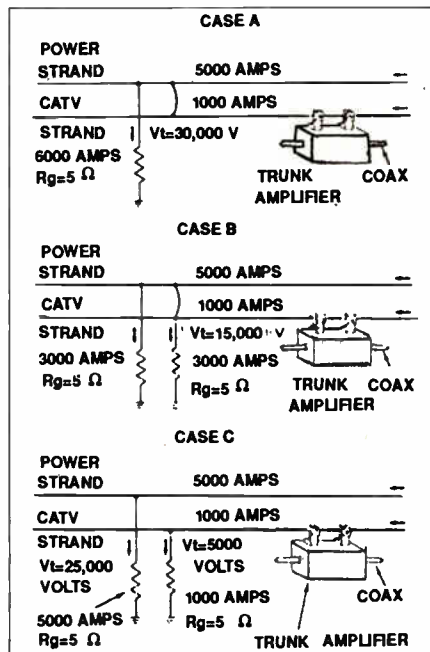
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Reader Service Number 14

Low impedance during conduction creates transient on ferro-resonant supplies.

ever, some systems having consistent transient problems were able to cure them only by removing the strap.

The magnitude of the currents and voltages are chosen only to illustrate the circuitry involved. Other factors such as cable resistance and inductance



affect the magnitude of the transient voltage at each amplifier. Analysis of equipment damage has shown that voltage transients of more than 2,000 volts commonly reach the equipment.

History of typical system experience

1. Area of high transient activity.
2. Trunk line of five miles on power line poles. All poles grounded with butt plates.
3. CATV system was strapped first, last and tenth poles to power strand.
4. Transients induced voltages on CATV strand and tripped amplifier over-voltage protection which consistently blew fuses.
5. Separate grounds were installed at each amplifier and each adjacent pole. This gave significant improvement.
6. Some outages continued until straps were cut from power strand.
7. No outages for several months during last storm season.

Protective devices

Spark Gap Surge Suppressor—

1. Used extensively directly on RF line to protect transistors. They are the only device with sufficiently low capacitance that can be used on coax center conductors without affecting the RF signals.

2. Firing time varies with transient rise time. At 500V/microsecond, firing time is approximately two microseconds. At 100V/microsecond, firing time is five to ten microseconds.

3. Firing point usually 200 percent of rated voltage to allow device to turn off.

4. Low impedance during conduction creates transient on ferro-resonant supplies. Can create a sustained short due to continued arcing. (A 35 amp follow on current rating will prevent this.)

5. Voltage across the device can rise to 400 percent of firing voltage during ionization and prior to arcing.

6. Specifications:

		Peak Surge Current
Siemens P/N	Firing volt	
B1-C90/20	90 ± 20 %	5 KA
B2-C145	145 ± 20 %	5 KA

Follow

On Current	Insulation Resistance	Capacitance
20A	10K	2 pf
35A	10K	1 pf

Silicon controlled rectifiers—

1. Breakdown to low impedance.
2. Are hard to turn off.

Metallic Oxide Varistors (type of selenium protector)—

1. Fire at 200 percent of rated voltage.
2. Will not take surges of ferro-resonant supplies.

Transient Clipper—

1. Is a bipolar (back to back) power type avalanche or zener diode.
2. Clamps at a fixed voltage level @ 130 percent rated voltage.
3. Does not break down to low impedance.
4. Fast firing and fast recovery.
5. Used across secondary of system power supply.
6. Responds to peak voltage.

Continued on page 72

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Reader Service Number 15

Cable and BTSC stereo

Stereo television is developing in the CATV industry, after getting off to a somewhat slow start. We now examine the unique characteristics of a cable system which affect BTSC stereo transmission. Though the transportation mechanism itself is broadband and generally transparent to stereo, practices at the headend and at the subscribers' home have an effect on stereo transmission. While stereo is quite possible in a CATV plant, one must take the proper precautions in order to achieve success.

How well does it work?

The first known stereo local origination telecast took place in Atlanta on Oct. 25, 1985, when a program produced by the Atlanta Newspapers was experimentally transmitted in stereo. Appropriately, the show was a discussion of stereo television, aimed at consumers. A report on this telecast has previously been made (ref. 1). A particularly interesting signal path was as follows.

The stereo audio was modulated onto a 4.5 MHz subcarrier at the Newspaper studio. The signal was added to the baseband video and transmitted on a video FM link to the first CATV headend, where it was demodulated (the sound remained on a 4.5 MHz carrier) and routed to a switching center. Next the signal was modulated onto a standard TV modulator and transmitted over an AM microwave link to a second headend. Here it was demodulated then remodulated onto a second FM carrier for transmission to a third headend site. At this site it was demodulated and modulated again onto a TV carrier for transmission on that cable system.

One of the authors recorded the program at his home near the end of this CATV system. No measurements were taken, but analysis of the tape later indicated that separation was

Proper precautions are necessary to achieve BTSC success.

good, limited by the acoustic separation in the studio. Signal-to-noise ratio was also limited by the studio noise, and was at least as good as that of monaural programming which followed the experiment.

More recently, Rovira (ref. 2) has reported the result of laboratory testing of a complete CATV system including 20 trunk amplifiers, two line extenders and the cable to accurately model a complete distribution system. The measured video carrier-to-noise ratio was 46.6 dB. Interface from the encoder to the modulator was as in figure 2A.

The calibration tone in the encoder and the modulator deviation indicator light were used to set deviation. Measured signal-to-noise ratio was 57 dB without scrambling and 53 dB with scrambling. Midband separation without scrambling but with an RF set-top converter was 37 to 40 dB. When the scrambling was turned on, separation remained above 35 dB.

These tests were performed using professional CATV quality equipment with no special adjustment. The set-top converter was standard production item. The results would likely have been somewhat less optimistic had consumer grade demodulation and decoding been employed, but clearly the system can be made to work well. This and other experience has led us to confidently assert that cable television and BTSC stereo can provide high quality service.

Historical perspective

Since its inception, cable television has seen its main purpose to be delivery of more and technically better entertainment than could be received off the air. In rural systems this often means delivery of television signals, period. However, in most systems, enhanced services are important for subscriber retention, as basic television signals are available off the air. The industry has long delivered audio programming. Historically, this has been done in the 88 to 108 MHz spectrum, with a

conventional FM tuner connected to the cable for reception. Many systems provide local and some imported FM signals this way. In some communities, special programming such as time and weather signals and shortwave broadcasts are provided. For several years some providers of premium programming have been supplying stereo audio feeds. These are traditionally carried in the FM band, permitting the subscriber to set his TV between his stereo speakers and hear the movie in stereo.

While such programming has a loyal following, it has proved to be of limited value to many subscribers because they are not set up with their TV between stereo speakers, and tuning both the TV and the FM receiver is confusing.

Numerous other systems have been proposed for delivery of out-of-band audio programming. Systems proposed range from normal FM transmission at unusual frequencies with a translator ahead of the FM receiver, to narrow band highly companded signals requiring decoders, to digital transmission of several programs, each with individual program control. The object of these systems has generally been revenue from sale of premium audio programming. Most have also offered some technical improvements compared with the normal transmission of stereo FM on cable. No such system has gained wide acceptance yet, largely due to the cost of the decoding apparatus in the home, and the problems already mentioned in connection with FM transmission.

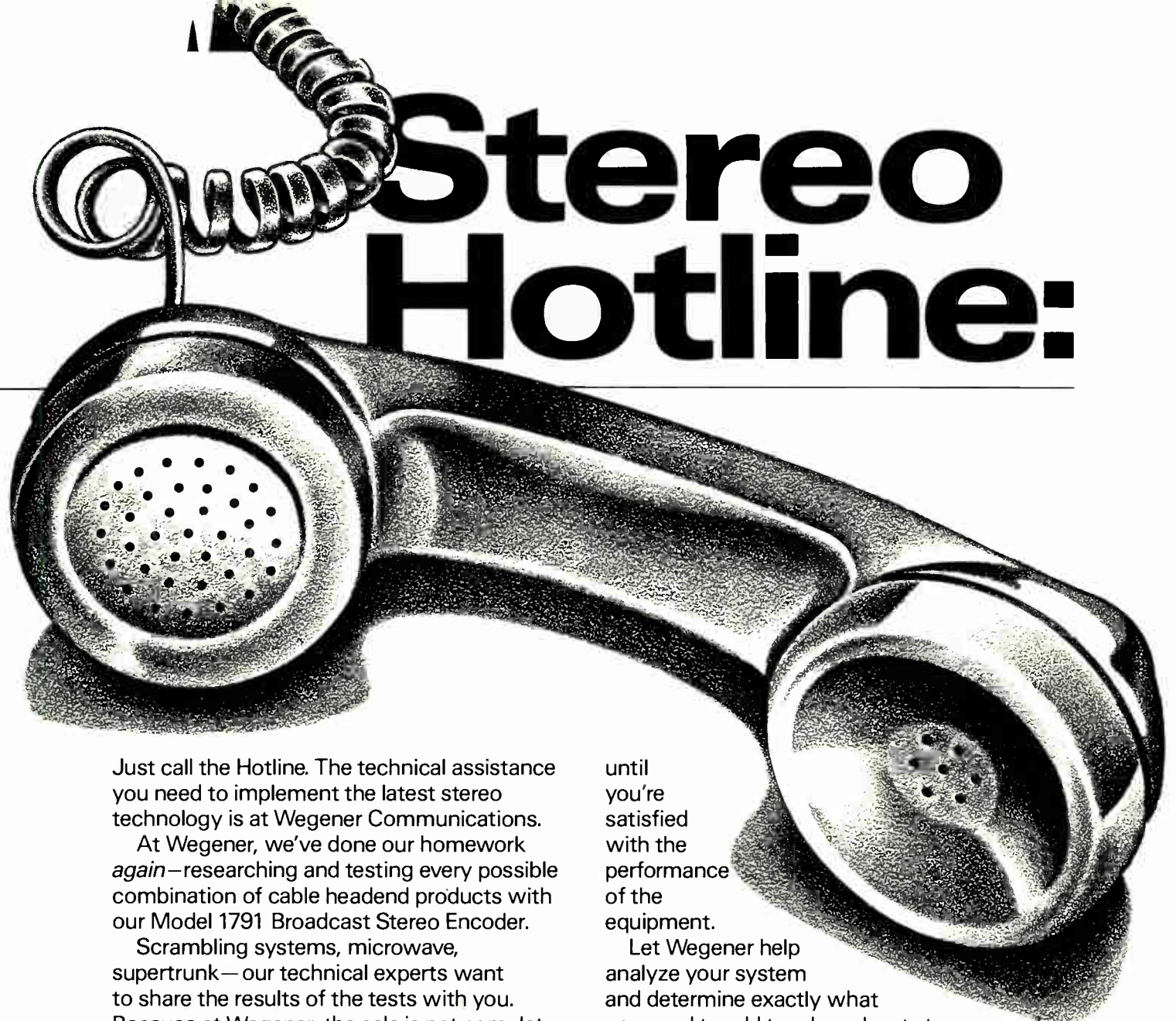
Early concerns

During a recent period of rather high energy level in CATV audio delivery, the BTSC standard for TV stereo was adopted by the EIA and protected by the FCC. Early reaction in the CATV industry was reserved. Partly this was due to recent activity involving other audio delivery means. It was also due to fears that BTSC would not work on cable.

One fear was that the carrier-to-noise ratio of a CATV system would not support the original concept of BTSC stereo. Under worst case CATV conditions, the BTSC signal was too noisy to serve the public interest. Thus,

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James O. Farmer, S-A, Alex B. Best, Cox Communications



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Reader Service Number 16

The heart of a CATV system is the headend, where signals are gathered, processed and put on the cable.

the CATV industry became a proponent of noise reduction as an integral part of the BTSC standard. Recent experience has shown that with the noise reduction which is part of the final standard, the signal-to-noise ratio is quite adequate for most listening requirements.

Another concern was related to the higher deviation of the sound carrier, and the effect that might have on the adjacent channel performance. If the lower adjacent sound carrier gets to the detector in the TV, it produces an irritating moving beat pattern. Television receivers generally have a lower adjacent sound trap which filters that signal before the desired signal is applied to the video detector. These sound traps expect a deviation of the sound carrier of 25 KHz. The fear was that the stereo signal, with its wider deviation, would ride out of the sound trap, producing an adjacent channel sound beat.

Tests at the original EIA lab in Chicago and in a Canadian CATV system, indicated that at a picture/sound ratio of 15 dB, the stereo signal did not produce picture degradation. However, if the sound carrier level was raised, interference due to a stereo signal was noted sooner than was interference due to a monaural signal.

The conclusion was that, at a 15 dB picture/sound ratio, BTSC stereo would

not cause adjacent channel interference, but the sound carrier level could not be raised without problems.

A further concern was that common headend processing equipment would not be able to handle the wider stereo signal for reasons shown below. While a few headends had to be modified to handle off-air stereo, this has not proved to be an onerous problem. Additional fears were that set-top converters used by subscribers would not be able to pass stereo. As shown below, this fear was founded in some cases, depending on the equipment in use.

The above concerns, plus the general fear of new technology by an industry which has been burned before, created widespread opposition to proposed FCC requirements that cable systems must carry BTSC stereo if the station being relayed was broadcasting it. The must-carry rule has not been adopted, but after an initial period of hesitation, the CATV industry is embracing BTSC stereo as the way to go. Most program suppliers are, or will be soon, delivering stereo sound, and economical high performance encoders are available to the industry.

Headend processor requirements

The heart of a CATV system is the headend, where signals are gathered from various sources, processed and put

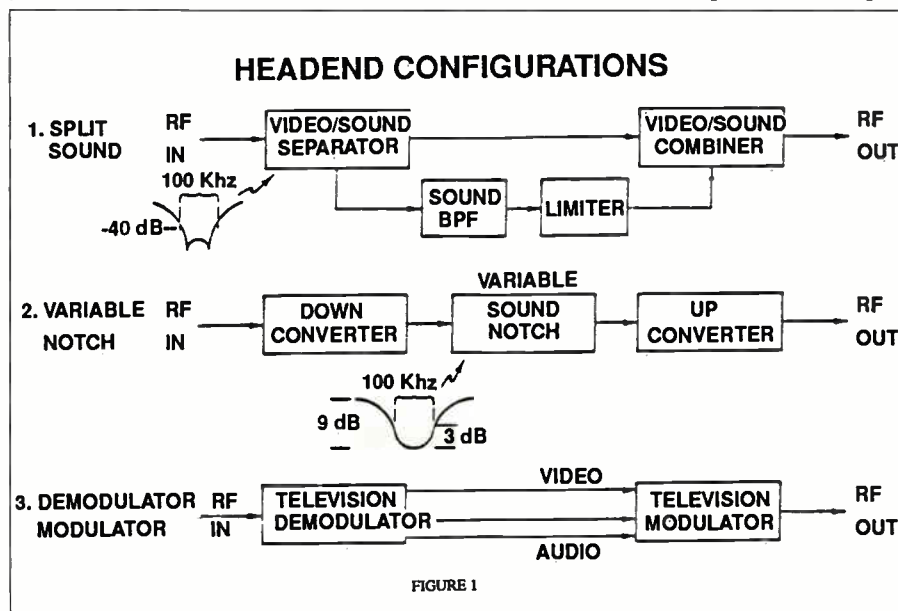
on the cable. Several techniques are used and each has a different relationship to stereo. Local off-air signals are normally handled in a device called a "processor." It receives the signal, converts it to intermediate frequency, filters, amplifiers, AGCs, and changes the relative level of the picture carrier. The IF signal is then up converted to the channel where it is carried on the cable.

Figure 1 shows common configurations for processing off-air signals. The top two illustrations apply to different types of signal processors used. The split sound processor separates the sound carrier from the picture carrier (at IF). The sound carrier is bandpass filtered and limited before being added back with the picture carrier (a trap in the video path prevents sound coupling through the video path).

The fear was that the bandpass filter in the sound path might be too narrow for the stereo signal, causing spectrum truncation. Also, the filter might have introduced group delay which would hurt stereo separation. Finally, we were concerned that the trap in the video path might be too narrow for stereo, resulting in FM/AM conversion, whose ultimate effect would be a function of the TV receiver.

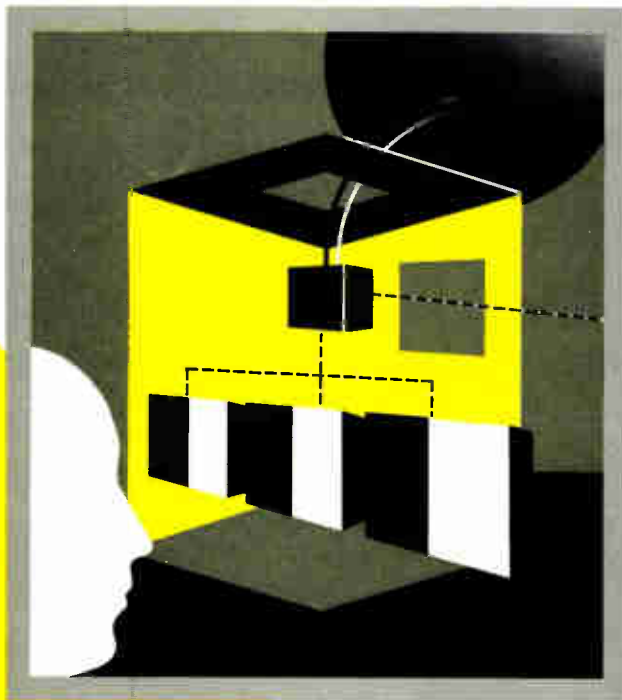
The second type of signal processing is shown in the middle of figure 1. In this variable notch technique, the sound carrier is not separated from the picture signal, but a variable depth notch is placed in the signal path. It is controlled by an AGC loop, which adjusts its depth to maintain the 15 dB picture sound ratio. Limiting is not employed in this processor. The concern with stereo here is first that the filter might not have been wide enough to accommodate the stereo signal. Also, due to design restrictions, this type of circuit inherently exhibits some FM/AM conversion of its own, and is incapable of removing any incoming AM components on the sound carrier.

Laboratory tests have shown that stereo signals passed through split sound processors retain good stereo separation, though in some cases slight degradation has been measured. Mid-band separation maintained better than 30 dB. The degradation was more pronounced on variable notch pro-



SOLUTIONS

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Stereo TV is quickly becoming an important part of the American home. Network and independent production of stereo programs is increasing rapidly and so is the number of Pay-TV services urging that their product be provided in stereo. All of this means that cable operators who want to take advantage of these marketing opportunities must implement ways of carrying the new stereo signals.

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Problems with handling off-air stereo in the headend can be overcome by using proper techniques and equipment.

cessors.

Figure 1 (3) shows the other major processing technique, in which the signal is converted to baseband in a demodulator, then converted to a modulator. When this type of processing is used, the stereo signal is normally lost. Most demodulators don't exhibit

adequate frequency response in the sound channel to pass the composite stereo baseband signal nor do most modulators. The problem could be solved with wide bandwidth demodulators and modulators, but a deviation setting problem explained below would still exist, and an easier way is available.

Demodulators usually make available the modulated sound carrier at the 4.5 MHz intercarrier frequency. Since it is obtained with heterodyne techniques, the incoming deviation and frequency response are maintained. A fairly sharp bandpass filter is used, but it is wide enough to pass the signal.

The 4.5 MHz sound carrier may be combined with the baseband picture information and supplied to the modulator. The modulator contains circuitry to again separate the two signals, and filter and limit the sound carrier. This technique has been found to yield good stereo performance.

Thus, problems with handling off-air stereo in the headend can be overcome by using proper techniques and equipment which is already available to the CATV operator. The more common equipment for processing signals uses the split sound technique, and many CATV systems began carrying stereo as soon as their first broadcast station converted.

The writer recalls asking the chief engineer of the cable system he was on if the system carried BTSC stereo. He was assured that it did not and would not in the near future. At the time this statement was made, the writer had spent several hours listing to very good quality stereo on that system.

Besides off-air signals, most other signals carried exist in the headend in

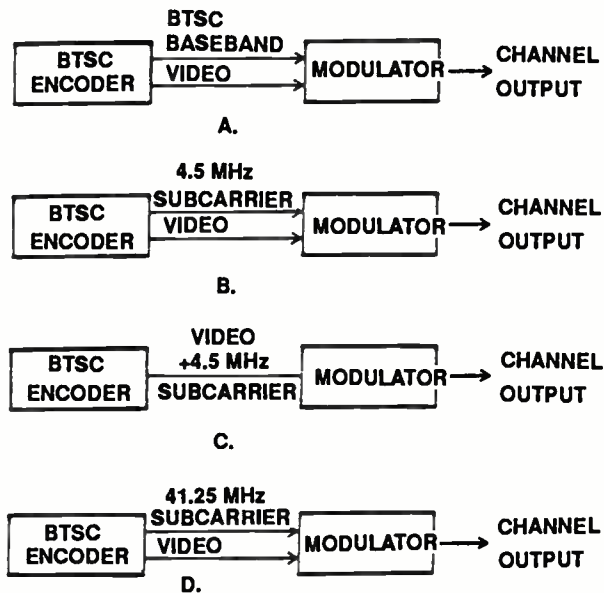


FIGURE 2

ENCODER TO MODULATOR INTERFACE



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Various methods may be used to interface the stereo encoder and modulator.

baseband form, either from locally generated video and audio sources, or from earth station receivers. In these cases, the processor is replaced by a modulator. Audio signals are available as left and right channels, which must be encoded into a composite stereo signal by an "encoder." The output of the encoder is supplied to the modulator.

Transmission of stereo over the satellite is by transmission of the left and right channel information, or in some cases sum and difference signals are transmitted. Proposals have been made to transmit the composite BTSC audio signal but this has been shown to produce excessive degradation in the stereo separation, and the resulting signal-to-noise ratio is unsatisfactory.

Some systems employ two sound subcarriers, for example, at 6.8 and 7.4 MHz, with "normal" transmission parameters (75 microsecond pre-emphasis, 75 KHz deviation). Others employ low deviations and a lot of companding. One system transmits sum and difference signals on separate subcarrier frequencies, but this system requires a lot of care at the headend to assure that the sum and difference channels are processed identically.

Many program services are now scrambling their signals. An integral part of the scrambling system is two channels of audio, transmitted digitally during the horizontal blanking interval of the video signal. The decoder which delivers an unscrambled baseband video signal also delivers the left and right audio channel information.

Encoders accept right and left channel inputs. These are filtered and matrixed to form the sum (L+R) and difference (L-R) signals. Video is looped through the encoder in order to synchronize the stereo pilot to the horizontal line rate. The pilot is generated and its second harmonic is double sideband suppressed carrier amplitude modulated, with the difference signal. If the SAP and professional channels are used, these are added to the composite stereo signal. This composite stereo signal is supplied to the modulator, along with the video for the channel.

Various methods may be used to interface the stereo encoder and modu-

lator. Figure 2 shows the more practical. Figure 2A shows interface of the composite stereo baseband signal. In many cases this is the recommended method of interface. Modulators may be obtained with broadband audio

inputs having the necessary frequency response to accept the composite input.

Older modulators of modular construction frequently can be upgraded by replacement of the audio modulator module. Since the BTSC standard calls

New Products from Sachs Communications Inc.



The SC18 series Saxxon Clips that are ever so popular have just had their price reduced at the MSO level. This reduction is mainly due to the mechanization of the assembly process of these clips using the new "robot". This has the capacity of doubling the production output of the product. Presently,

the clips are available in three sizes: 6mm for RG59 cables; 7mm for RG6 cables and 8mm for Quad cables. The company now also produces these clips painted in black.

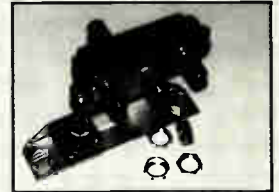
The new SC28 series identification tags from Sachs are made of special MG10 aluminum alloy, which permits the installer to scribe/write any information that may be required. There are three variants in the series: 3/4" long, 7" long and 7" pre-stamped, with a company name or logo, for example, as desired by the customer. There is no additional charge for pre-stamping except a small initial stamp preparation charge.

The SC29 series I.D. Flags are for identifying coax cables but at 1" length, are much smaller than the SC28. These are available in plain MG10 aluminum alloy for scribing on or painted alloy, in literally any colour desired.

Other new items: To add drops to an existing clamp, Sachs is now producing the **SC03EK** kit to attach to a previously installed SC03E Span Clamp. This saves the time of a second installation and saves on hardware costs as well.

The SC23 series tap brackets come in two inch or four inch heights with vertical or plain type clamps and with or without common grounding.

The SC24 series tap brackets are for wall mounting situations of taps such as in apartments. The two types are for taps facing down or taps facing out.



The SC12 & SC12D series of ground brackets and the SC13 ground straps are now UL Listed. The SC12D - S81 includes one F81 connector, permitting a second one to be added later on. It also permits the addition of a splitter whenever required using the **SC09 Splitter Ring Nut**.

The SC22 series Ground Connectors are available for #4 or #6 wire, copper or cadmium plated, to attach to copper pipes or various fixtures.

The SC26 House Hook is for messenger applications. It has an oval head, where the messenger is wrapped, thus eliminating the need for other hooks.

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Some stereo encoders provide a test tone which allows the modulator deviation to be set accurately.

for pre-emphasis in the sum channel only, the pre-emphasis circuit in the modulator must be disabled. Pre-emphasis is provided by the encoder.

This method of interface requires the modulation level to be set accurately. Some stereo encoders provide a test tone which allows the modulator deviation to be set accurately. Once the modulator deviation sensitivity is set with the test tone, it is not adjusted. Further level adjustment must be done from the controls on the encoder.

Figure 2B shows another method of interface which is even more advantageous if the equipment will allow it. As shown below, deviation of the sound carrier by the composite stereo signal must be very accurate. Otherwise the separation will suffer. If the interface of figure 2A is used, then the headend technician will have to set the deviation sensitivity accurately. In figure 2B, the encoder includes a 4.5 MHz sound carrier oscillator, which is mod-

ulated by the composite stereo signal. The deviation adjustment may now be done by the encoder manufacturer. Controls and indicators on the encoder permit matching its input to the audio level presented, and this adjustment, while affecting balance, doesn't affect separation. The only drawback to this approach is that a number of modulators aren't configured to accept the separate 4.5 MHz sound carrier, though some of them can be modified to do so.

A more common modulator arrangement is to accept the 4.5 MHz sound carrier combined with the video baseband. This configuration has long been available because microwave techniques used in distant signal importation deliver such a signal to the modulator. Figure 2C shows this applied to the stereo signal. The signal path in popular modulators has been found adequate for handling the stereo carrier. However, some equipment has been upgraded by the manufacturer to allow

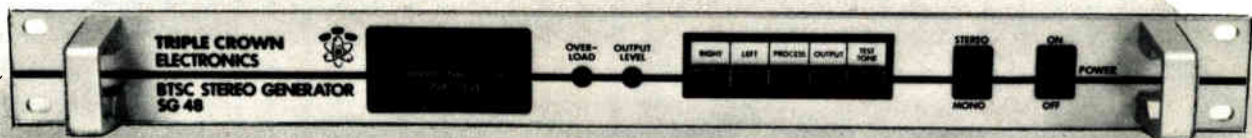
a slightly wider passband for the sound carrier, to improve performance when the SAP channel is present. Originally, this interface was thought to be the interface of choice, because most existing modulators could be used as is and the critical deviation could be set in the encoder by the manufacturer.

We have discovered, though, that some satellite delivered signals contain enough video energy around 4.5 MHz to contaminate the sound path so as to reduce the quality of the delivered stereo. High grade modulators frequently contain a 4.5 MHz notch in the video path to reduce this energy, but if the sound carrier is combined with the picture signal, then this video energy will pass through the sound channel. Earlier in this paper we claimed this to be a preferred headend technique, but the assumption implicit in that claim was that an off-air signal had the video spectrum around 4.5 MHz cleaned at the transmitter. If not, the audio was

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It is on the subscriber end of the system that we encounter the most variation in the difficulty of stereo delivery.

already contaminated.

Figure 2D shows another method of interfacing the encoder with the modulator. In this case, the audio circuits of the modulator are not used at all, but the encoder supplies the modulated

sound signal on the 41.25 MHz sound IF frequency. However, the FCC requires, at least for off-air signals, a picture-sound spacing of $4.5 \text{ MHz} \pm 1 \text{ KHz}$. If the interface of figure 2D is used, then this would require that the

sound and picture IF frequencies independently be within 500 Hz of the nominal frequency, a difficult thing to ensure. Modulators generally develop the 41.25 MHz signal either by mixing the 4.5 MHz sound carrier with the 45.75 MHz picture IF, or by directly modulating at 41.25 MHz, which is phase locked to a 4.5 MHz offset, from the picture IF.

Thus, the currently recommended interface techniques are, first, as in figure 2A, if the sound carrier deviation can be set accurately. Figure 2B is preferred if feasible with the equipment available. Alternatively, figure 2C is favored if the 4.5 MHz energy content of the video signal is low.

Transportation system

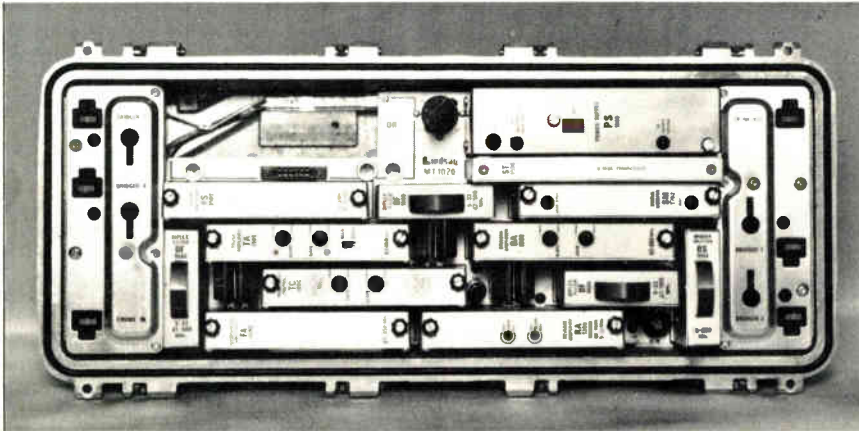
A CATV transportation system consists of a broadband, very linear network. It is generally free of any effect on the stereo signal, except that the signal-to-noise ratio is decreased as one progresses through the system. As noted earlier, this caused concern in the early days of stereo, but with the noise reduction method included in the standard, satisfactory results are obtained.

Subscriber interface

It is on the subscriber end of the system that we encounter the most variation in the difficulty of stereo delivery. In the case of a subscriber who has a stereo TV set directly connected to the cable, no problems exist. Stand-alone decoders are available for use with monaural TV sets, and these may be connected to the cable through a splitter, which provides cable signals to both the TV and the receiver. FM receivers are frequently connected this way. One drawback is that when energy is split two ways, the signal level supplied to each apparatus is reduced by about 3.5 dB (including resistive losses in the splitter).

Depending upon the signal level coming in and the noise figure of the receiving apparatus, this may or may not introduce unacceptable noise into the signal. Sometimes the splitter can be replaced with a directional coupler which sends a signal to the stereo

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Reader Service Number 22

receiver which is 10 dB lower than that sent to the TV. This allows the signal to the TV to be reduced by around 1 dB rather than by 3 dB, the trade-off being less signal to the stereo receiver. Another drawback remains the problem of tuning two separate receivers.

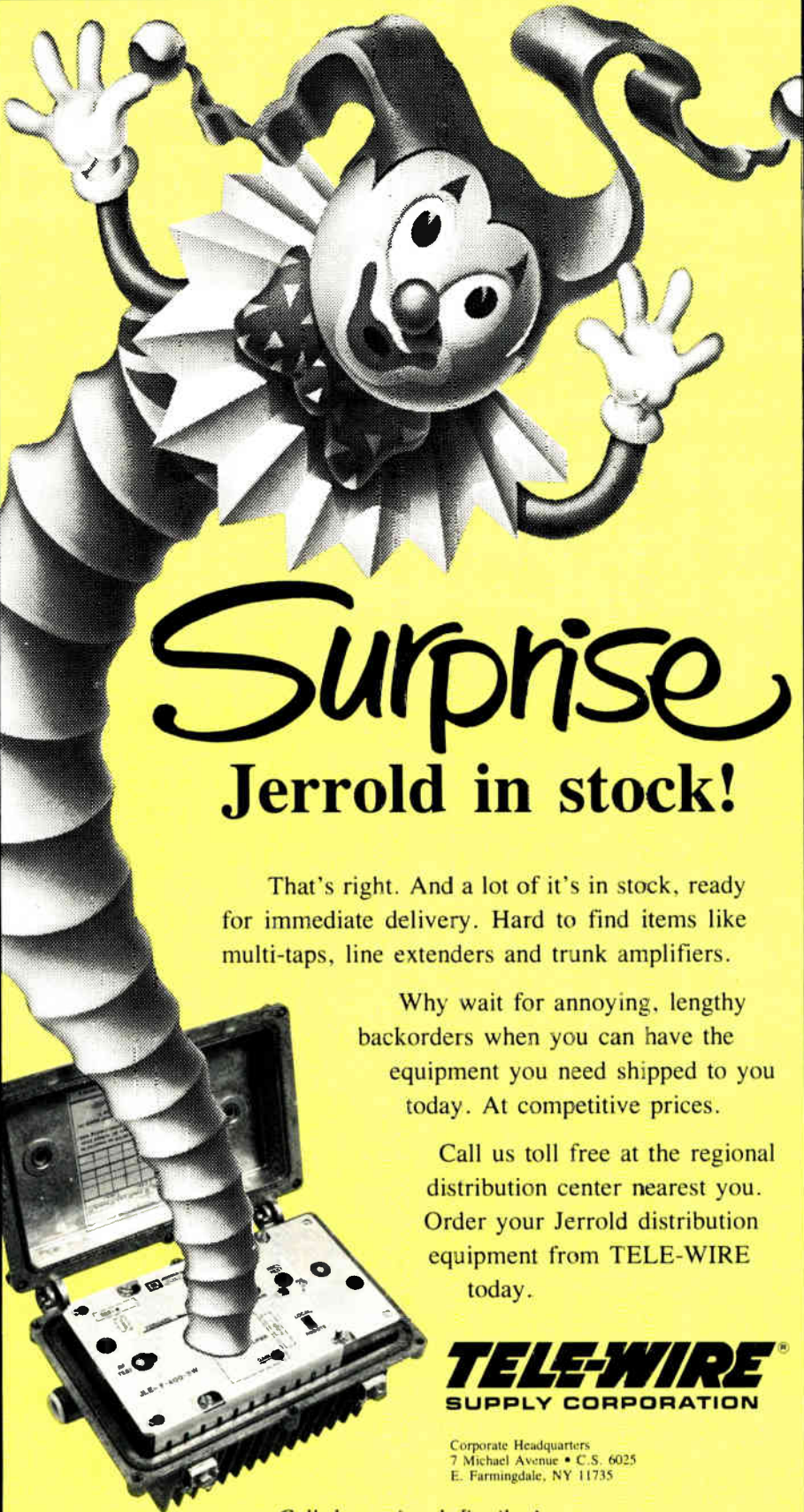
One manufacturer makes available a decoder which obtains sound energy from the TV receiver intercarrier detector using an RF probe attached to the outside of the receiver. This works well in some cases. If a basic set-top converter is used ahead of the TV, a stereo receiver may be connected between the converter and the TV to overcome the dual tuning problem.

In most CATV systems today, scrambling is employed in order to hide premium signals from subscribers who don't purchase them. The descrambling function is contained within a set-top converter, which also contains channel tuning functions. A number of issues relate stereo to the set-top converter.

Set-top converters may be broadly divided into two types, RF and baseband, illustrated in figure 3. The RF converter is shown in figure 3A. Incoming signals from the cable are supplied through a low pass filter, to a mixer which up converts the signal to an UHF intermediate frequency. Normally 608 to 614 MHz is used as an IF because no TV stations are assigned to that channel (37). The first oscillator is usually either controlled with a phase locked loop (PLL) or is controlled from a DC voltage supplied from a potentiometer. At IF the signal is filtered and amplified, then converted down to the output channel, usually 3 or 4.¹ If a descrambler is used it is normally included after the down conversion to the output channel. The effects of the descrambling will be covered after we discuss the basic set-top.

RF set-top converters should not damage the BTSC signal, so long as an intercarrier detector is employed in the receiver. The oscillators in the set-top terminal tend to introduce phase noise to the picture and sound carriers. This is especially true if the oscillator is phaselocked.

In wide bandwidth set-tops covering 50 to 550 MHz, the first LO tunes from 668 to 1166 MHz, 75 percent of an octave. With this wide a tuning range



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Baseband converters produced in the pre-stereo era could not anticipate the needs of stereo.

and consumer size dollars to spend, the PLLs usually introduce enough phase noise that direct detection of the sound signal would introduce unacceptable noise. The same can be said for many game and VCR modulators. Since the picture and sound carriers are simultaneously passed through the mixer, they will receive identical phase noise.

In the TV set the picture and sound carriers are mixed to obtain the 4.5 MHz sound signal in an intercarrier detector. This process removes the phase noise from the 4.5 MHz signal, so quality detection is possible. Intercarrier detection is universal in TV receivers and in VCRs, as well as in many TV tuner/decoder units. However, we are aware of at least one case in which a manufacturer marketed a TV band audio tuner which directly detected the sound carrier. Noise from this device was totally unacceptable when a set-top terminal was used ahead of it.

Baseband converters, on the other hand, have the potential to eliminate the stereo signal in a manner similar to that described above for demod-remod headends. Figure 3B shows such a device. The front end of the baseband converter is essentially identical to the RF converter except for the descrambler and the second LO frequency. The second LO is placed below the UHF IF, so that the spectrum is inverted from

the incoming signal, at the normal TV IF frequency of 45.75 MHz for the picture and 41.25 MHz for the sound. The signal is then passed through a normal TV IF strip and detector, whose output is baseband video and audio. Descrambling is normally done on the baseband video signal. Since the audio signal is also available at baseband, it is customary to provide a volume control function on such converters. After descrambling and volume control, the signals are remodulated onto carriers at channel 3 or 4, for delivery to the TV set.

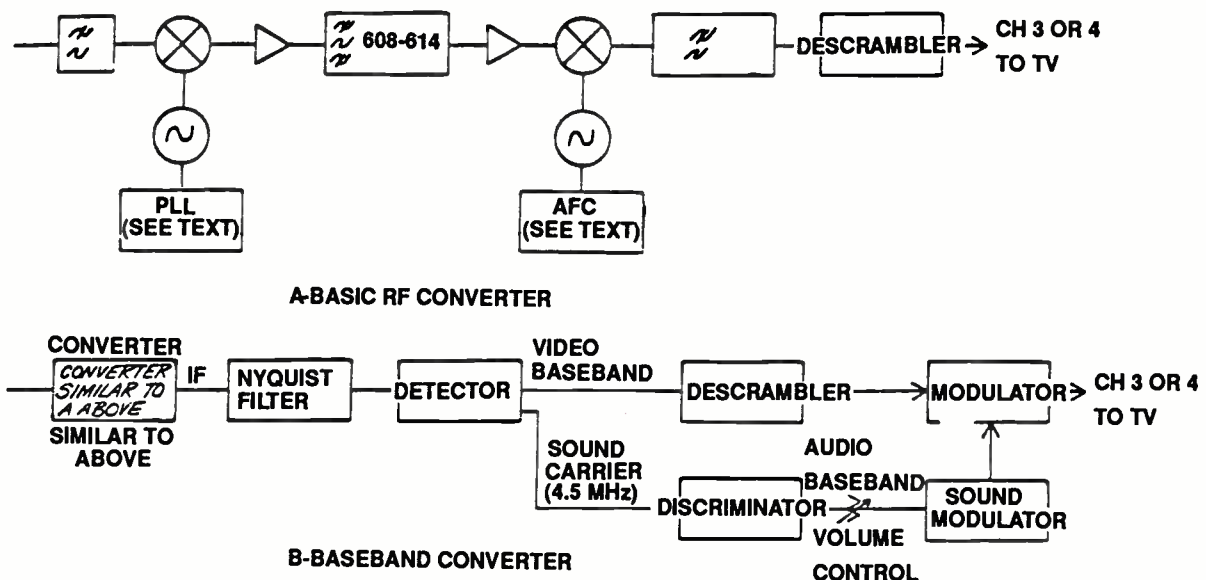
Baseband converters produced in the pre-stereo era could not anticipate the needs of stereo, so they don't have sufficient bandwidth to pass the composite stereo signal. They may or may not pass enough of the pilot to activate the decoder, but certainly the difference signal will not make it through. Current baseband converters have been modified to pass the composite stereo signal. The volume control function still presents a problem with baseband converters, however. For economic reasons it is not feasible to decode stereo to left and right channels, control the volume then re-encode before modulation. Rather, the volume control function continues to be performed on the composite stereo signal.

Unfortunately, due to the companding used in the difference channel, this

degrades the separation. One can see why this is by remembering that in the noise reduction system, the difference channel amplitude is raised or lowered based on the signal level with respect to a reference level. The reference level is carried with the stereo signal not as a separate signal, but rather is carried simply in the amplitude of the difference signal with respect to a factory-set standard. Thus, as the amplitude of the composite signal is changed by the volume control, the reference level is incorrectly interpreted by the decoder. This results in the difference signal being expanded incorrectly, and therefore, it will not properly add and subtract from the sum signal. The end result is loss of separation.

Figure 4 plots the separation vs. modulation error assuming no phase error (phase error would make amplitude error even more critical). From this figure, an amplitude error of 20 percent will reduce the separation to about 18 dB. This much error represents an amplitude change of only 1.9 dB, so with error in both directions we may achieve an overall gain reduction capability of under 4 dB if we wish the volume control to cause loss of separation down to 18 dB.

Proponents of baseband volume control argue that separation of much less than 10 dB yields adequate stereo effect. One may achieve, perhaps, a 10

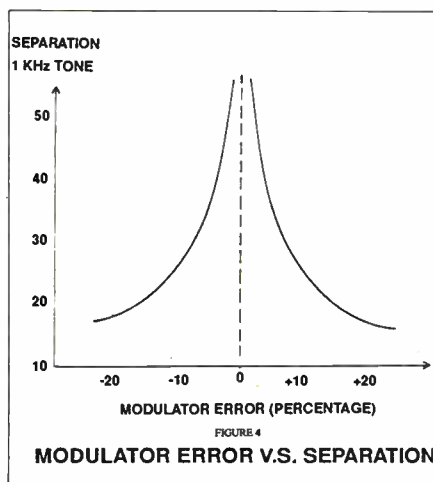


Concern exists that BTSC and scrambling don't get along too well.

or 12 dB volume control range and still maintain adequate separation according to the proponents.

Scrambling and stereo

Concern exists that BTSC and scrambling don't get along too well. The issue generally revolves around scrambling techniques which put AM pulses on the sound carrier for synchronization. These systems have been popular in recent years due to their reliability, adequate scrambling and low cost. Popular scrambling systems in use today rely on suppression of the horizontal and, usually, the vertical sync. The sync is shifted to occupy a carrier amplitude which is also occupied by video information. Upon detection, the sync appears buried in the video, and is not accurately identified by the sync separator in the TV. Descrambling in an RF set-top is by amplifying the RF carrier at the output channel, during the



blanking intervals (see Figure 3). Synchronization information is transmitted to the descrambler as a series of AM pulses on the sound carrier. Television sound being FM, the AM pulses don't normally interfere with the sound

and vice-versa.

Typically, the synchronizing pulses on the sound carrier are 6 dB in amplitude (the amplitude of the carrier is doubled) and has a duration from four to 12 microseconds, depending on the particular manufacturer. The additional gain switched in during the blanking intervals is also about 6 dB, and is switched in for about 12 microseconds during horizontal blanking, and may be switched in for up to 1.3 milliseconds during vertical blanking. Referring again to Figure 3, one may see that the sound carrier arriving at the TV receiver has two sets of amplitude pulses on it: a series of short pulses representing the timing information, and a series of longer pulses which are a by-product of the video descrambling. Depending on the particular manufacturer, the timing pulses may or may not partially overlap the restoration pulses.

Continued on page 90

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**by the NCTA Engineering Committee's
Subcommittee on Consumer Interconnection**

Chairman: David Large

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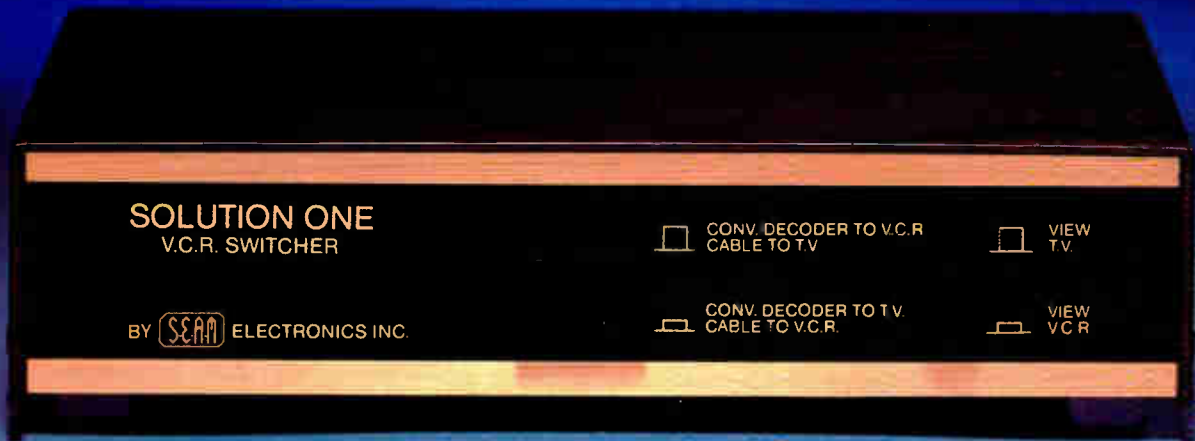
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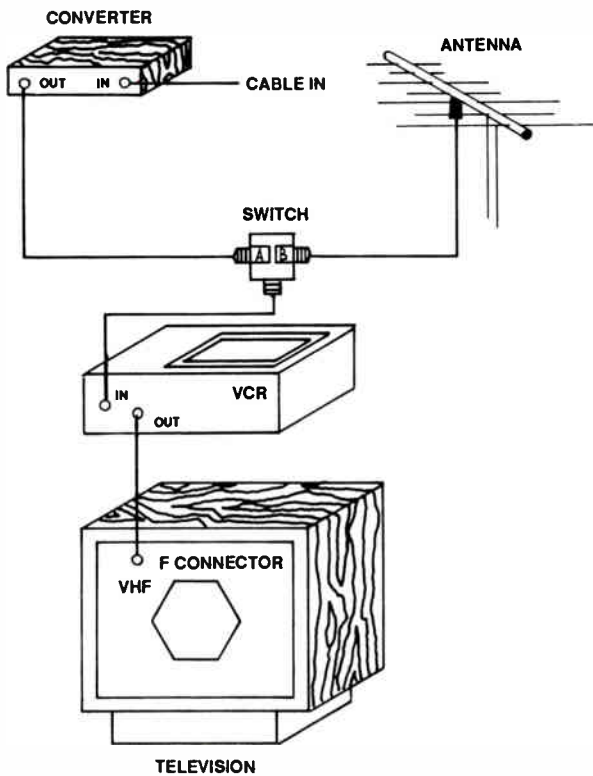
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ILLUSTRATION # 15



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- recording of ANY CABLE CHANNEL, while viewing THE SAME CABLE CHANNEL
- recording of any off-air channel, while viewing any off-air channel

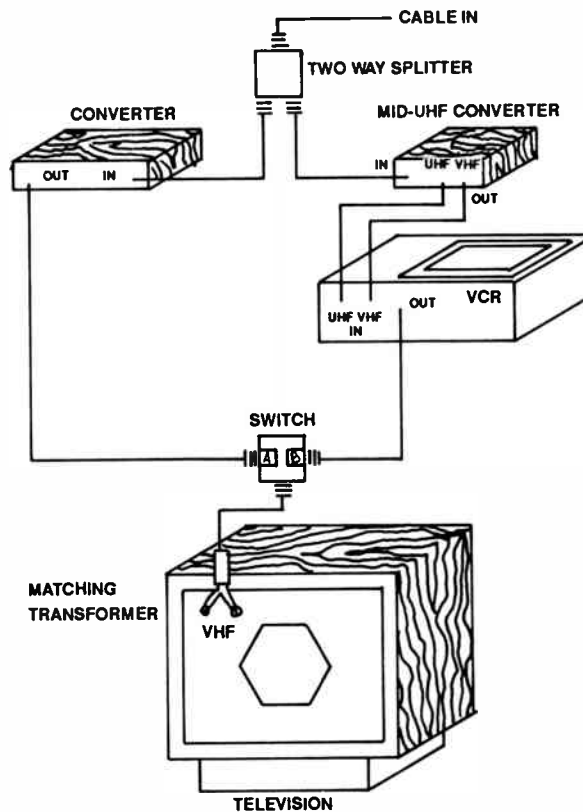
Also allows (for OFF-AIR CHANNELS ONLY):

- timed, multi-channel, multi-event recording (i.e. ability to program VCR to record a movie on channel 5 at 6 p.m., and then a second program on channel 26 at 8 p.m.)
- channel selection by the TV remote control
- channel selection by the VCR remote control

Precludes (for CABLE CHANNELS):

- timed, multi-channel, multi-event recording, use of TV or VCR remotes
- NECESSARY DROP LEVEL: 0dBmV

ILLUSTRATION # 16



Allows:

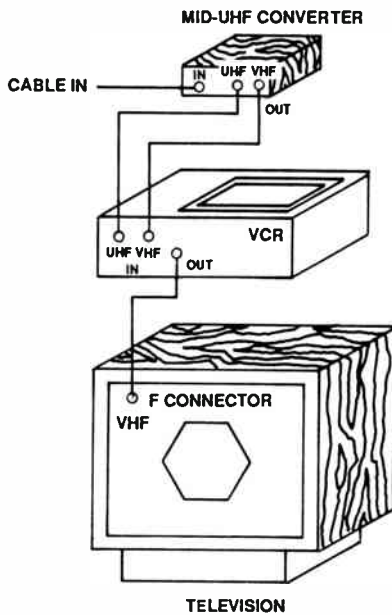
- recording of ONLY NON-SCRAMBLED channels, while viewing ANY channel

Also allows (except when using the converter):

- timed, multi-channel, multi-event recording (i.e. ability to program the VCR to record a movie on channel 5 at 6 p.m., and then a second program on channel 26 at 8 p.m.)
- full use of the TV remote control
- full use of the VCR remote control

NOTE: allows for viewing of all channels on a non-cable ready TV
NECESSARY DROP LEVEL: +3.5dBmV

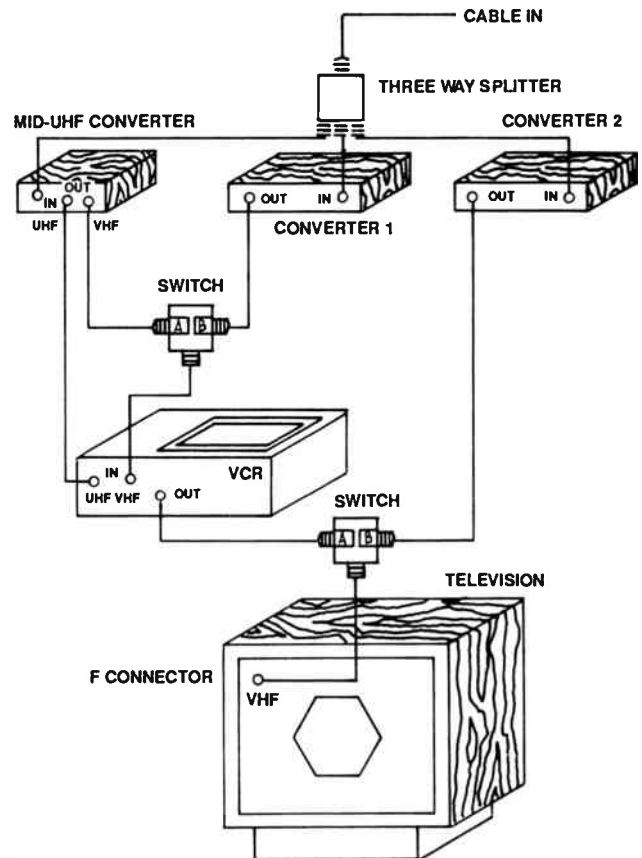
ILLUSTRATION # 17



- Allows:
- recording of NON-SCRAMBLED channels, while viewing ONLY NON-SCRAMBLED channels
 - timed, multi-channel, multi-event recording (i.e. ability to program VCR to record a movie on channel 5 at 6 p.m., and then a second program on channel 26 at 8 p.m.)
 - full use of the TV remote control
 - full use of by the VCR remote control

Note: This illustration is useful if the non-cable compatible VCR has a remote control but the TV doesn't. Illustration #25 is superior for VCRs with bypass circuitry
 NECESSARY DROP LEVEL: +5dBmV

ILLUSTRATION # 18

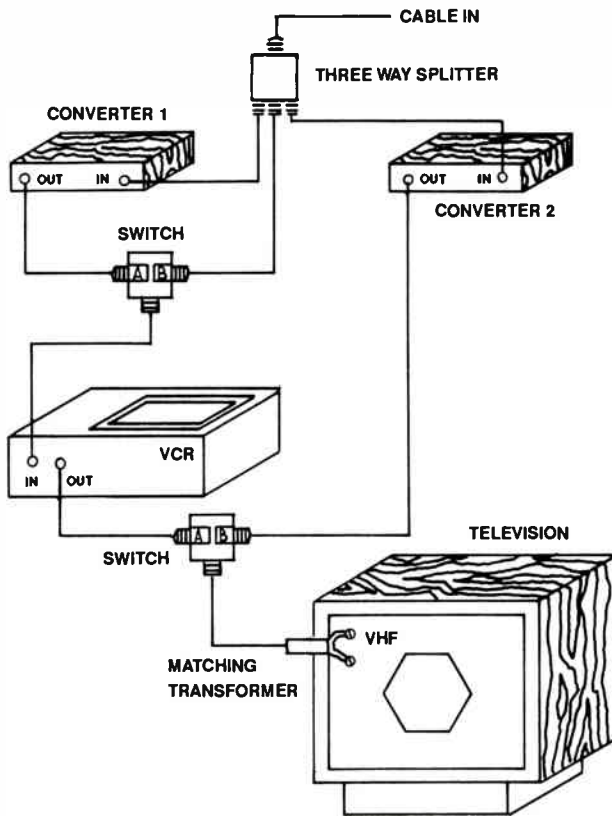


- Allows:
- recording of ANY channel, while viewing ANY channel
 - timed, multi-channel, multi-event recording (i.e. ability to program VCR to record a movie on channel 5 at 6 p.m., and then a second program on channel 26 at 8 p.m.) of NON-SCRAMBLED CHANNELS ONLY

- Precludes:
- channel selection by the TV remote control
 - channel selection by the VCR remote control

Note: use of converter remote control will affect both converters simultaneously
 NECESSARY DROP LEVEL: +7dBmV

ILLUSTRATION # 19



Allows:

- recording of ANY channel, while viewing ANY channel

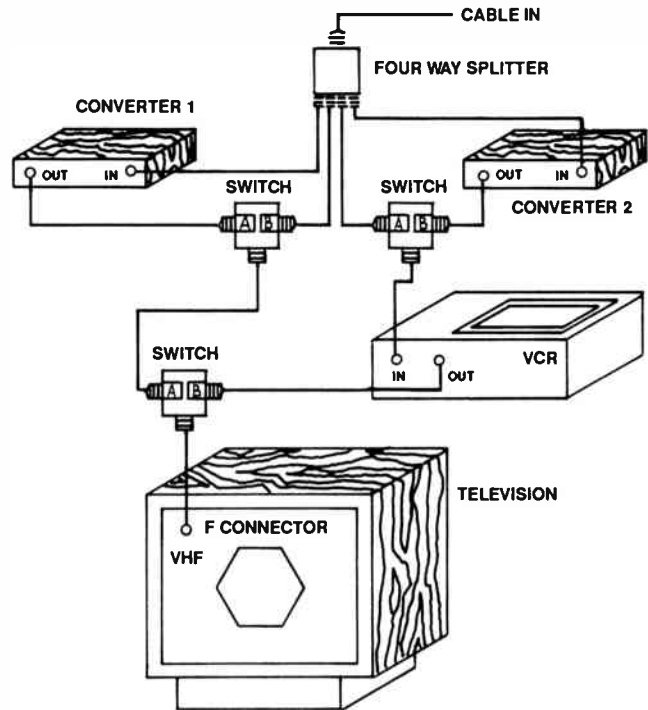
Allows (when VCR in non-converter, bypass mode):

- timed, multi-channel, multi-event recording (i.e. ability to program VCR to record a movie on channel 5 at 6 p.m., and then a second program on channel 26 at 8 p.m.) (NON-SCRAMBLED CHANNELS ONLY)
- channel selection by the TV remote control
- channel selection by the VCR remote control

Precludes (on scrambled channels):

- timed multi-channel, multi-event recording, use of TV or VCR remotes
- Note: use of converter remote control will affect both converters simultaneously
NECESSARY DROP LEVEL: +7dBmV

ILLUSTRATION # 20



Allows:

- recording of ANY channel, while viewing ANY channel

Also allows (for NON-SCRAMBLED CHANNELS ONLY):

- timed, multi-channel, multi-event recording (i.e. ability to program VCR to record a movie on channel 5 at 6 p.m., and then a second program on channel 26 at 8 p.m.)
- full use of the TV remote control
- full use of the VCR remote control

Precludes:

- timed multi-channel, multi-event recording, use of TV or VCR remote control on SCRAMBLED CHANNELS

Note: converter's remote control will affect both converters simultaneously
NECESSARY DROP LEVEL: +7dBmV

ILLUSTRATION # 21

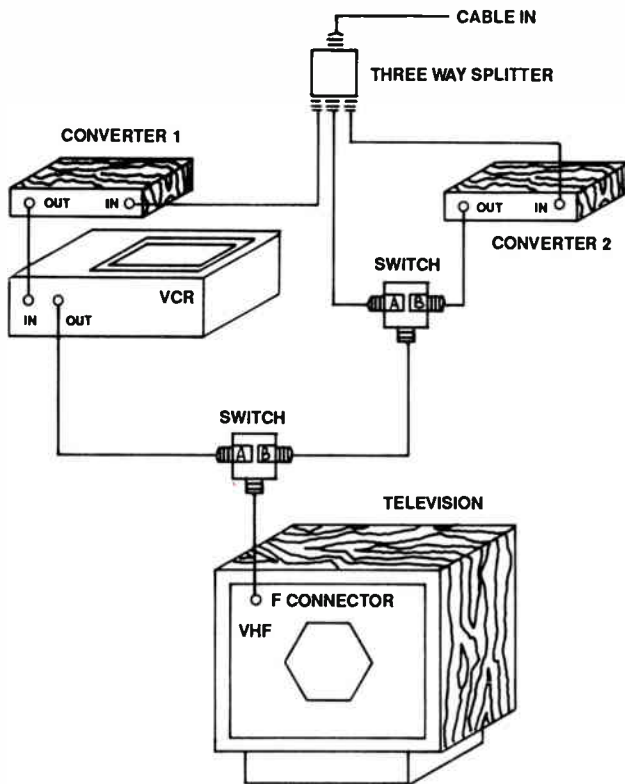
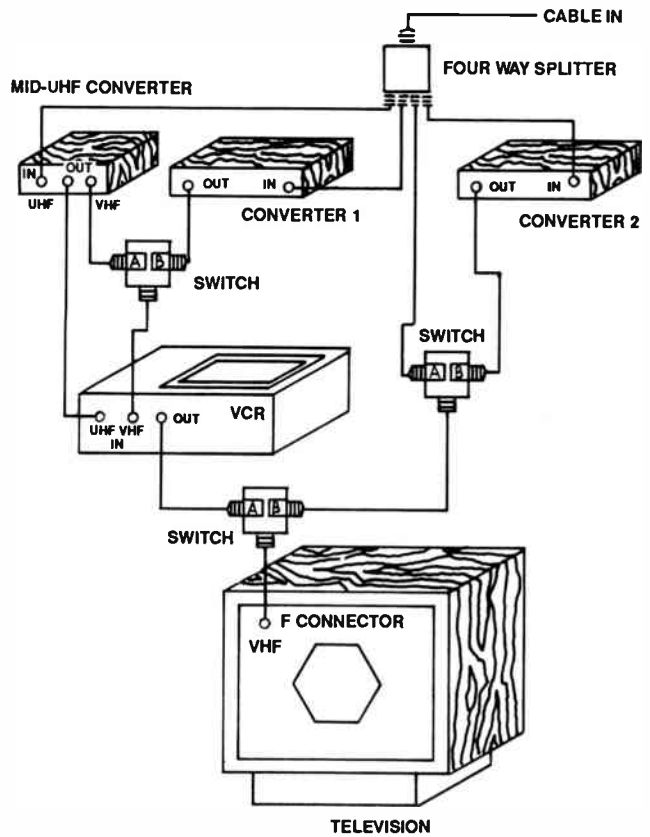


ILLUSTRATION # 22



Allows:

- recording of ANY channel, while viewing ANY channel
- full use of the TV remote control

Precludes:

- timed, multi-channel, multi-event recording (i.e. ability to program VCR to record a movie on channel 5 at 6 p.m., and then a second program on channel 26 at 8 p.m.)
- use of TV remote control for SCRAMBLED CHANNELS
- channel selection by the VCR remote control

Note: converter's remote control will affect both converters simultaneously
NECESSARY DROP LEVEL: +7dBmV

Allows:

- recording of ANY channel, while viewing ANY channel

Also allows (for NON-SCRAMBLED CHANNELS ONLY):

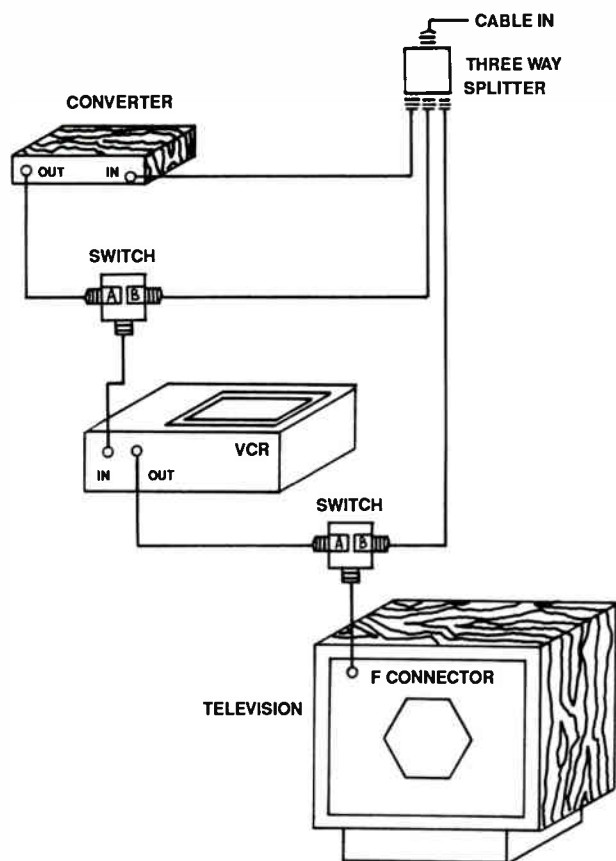
- timed, multi-channel, multi-event recording (i.e. ability to program VCR to record a movie on channel 5 at 6 p.m., and then a second program on channel 26 at 8 p.m.)
- full use of the TV remote control
- full use of by the VCR remote control

Precludes:

- timed multi-channel recording, use of the TV or VCR remote control on SCRAMBLED CHANNELS

Note: converter's remote control will affect both converters simultaneously
NECESSARY DROP LEVEL: +7dBmV

ILLUSTRATION # 23



Allows:

- recording of ANY channel, while viewing A NON-SCRAMBLED channel

Also allows (for NON-SCRAMBLED CHANNELS ONLY):

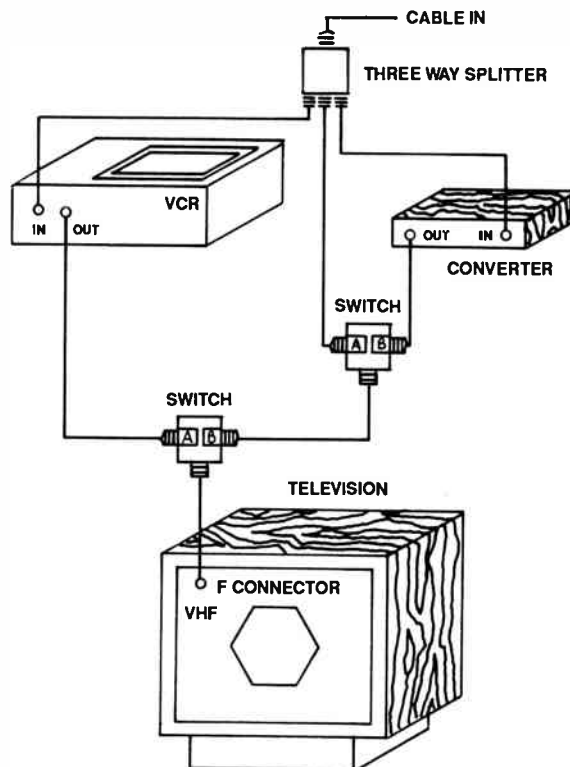
- timed, multi-channel recording (i.e. can program VCR to record a movie on channel 5 at 6 p.m., and then a second program on channel 26 at 8 p.m.)
- full use of the TV remote control
- full use of the VCR remote control

Precludes:

- timed multi-channel recording, use of TV or VCR remote control for SCRAMBLED CHANNELS

NECESSARY DROP LEVEL: +7dBmV

ILLUSTRATION # 24



Allows:

- recording of A NON-SCRAMBLED channel, while viewing ANY channel

Also allows (for NON-SCRAMBLED CHANNELS ONLY):

- timed, multi-channel recording (i.e. ability to program VCR to record a movie on channel 5 at 6 p.m., and then a second program on channel 26 at 8 p.m.)
- full use of the TV remote control
- full use of the VCR remote control

Precludes:

- timed multi-channel, multi-event recording, use of TV or VCR remote control for SCRAMBLED CHANNELS
- recording of scrambled channels

NECESSARY DROP LEVEL: +7dBmV

ILLUSTRATION # 25

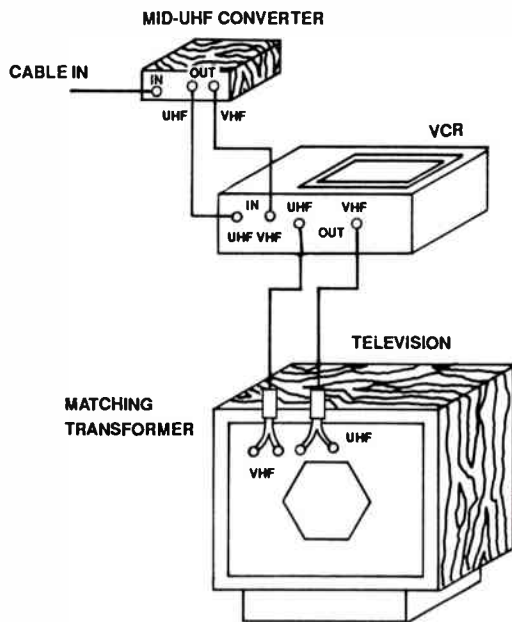
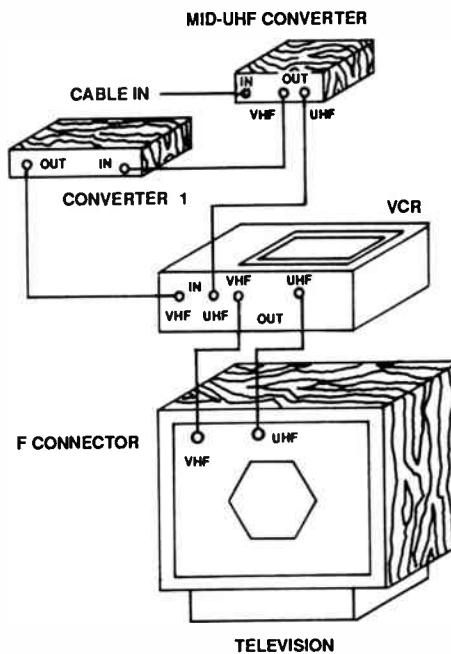


ILLUSTRATION # 26



Allows:

- recording of NON-SCRAMBLED channel, while viewing A NON-SCRAMBLED channel

Also allows (for NON-SCRAMBLED CHANNELS ONLY):

- timed, multi-channel, multi-event recording (i.e. ability to program VCR to record a movie on channel 5 at 6 p.m., and then a second program on channel 26 at 8 p.m.)
- full use of the TV remote control
- full use of the VCR remote control

Precludes:

- recording of scrambled channel while viewing a scrambled channel
- timed multi-channel, multi-event recording, use of TV or VCR remote control on SCRAMBLED CHANNELS

NECESSARY DROP LEVEL: +3.5dBmV

Allows:

- recording of ANY channel, while viewing A NON-SCRAMBLED channel

Also allows (for NON-SCRAMBLED CHANNELS ONLY):

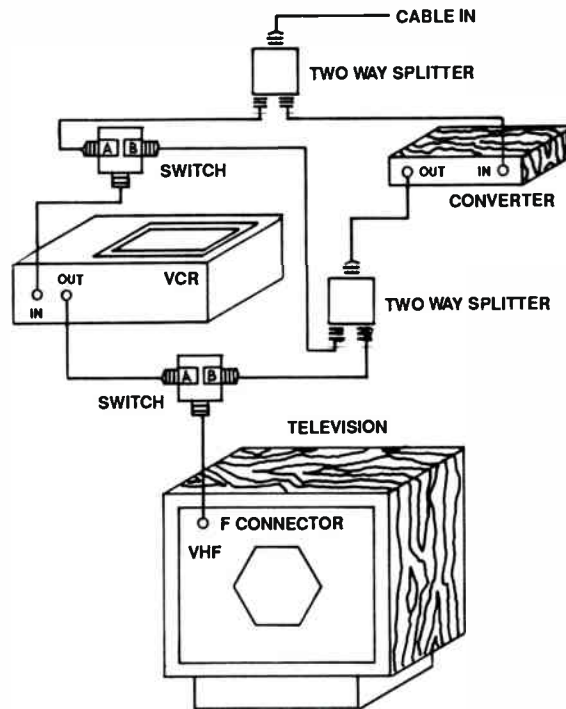
- timed, multi-channel, multi-event recording (i.e. ability to program VCR to record a movie on channel 5 at 6 p.m., and then a second program on channel 26 at 8 p.m.)
- full use of the TV remote control
- full use of the VCR remote control

Precludes:

- timed multi-channel, multi-event recording, use of TV or VCR remote control on SCRAMBLED CHANNELS

NECESSARY DROP LEVEL: +0dBmV

ILLUSTRATION # 27



Allows:

- recording of ANY channel, while viewing THE SAME channel
- recording of ANY channel, while viewing a NON-SCRAMBLED channel
- recording of a NON-SCRAMBLED channel, while viewing ANY channel

Also allows (for NON-SCRAMBLED CHANNELS ONLY):

- timed, multi-channel, multi-event recording (i.e. ability to program VCR to record a movie on channel 5 at 6 p.m., and then a second program on channel 26 at 8 p.m.)
- full use of the TV remote control
- full use of the VCR remote control

Precludes:

- timed multi-channel, multi-event recording, use of TV or VCR remote control on SCRAMBLED CHANNELS

NECESSARY DROP LEVEL: +7dBmV

Chapter Three-Ingress/Egress Discussion

Analysis of Ingress/Egress Issues in the Home:

Ingress and egress can be found at any device between the cable drop and the viewer, including the TV receiver itself. Ingress, also known as direct pickup or DPU, can be defined as any undesirable signal induced on the cable from an electro-magnetic environment outside the cable system. Egress is defined as any signal originating within the cable being radiated to the outside environment from the cable or any device connected to it.

Ingress

Ingress is not limited to the near proximity of TV transmitting sites, it has been observed more than 50 miles from the source of the signal. Sources of ingress can be many, but high power TV transmitting stations, amateur radio and private and public safety land mobile radio operations are the most common sources of ingress. Field intensities in excess of 1 volt/meter have been recorded within two miles of TV stations. Cable channels 2-13 and 18-21 are most often affected. Early TV receivers offered virtually no protection from ingress; this led cable operators to use converters to overcome the effects of DPU.

More recently, TV receiver manufacturers began offering "cable-ready" receivers for sale; these are distinguished by the ability to tune the unique cable channels in the mid and super bands. While the 300 Ohm twinlead, used between the antenna terminals and the tuner in earlier sets, was often replaced by F-fittings and coaxial cable, the shielding was often not adequate to operate satisfactorily in most urban environments.

A test to measure the amount of ingress has been developed. All connections are removed from the device to be tested. A signal level meter is connected to the input connector of the device. The level of ingress can be measured directly on the signal level meter while the tuner on the device under test is operated over all channels. The highest level observed should be recorded; the relative impairment can be determined by taking the ratio of signal on the cable to the level recorded from the meter. For example, if the signal from the cable is 0 dBmV and the level recorded from the meter is -30 dBmV, the Carrier-to-Ingress ratio is 30 dB. If the interfering signal is another TV signal, the interference should be suppressed at least 45-50 dB; if the interfering signal occupies a narrow band of frequencies, such as from a two-way radio, the interference should be suppressed at least 55-60 dB.

Measurements like those just described have been made on 1984 and 1985 model TV receivers, VCRs and CATV converters. The ambient field intensity ranged from 133 mV/m to 1.2 V/m. Ingress on the TV receivers ranged from -44 dBmV to -2 dBmV, VCRs ranged from -30 dBmV to -20 dBmV and CATV converters ranged from -46 dBmV to -32 dBmV. In spite of the foregoing, experience has shown VCRs are more likely to experience ingress as a result of their poorer shielding integrity. Older receiving equipment,

especially that employing 300 Ohm twinlead for the antenna connection, experiences ingress to a much greater degree. Levels from nearby transmitters have been recorded as high as +50 dBmV on some equipment. FM tuners which have built-in antennas, or are coupled to the power line for an antenna, are especially prone to high levels of ingress. When connected to a cable system, this equipment causes back-feeding of the signals into the cable system. The EIA/NCTA Joint Engineering Committee Interface Working Group is expected to issue an interim standard which will increase the field intensity in which TV receiving equipment is to operate satisfactorily from 100 mV/m to 1 V/m.

In some instances, ingress in the home has been so severe that not only is the affected subscriber's viewing disrupted, but signals are back-fed into the cable distribution system. In these cases, everyone downstream from the affected subscriber also experiences the effects of ingress. In these cases, the operator will often try to use a converter as an isolation device to prevent back-feeding; where this is not practical, special amplifiers which exhibit good back-front isolation can be installed in the line to reduce or eliminate back-feeding.

CATV operators selecting components for installation between the subscriber tap and the TV receiver should take care to select products with adequate protection from the effects of ingress. In addition to the usual care in choosing cable and connectors, the operator should also take care in selecting A-B switches, two-way splitters, VCR switch units and converters.

Ingress can occur from standard broadcast radio stations operating in the 550-1620 Khz band. This ingress can be exacerbated when CATV distribution and drop cable shields act like long wire antennas increasing signal intensity at the connected devices. Interference has been observed in both TV sets and VCRs. Although this type of interference is hard to eliminate, its effects can be minimized by good local grounds at the affected equipment.

Egress

Egress can result from inadequate shielding, either from equipment provided by the cable operator or from subscriber-owned equipment. In general, emissions from CATV systems must be limited to 20 μ V/m at three meters. Any operator using channels in the aeronautical bands (108-137 MHz and 225-400 MHz) is required to monitor all portions of the cable system annually; any egress in excess of 20 μ V/m must be identified and corrected. Under certain conditions and after 1990, operators must monitor all portions of the system on a quarterly basis.

The FCC Rules assign responsibility for egress from cable systems and subscriber-owned equipment connected to it as follows:

76.617 Responsibility for receiver-generated interference

Interference generated by a radio or television receiver shall be the responsibility of the receiver

operator in accordance with the provisions of Part 15, Subpart C, of this chapter: Provided, however, that the operator of a cable television system to which the receiver is connected shall be responsible for the suppression of receiver-generated interference that is distributed by the system when the interfering signals are introduced into the system at the receiver.

Even though the subscriber might be responsible for correcting problems with subscriber-owned equipment, the cable operator is faced with the often difficult task of isolating the source of egress. If the cause of the egress is inadequate shielding in a TV receiver or VCR, the owner is often precluded from using the equipment as it was intended; e.g. a "cable-ready" TV receiver or VCR that cannot be connected directly to the cable. Generally, as ambient signal levels increase, ingress will become a problem before egress will. This is true because taps and splitters used by the cable industry have inherent isolation, usually at least 20 dB. Therefore, DPU will become visible on a customer's TV set before it gets high enough to affect the neighbors. Systems will sometimes provide converters to some but not all subscribers. Those subscriber's TV sets not using a converter are usually connected directly to the cable. In cases where shielding in the TV sets is poor, cable signals radiated by the TV receivers can and do cause interference to licensed radio services such as amateur radio operators, fire, police and forestry services. CATV maintenance personnel need to be especially vigilant to find and control or eliminate this type of egress. If necessary, the offending drop should be disconnected until the egress can be eliminated.

It should be apparent many people are affected by ingress and egress; the cable operator experiences increased operating costs and deteriorated signal quality. If the offending equipment is relatively new, the dealer often experiences the wrath of a dissatisfied customer. The biggest loser of all is the cable customer who suffers from impaired service, often after paying a premium for special "cable-ready" equipment. If the cooperative efforts of the EIA and NCTA are successful, designers of new equipment will be cognizant of the cable environment and include shielding to make their products immune to the effects of the electro-magnetic environment.

Following, on the next page, is a document which is suitable for use by field personnel who are faced with problem solving when equipment is connected directly to the CATV system. A complete treatment of all problems encountered would be voluminous, so this will only serve as a guide. It does not treat every possible situation which might be encountered.

Technical Guidelines for Direct Connection to Customer Owned Equipment: Introduction

Surveys have shown the number of cable-ready television sets have increased exponentially in recent years; we estimate about one-third of our customers now own a receiver capable to tuning most or all of our non-scrambled

channels. These sets are selling at a rate of 10 million per year. So we expect the number of customers desiring to connect directly to the cable will increase substantially in the next few years. Concurrently, the number of VCRs sold has increased remarkably. CATV converters and converter/descramblers are a barrier to using the features of these consumer devices. We desire to accommodate and aid our customers in using their own equipment to tune CATV channels whenever possible; at the same time the CATV operator can reduce his investment in owning and maintaining converters.

However, in accommodating direct connections to the cable we must establish policies and procedures to protect the quality of the service we provide. These guidelines are intended to protect the customer and the CATV network from service problems and picture impairment which could be caused by the direct connection of inadequately shielded equipment.

While a converter/descrambler or a descrambler will continue to be necessary for anyone receiving scrambled signals, use of plain converters can be reduced and perhaps eliminated in the future. Based on survey data, we believe one-third of our basic customers may not require a converter to receive our service.

Unfortunately, only a few of the cable-ready television receivers and VCRs are completely satisfactory for direct connection to the cable system. While more present day consumer products designated as "cable-ready" can tune most or all CATV channels, few, if any, have adequate shielding for signal ingress and egress. Egress can result in re-radiation of CATV signals in excess of FCC limits. (Section II, chapter one contains definitions and a general discussion of these mechanisms.)

The most common problem results from signals from television stations and mobile radios entering the equipment and disrupting customer viewing. The phenomenon is known as ingress or Direct Pick Up (DPU). Disruption can take two forms: echoes and other interference and/or beats in the connected television set or VCR. This can have an impact on the owner of the equipment. The more disturbing effects occur when DPU is so intense so as to feed DPU back into the cable system from poorly shielded equipment. Not only can this impair reception for the equipment owner, but for every other customer downstream from that location. Diagnosis and elimination of this "back fed" DPU can be very difficult and time consuming, especially if there is more than one location where DPU is being introduced on the system.

It is the purpose of these guidelines to establish procedures to prevent DPU from impairing the viewing for the customer where the direct connection is made, and to prevent DPU from direct connections from back feeding into the cable system.

Many of these situations already exist and the number can be expected to increase as sales of cable compatible television receivers and VCRs continue.

Installation and Maintenance of Basic Service

A. Identification and Prevention of Back Feeding

(1) Discussion

Most CATV passive devices have at least 20 dB isolation between any two ports; this is depicted on Figures 1 and 2.

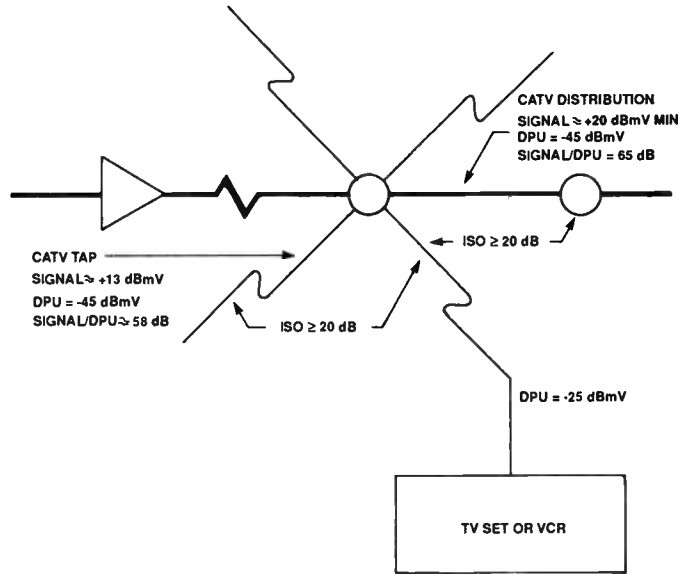
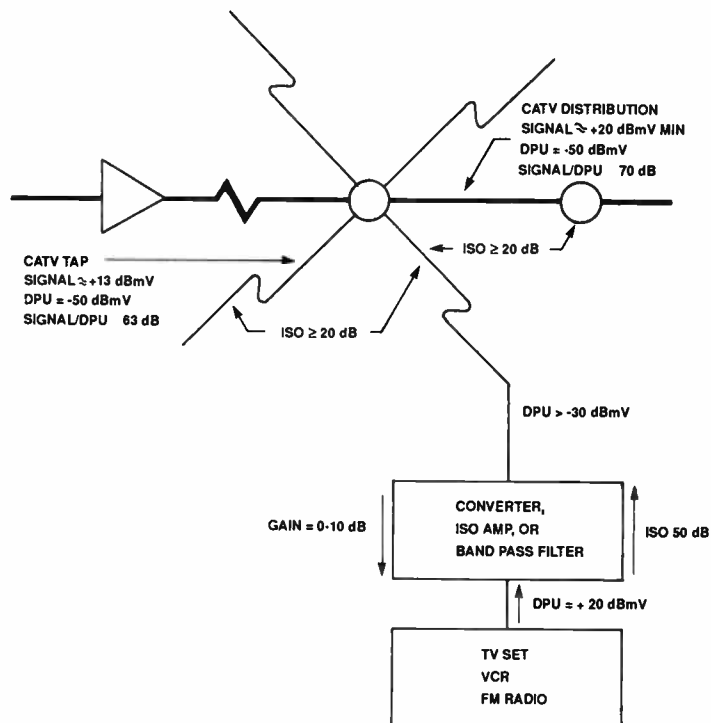


FIGURE 1

TYPICAL TAP ISOLATION



ISOLATION AMPLIFIER OR CONVERTER FOR ISOLATION

DPU from television stations, which is manifested as a sync bar or echo in the picture, should be suppressed at least 45-50 dB if DPU is not to produce visible echoing. If the passive components provide a minimum of 20 dB isolation, then DPU levels from television sets and VCRs should be less than -25 dBmV. This assumes drop levels are 0 dBmV. Beats caused by other services such as land mobile radios and television stations off frequency from cable channels should be suppressed 50-55 dB if they are not to cause visible beats in the picture. In these cases, levels at receiver and VCR connectors must be less than -30 to -35 dBmV if they are not to cause harmful back feeding.

When DPU at the antenna terminals exceeds the limit, a converter or isolation amplifier is needed to reduce the amplitude of the DPU signal back fed into the CATV system. The amplifier has modest forward gain (approximately 10 dB), but has at least 45 dB attenuation from the output port to the input port. It should be understood, the isolation amplifier only protects the CATV network from back feeding, it will have minimal or no effect in reducing echoing in the receiver or VCR; if echoing is present as a result of DPU in the VCR or receiver, only a converter will eliminate the phenomenon.

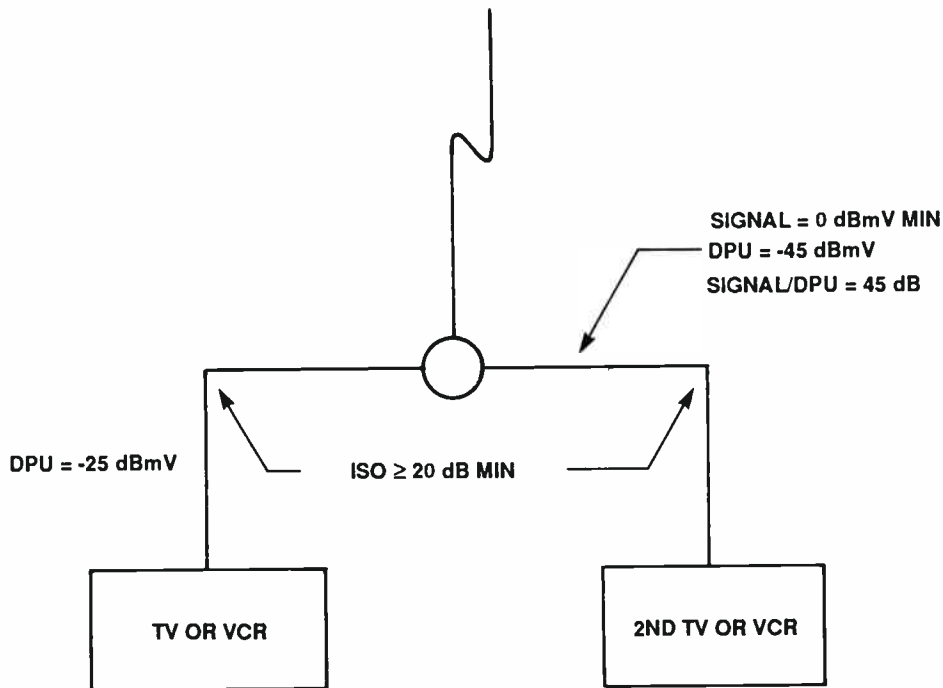


FIGURE 2

TYPICAL SPLITTER ISOLATION

Although a complete discussion of locating and curing back feed problems in the distribution plant is beyond the scope of this document, it should be mentioned that single sources on a given trunk or distribution cable can be difficult to locate and isolate, multiple sources of back feeding can be very difficult to isolate. Technicians will necessarily have to use television sets to observe and clear sources of back feeding. As more customers begin direct connection, the number of back feeding incidents can be expected to increase substantially.

(2)Diagnosis

- Remove all cable connections, and connect a SLM to the input terminal of the television receiver to be connected directly to the system. Keep the test lead as short as possible and do not use push on connectors.
- Measure the amplitude of all local VHF off-air channels and note highest level.
- If a VCR is also to be connected directly to the cable, measure levels at the input terminal on it also.
- If the measured level exceeds -25 dBmV on any channel(s), the direct connection to the CATV system should not be made; a converter or isolation amplifier must be connected between the customer's equipment and the CATV system.
- Repeat the procedure for each outlet not using a converter. If an amplifier is installed, the preferred location is on the input side of any splitters that may be installed. With an amplifier located at the splitter input, it would be possible to connect equipment directly to any outlet without installing additional amplifiers. If the splitter is installed in a location where an amplifier connected to its input would be exposed to the elements, then the amplifier should be installed between the splitter output and the television set. This will necessitate the use of a separate amplifier for each outlet. If the need is demonstrated, we will begin development of a weather tight version which can be cable powered that could be installed before the splitters. This will necessarily include concurrent development of a power passing splitter.

B. Identification and Elimination of DPU in Television Receivers and VCRs

(1) Discussion

This phenomenon will be the one most often encountered since the inherent isolation of the system passives provide at least 20 dB of protection to other equipment connected to the cable. Measurements have shown the worst victims of DPU in present day equipment will be VCRs. Standards to raise the shielding of television receivers and VCRs are being promulgated by the EIA and NCTA. As they are placed in practice, we hope to see improvement in television receiver and VCR performance.

Unlike VHF broadcast television signals, which are ubiquitous, amateur radio and mobile service signals tend to be localized to an area in the near vicinity of the transmitter. Isolation of signals from mobile radios can be made by observing the picture when the offending unit is transmitting. This is almost impossible when the offending transmitter is in a vehicle. While DPU from television

stations should be suppressed at least 45-50 dB below the television carrier, other types of interference need to be suppressed at least 55-60 dB.

(2)Diagnosis

- Disconnect all inputs from television receivers under test and terminate input connector if possible.
- Tune the receiver's channel selector to each local VHF channel and look for the presence of a picture.
- If a picture is observed on any channel, remove the terminator, connect the cable directly to the television receiver and look for a sync bar, echo or co-channel in the picture.
- If no sync bar, echo or co-channel is present, then the cable can be connected to the television receiver; if an echo is observed, proceed to the next step.
- Measure the drop level; if it is less than +5 dBmV, then connect an isolation amplifier between the drop and the television receiver. This is to prevent overloading of the amplifier and/or the television receiver.
- Look for a sync bar, echo or co-channel in the picture. If it is still present, it will be necessary to use a converter.
- If a VCR is also connected, the preceding test should be repeated with the VCR output connected to the television receiver and the VCR input terminated.

C. Other Connected Devices

(1)Discussion

Other types of equipment connected to the cable system can also cause DPU problems. Often equipment designers are not cognizant of potential DPU problems from inadequate shielding. FM receivers, burglar alarm equipment, modems, VCR switch boxes, computers and games are examples of equipment which is often connected directly to the cable that can cause problems.

Some of this equipment subjects CATV service personnel to two types of problems: DPU and the associated back feeding, and egress. In many instances, device shielding is so poor, emissions from the device exceed the 20 μ V/m at 3 meters limit established by the FCC. While Part 76.617 of the Rules holds the customer responsible for emissions from most or all customer owned equipment, cable maintenance personnel are faced with the difficult task of finding and isolating the offending equipment.

Use of special band pass filters and/or isolation amplifiers can help reduce or eliminate back feeding to other outlets on the same dwelling and the cable distribution plant. With their inherent 10 dB gain, use of isolation amplifiers can make the signal leakage problem worse.

If this is found to be the case, consideration should be given to installing attenuator pads to reduce levels to the offending device, however care should be taken to keep levels well above the minimum needed for reliable operation of the equipment.

(2)Diagnosis

If the equipment to be connected is to be used with a television receiver or VCR (such as A-B switches, VCR switches or games) use the procedures described in chapter two.

If the equipment to be connected is used for other

services, such as FM radio or data receivers (like X*PRESS), the procedures should be as follows:

- Disconnect all inputs from the equipment to be measured and connect a SLM to the input connector. Keep the test lead as short as possible and do not use push-on connectors.
- Measure the amplitude of all local VHF off-air channels and measure the highest level.
- If the highest level exceeds -25 dBmV on any channel, direct connection to the cable system should not be made; an isolation amplifier should be connected between signal splitter or tap and the equipment to be connected. If the equipment is an FM receiver or will receive signals in the FM band, then an isolating bandpass filter can be used to reduce or eliminate back-feeding.
- If the recorded levels exceed -25 dBmV, then the potential for harmful back-feeding exists. If the recorded levels exceed the -25 dBmV limit by only a small amount, television receivers served by the same splitter or tap should be checked for a sync bar, echo or co-channel. If it is observed, then the equipment being measured should not be connected to the cable system.
- Alternatively, an isolation amplifier with 60 dB or more isolation could be tried if they are available.

D. General Discussion

As the use of cable-ready receivers, VCRs and other ancillary equipment increases, we can expect to experience a corresponding increase in related service requests. Effective training of all personnel in dealing with related problems can be beneficial to both the cable company and the customer. The cable company can enjoy reduced costs while the customer can get the most benefit from the cable service and the equipment to be purchased.

It is best for everyone if problems can be handled by the telephone whenever possible. Therefore, the importance of training office personnel cannot be over-estimated. Examples of questions which might be used by CSRs to diagnose and isolate problems are shown below:

- Did you buy a VCR and connect it?
- Did you move your television receiver to a different location in the room?
- Have you connected an FM receiver to the cable?
- Have you installed any splitters or cable from a source other than the CATV operator?
- Did you connect a different television receiver to the cable?
- Is the isolation amplifier plugged in?

The details of a CSR training program are beyond the scope of this policy; they will require the cooperative efforts of everyone involved to be effective.

Very Important: Every location not using a converter needs to be identified in the billing system. This will help prevent future service calls and will help CSRs identify problems resulting from direct connections.

In the future, consumer equipment will be designed and manufactured with cable in mind. Then CATV customers can use all their features without the resultant degradation in service quality being experienced now. Hopefully, this document will help during this transitional period.

Appendix A-Summary of Scope and Progress of other Industry Groups

RF Cable Interface and Decoder Interface Working Groups: Introduction

Standards committee progress is often painfully slow. To a newcomer, especially someone accustomed to the "fast lane," this activity can be quite frustrating. There are several points to be made about this. Firstly, if cable interface and decoder interface standards were easy to achieve, they would have been agreed to a long time ago. There has been pressure for an extended period of time. Secondly, the issues being settled are delicate points involving trade-offs which impact the economics and performance of two industries. These two industries have a history short on cooperation and long on confrontation. Fortunately, the trend toward cooperation is on the up swing.

At first blush, it would seem difficult to find two industries with more reason to cooperate than the Cable Television Industry and the Consumer Electronics Industry. Better pictures should enhance satisfaction in cable service and better choice should increase the desire for quality images. Most of the difficulties to date have been due to a lack of information and misunderstanding. Open, honest, and frank contacts should be helpful to all.

Structure

In 1982, the National Cable Television Association, NCTA, and the Electronic Industries Association, EIA, formed a Joint Engineering Committee to discuss technical issues which impact both industries. The first order of business of that committee was to create a channelization standard for frequency assignment. After considerable debate, the committee recommended the plan which became an EIA Interim Standard for one year. It has recently emerged from this probationary phase to become an official recommended standard.

It is important to note that these standards are voluntary standards. Neither the NCTA nor the EIA have enforcement powers. Adherence to the standard depends on the good faith of the companies involved.

After the channelization standard, two Working Groups were formed to consider an RF cable interface standard and a decoder interface standard. Shortly after formation of the Decoder Interface Working Group, it was discovered that the EIA R-4 Group had its own decoder interface group. Seeing little point in duplication of effort, the Joint Committee decoder working group disbanded.

Attitudes

An important reason for the successes of the Joint Committee has been a change of attitude on the part of the participants. In the past, cable/consumer electronics relations were marked with finger pointing and name calling.

Very important technical trade-offs were the focus of arguments which had significant economic impact. This behavior has been replaced with a realization of the importance of customer satisfaction. The customer/subscriber must be satisfied if the two industries are to prosper. It is pointless to try to shift blame. The customer/subscriber demands satisfaction from both industries.

A significant step in the right direction has been the relaxation of what has been called the "70 dB syndrome." In the past, the cable industry has tended to demand that any potentially harmful phenomenon be suppressed by 70 dB. The consumer electronics industry has become offended by this approach since this degree of suppression is difficult to measure for most parameters and impossible to achieve in practice. The result has been near zero progress.

The "70 dB syndrome" has been replaced with a much more reasoned discussion of actual problems. A phased approach has been recommended which sets achievable targets, timed to cover frequencies ranges as they are implemented in the cable practice over time. When a cable representative believes there is a need for a specification which the manufacturers feel can't be presently achieved, a tutorial is included. This motivates the manufacturers to strive for solution in future designs.

The defensive guards have been lowered and technical people are listening to one another in open dialog. People are trying to understand each others problems and accommodate.

Occasionally, a new member joins the committee and makes moves in the old ways. The committee brings the newcomer in line and progress resumes.

The RF Cable Interface, IS-23, Working Group

The RF Cable Interface Working Group's major concern is the Cable Compatible Consumer Product, such as the Cable-Ready TV. The committee very quickly got over the issues of connector type, impedance, and signal levels. A more serious problem has been Direct Pick Up (DPU) of broadcast signals.

The committee has taken voluntarily committed receivers and measured them in a T.E.M. (Transverse Electro-Magnetic) cell. The tests were funded by the EIA, and each participating manufacturer received data on his products. A non branded table of data was supplied for committee use. Sets ranged in performance from satisfactory behavior to sets with considerably lower levels of tolerance. Manufacturers have been carefully considering the art of radiation immunity as it applies to their products. Progress has been made.

The most significant aspect of this work is a ten-times increase in the direct pick up specification. Under this proposal, a complying product must not show noticeable degradation of performance in the presence of broadcast electromagnetic fields having a strength of one volt per meter. The previous specification came from the Canadian standard and was based on one-tenth of a volt per meter. It is expected that the proposal will cover 80 percent to 90 percent of all cable DPU problems. The remainder will require a converter to completely solve the problem.

It is important to realize that the TV receiver manufacturers have taken on a significantly greater burden with this new standard. This level of performance will be difficult to achieve. However, the customer/subscriber will benefit. This achievement demonstrates that two industries can work together to resolve difficult issues when a cooperative approach is employed.

Cable converter product has also been measured in T.E.M. cells. These tests were funded by cable volunteers and the NCTA. The goal was to understand techniques for implementing the converter's seemingly better performance.

A recurring problem in this committee work is the separation of performance standards from interference standards. It is felt that the regulation of performance is best left to the marketplace. However, the control of interference is a bona fide standards matter. Four kinds of interference have been considered in order of increasing severity:

1. Interference with the product's own performance
2. Interference with other products in the same home
3. Interference with other subscriber's reception
4. Interference with other users of the electromagnetic spectrum, such as aircraft navigation and communications radio.

The Long Term Future

The logical conclusion for the trends in CATV home terminals is for subscriber ownership. This is the best outcome for nearly all concerned. The subscriber has his favorite hardware relationship: ownership. Unlike his European cousin, the US TV receiver user has historically preferred ownership to rental. The same should apply to the decoder hardware. This will especially be the case if he can own the tuner, remote control, and other convenience features as part of the bargain. These later goals are achieved by having the descrambler come after the TV receiver's tuner. There are two ways of accomplishing this. One way has a "decoder interface plug" on the back of the TV receiver (or VCR, etc.) into which the subscriber owned (or leased) descrambler fits. The second method is to build the decoder directly into the receiver by the receiver manufacturer. The latter will happen if there is a de facto or actual decoder standard which would permit free movement from cable system to cable system. If this is not achieved for whatever reason, then plug-in, re-sell, or swap devices will be required.

The principal entity which is disturbed by this approach is the manufacturer of home terminals who doesn't also make TV receivers. He sees more than half of his "value added" eliminated. But from the bigger picture, the waste and inefficiency of having a tuner, remote control circuits, and related components in the home terminal, only to have them duplicated in the TV receiver, is undesirable.

From the cable operator's point of view, the program protection method must ensure that subscribers cannot defeat the system and receive the programming for free. Another interested party in all this is the programming producers. If they believe their product can be stolen, they will not make it available to the cable operator. The cable

operator realizes that the would-be pirate has nearly unlimited time and resources at his disposal. The system which meets this test will be robust indeed. Once this assurance is obtained, the cable operator will gladly give up the capital requirements caused by the need to supply the descramblers. The money would be better invested in more programming, service-enhancing facilities, or home terminals that provide new services to subscribers.

The Decoder Interface, IS-15, Working Group

The Decoder Interface Working Group is not a Joint Committee effort, rather it is entirely an EIA activity. In spite of this, there has been significant friendly dialog between the two industries. Cable participation in this committee work has been welcomed. Specifically, there have been cable industry contributions to the design and testing of the interface plug.

The Interface Plug is also called the Cenelec 20 pin plug. Even with twenty pins, the committee wished it had more! Composite video in and out is provided. RGB inputs are optional. A data line pair to communicate logical instructions such as EIA Home Bus signals, has been provided. At some day in the future, it will be possible to connect consumer electronics products to a master home system. Fast-blank for text insertion and decoder restored sync input pins are provided. Devices with the interface plug are intended to be optionally "daisy chained." That is, devices may be designed in such a manner as to be connected in series, allowing interaction between devices and an extension of product into an easy to use, consumer friendly system.

The most serious and controversial issue regarding the interface plug is automatic gain control (AGC) design philosophy. AGC has two modes of operation with strongly conflicting demands, acquisition and stable operation. The circuit time constants must be different for these two modes. Additionally, the AGC time constants of the cable converter and television receiver must be significantly different so one is dominated by the other. If the two time constants are close together in value, oscillations may result. The problem is that some receiver manufacturers are using long time constants while others have decided upon short time constants. An important difficulty to appreciate is the fact that in scrambled mode, most systems suppress horizontal sync pulses. For decades, television AGC design philosophy has depended on finding and accurately measuring sync pulse parameters. The two processes are in fundamental conflict. Without sync pulses, there is a tendency for the amplifiers to increase gain and saturate. This crushes the signal and ensures that sync pulses will never be found. This "lock-out" condition is a disaster which must be avoided. It is most complicated in systems which suppress sync pulses in the vertical interval as well. This phenomenon is extremely non-linear and not well understood. Some engineers insist that there is no theoretical basis for these systems to ever work! They claim that each time the system achieves synchronization and decoding, a fortunate electrical accident has occurred!

One serious complication is the fact that AGC expertise

in television receivers is a scarce resource. There are probably less than twenty experts in the entire world. The subject is very complex with almost no published technical literature. An engineer becomes an expert in this field through years of apprenticeship to an existing expert. A second complication is that competitive performance between manufacturers' products is largely determined by AGC characteristics. To someone who appreciates this, the committee interactions take on a whole new dimension. There is the careful guarding of secrets, the pained release of just enough information to make the interface plug system work, but the anxiety that too much may have been revealed to a competitor.

The Decoder Interface Working Group has had three field tests in ATC's cable systems in Denver, CO. Several TV receiver manufacturers and several decoder manufacturers participated with varying, but basically very good, results. The level of success exceeded expectations and re-energized the committee. At least one receiver manufacturer's engineers formed a strong alliance with a decoder manufacturer's engineers. Extensive cooperation and mutual sharing of information has resulted in a raising of the potential for success of these two companies. At least one other manufacturer took a very unfriendly, parochial approach in the first test which offended the other participants. This has caused embarrassment to others at that company who have worked long and hard at trying to establish a record of cooperation and leadership. By the second test, this was corrected.

The best indication of the success of the field tests has been the lively interchange that took place afterwards, resulting in significant improvements in the proposed standard. The most interesting improvement is the proposal of an AGC time constant control pin which would yield control of the time constant to the decoder.

Current tests have concentrated on base band scrambling schemes because the interface plug connections do not include RF signals.

Committee agreement on the interim standard was achieved by mid-April 1986. The parent group approval process is essentially complete.

Upon completion of the Base Band Decoder Interface, the committee will turn its attention to two more issues: a) practical details of implementation of the standard and, b) potential of the standard to include an IF (Intermediate Frequency) connection.

Practical issues include the facilitation of testing of designs. To that end, the New Technologies department of ATC volunteered to host tests. Decoder manufacturers will supply encoders and decoders and Television receiver manufacturers will provide TV sets. Engineers will be welcome to use the laboratory to make measurements and conduct experiments. Confidentiality will be preserved by proper attention to ethical practices. Another practical issue is the promotion and promulgation of the standard. For that purpose the EIA and selected manufacturers had a hospitality suite at the International Conference on Consumer Electronics (ICCE) in Chicago June 4 through 6, 1986. ATC helped in equipping that suite. The ICCE is the principal technical conference for consumer electronics

design engineers. Similar hospitality suites are contemplated for upcoming cable shows. Strategies for generating cable support of the Interface Standard are under consideration.

Both the EIA and the NCTA recognize that most of the scrambling systems displayed are not base band. The next order of business is to strategize a way of accommodating RF scrambling at IF. This may be done on a separate plug, or the signals may be descrambled at base band. Whether the return will also be at IF or through the base band plug at base band, will be determined by the committee. This work is expected to take no more than an additional six months, perhaps less because the issues are less complicated than the previous problems.

First availability to TV receivers incorporating the interface plug will likely be in late 1986.

The Committee Process

The committee has a life cycle of its own. At first there is a small group of attendees trying to make it happen. Slowly the group expands until so many attend that it is difficult to get anything done. After several months, those low on patience cease to attend. Decision-making picks up. Then some dramatic event such as a field trial takes place. Once again, attendance soars. A new danger to progress takes place. New members attend for the first time. They start questioning the fundamental philosophy. Old ground is revisited. The skillful chairman must maintain progress, yet not turn off the new attendees. The new attendees will have their say in the final standards approval process. They must not be alienated. As the committee reaches the end of its work, two forces come to conflict. Those who have put in years of work want to bring it to a close. Others who have been alerted to the committee's work by the expected issue of a new standard become alarmed. They see all kinds of threats to their interests and, of course, better ways to do the job, usually using advanced technology which wasn't available when the committee started its work. The committee chairman must manage these forces or total grid lock will result.

Another practical difficulty with committee work is the fact that the most likely contributors are industry experts and industry decision-makers. By definition, these individuals are very busy and in demand by their company's engineering departments and by other committees. Getting the right people involved is critical to success. Occasionally, a company's management's view of committee work is too parochial. Important contributors are denied permission to attend, or are not supported in this activity.

An important element of the committee process, is the mutual education of the two participating industries. Committee work is an excellent means of communication between experts in the cable and the consumer electronics industries. Well before an agreement on standards is reached, the TV receiver design experts are applying what they have learned from the committee work and are anticipating the new standard. This process makes timely

introduction of product, based on the new standard, possible.

While it will be years before a significant penetration of product built around these standards takes place, those customers with an urgent need or desire will be able to purchase products in the second half of 1986. Thus, a timely impact will be made even though extensive use of the standard will take many years.

Thanks go to the EIA and the NCTA for their leadership in these issues. Special thanks to the EIA for sponsoring the meetings and to Tom Mock, of the EIA, in particular. The task would have been much more difficult, if not impossible, without his time and energy. And, of course, thanks to the committee participants for their participation and time away from home.

Conclusion

Progress is being made on two fronts, the RF cable interface and the decoder interface. Progress is slow and painful but essential if the customer/subscriber is to be provided with the maximum utility potential of the technology. These are long term solutions. But they will never arrive without heavy investment of energy and time in current committee work.

Consumer Electronics Bus Committee:

Introduction

The Consumer Electronics Bus Committee (CEBC) was formed by the Electronic Industries Association's Engineering Policy Council to recommend voluntary standards for what has been popularly called the Home Bus.

The Committee chose not use that name, but used the Consumer Electronics Bus (CEB) instead, because past use of the name Home Bus has inferred a purely digital environment. The standards under development now are for multiple media, some of which will use mixtures of analog and digital techniques.

The media for which standards are under development are:

1. The Power Line Bus (PLBUS).
2. The Wired Bus (WIBUS).
3. Infrared media for use in a single room (SRBUS).
4. Low Power RF (RFBUS).

At the heart of the CEBC standards development effort are a number of basic requirements:

1. From the consumer's point of view, extreme "ease of use" is required.
2. Future expansion for unknown uses built in.
3. Commonality of language across the media.

The methodology of the CEBC is to focus on systems and techniques proposed by member companies. Where there are no proposals forthcoming, consultants are used to gain a particular goal agreed upon by the Subcommittee responsible for it.

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Scrambling across the country...

Now that the M/A-Com VideoCipher has almost become a de facto scrambling standard for the cable industry, many more programmers are expected to implement scrambling, resulting in more installations at cable headends. Experience has indicated that the VideoCipher unit is a reliable unit and that a large number of the units returned to the manufacturer for repair needed simple adjustments or did not exhibit any failure symptom at all. It should be noted, however, that proper operation of the descrambler necessitates that the TVRO site receives the video signal as well as its associated digital control and audio data streams. In general, good reception of data information demands superior performance from an earth station than reception of normal analog video and audio. For a marginally designed TVRO site equipped with small aperture receive antenna and marginal receive equipment, it is possible that data reception may be affected while minimum or no visible picture impairments may be detected. In such cases operation of the descrambler may be marginal, causing undue and unnecessary outages. It is therefore imperative that the TVRO site operates at its highest standard at all times and that maintenance personnel continue monitoring their TVRO stations to ensure that the stations meet their optimum performance objectives and do not depart from these objectives at any time.

The 10 steps listed below are intended to help in understanding some of the issues necessary to ensure a minimum of service interruption and to maximize the quality of the descrambled signal, thereby avoiding unnecessary future outages:

1. Ensure that the satellite receiver used at your TVRO site meets the VideoCipher interface requirements. These requirements are set forth in the VideoCipher User Guide. If you are in doubt whether your satellite receiver meets these parameters, contact the M/A-Com Technical Hotline for advice and further instructions.

2. Ensure that the composite video output of the satellite receiver mea-

...means more programmers are turning to VideoCipher for their installations at cable headends.

sures 1VP-P on an unscrambled channel (terminate the composite video with 75 ohms when taking the measurement).

3. Make sure that the AGC on your VideoCipher measures +4.0 Vdc. Procedures for adjustment and measurement are detailed in the VideoCipher User Guide. If in doubt, call the M/A-Com Technical Hotline.

4. Align the TVRO antenna when the satellite is at the center of its box.

5. Cross polarize the antenna feed.

6. If you are using IF or RF filters for TI suppression, make sure that the filters are not degrading the data transmitted with the scrambled signal. If in doubt about the type of filters used, call the M/A-Com Technical Hotline.

7. Carefully listen to the sound quality associated with the scrambled channel (especially the high frequencies). Pops or clicks at normal listening levels indicate signal reception problems.

8. If you are connecting a stereo modulator, maintain proper phase relations when connecting the VideoCipher stereo outputs to the FM modulator (connect the left and right positive VideoCipher terminals to their corresponding positive FM modulator terminals).

9. Occasionally assess the performance of your TVRO and headend by making RF, audio and video measurements during satellite tests conducted by the different programmers.

10. Occasionally check the operation of your spare VideoCiphers.

Here are some of the details you should be familiar with:

Optimizing the TVRO signal

Antenna alignment—geostationary communication satellites are kept within specified boundary limits from their assigned orbital slots. Typically, a satellite is allowed to drift no more

than ± 0.1 degrees from its assigned orbital slot. This specified boundary is called the Satellite Station Keeping Box.

Ideally, antenna alignment should be accomplished when the satellite is in the center of its Station Keeping Box. Alignment of the antenna when the satellite is at one edge of the box contributes to a lower S/N ratio and causes a degradation of cross-polarization isolation when the satellite drifts to the other end of the box edge. The time of day and date that the satellite is in the center of its box can be predicted some 10 to 13 days ahead of time and can be obtained by calling the corresponding satellite NOC center-assigned telephone number.

Manufacturer instructions must be followed carefully when peaking the antenna. The front panel meter on your satellite receiver or a power meter connected to the receiver IF can be used as an indicator for maximum received signal level. Make sure the antenna is peaked on its main beam and not on a sidelobe. A good practice is to detect a sidelobe of equal level on either side of the main beam and center the antenna on its main boresight.

Cross polarization of the feed—modern satellites transmit their signals on a frequency reuse spectrum configuration. A frequency reuse satellite uses two banks of transponders that share the same frequency spectrum but transmit in different polarizations. The polarization of one bank of transponders is at a right angle to the other to enable an earth station on the ground to fully discriminate between both sets of transponders. It is important then that the TVRO antenna be properly cross-polarized on the ground so that it differentiates between the two incoming polarizations and prevents odd polarized transponders from leaking into even polarized ones and vice-versa. Failure to properly cross polarize the antenna feed results in interference in the received signals and degradation in the C/N ratio at the receiving locations.

To properly cross polarize the antenna feed, connect a spectrum analyzer to the LNA port. Turn the antenna feed to the point where the cross-polarized signals appear to have

Mark Elden,
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Cross polarization of the feed should be undertaken after the antenna has first been aligned.

reached a null or a minimum on the spectrum analyzer display. Alternatively, connect the spectrum analyzer to the IF output of the satellite receiver. Position the feed to minimize a cross-polarized channel that the re-

ceiver is tuned to (the receiver should be placed on MGC; ensure that cross-polarized signals are being minimized and not components of any co-polarized signals).

A less accurate method is to turn the

antenna feed in one direction until a perceptible picture degradation occurs while observing a TV picture monitor. Mark the antenna hub at that position. Rotate the feed in the other direction, and again mark the feed at the point where the same picture degradation occurs. The approximate position of the feed is the midpoint between the two markings.

Cross polarization of the feed should be undertaken after the antenna has first been aligned. Under no circumstances should cross polarization of the feed be undertaken in any location where heavy rain is being experienced. The de-polarization effect of the rain cells on the incoming signals can cause an erroneous set-up and a maladjustment of the feed position.

Dealing with terrestrial interference—the presence of terrestrial interference (or any other kind of interference) can severely degrade the data transmitted with the scrambled signal causing unnecessary outages. If terrestrial interference (TI) is detected at an earth station site, appropriate procedures should be taken to reduce its strength. Contact one of the various survey teams available to undertake a frequency coordination survey of your TVRO site and to identify potential TI sources affecting the site. A course of remedial action is then selected and procedures to suppress or avoid the interference is initiated.

These procedures can vary in their expense, depending upon the severity of the interference present. In many cases, solving TI cases is a challenge even to the experts and specialists in the field.

Expensive undertakings include digging pits, erecting artificial shields and fences, relocating the earth station, replacing antennas, etc. Inexpensive solutions include installation of filters at RF and/or IF frequencies and undertaking thorough signal troubleshooting at the TVRO site (look for ungrounded equipment, unshielded equipment, extra long cable runs, etc.).

Normally, however, a filtering system is used in most locations encountering TI problems. If you are using or planning to use a TVRO filtering system, ensure that the filters used are not affecting the data transmitted with the

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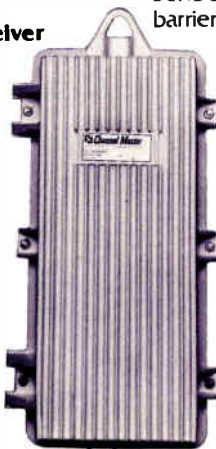
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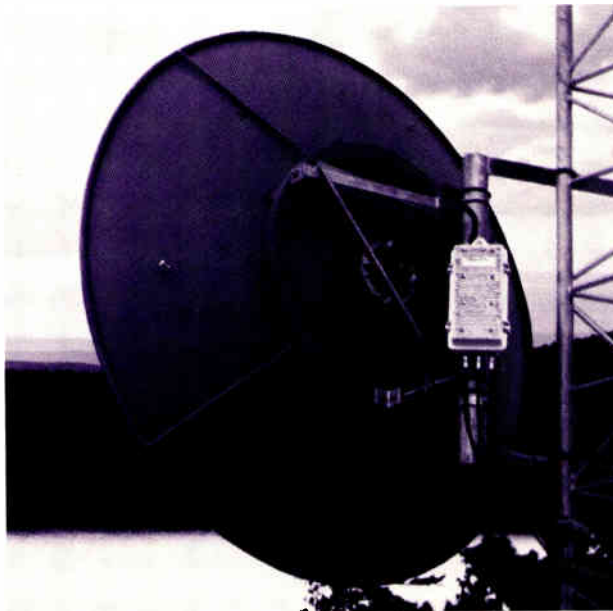
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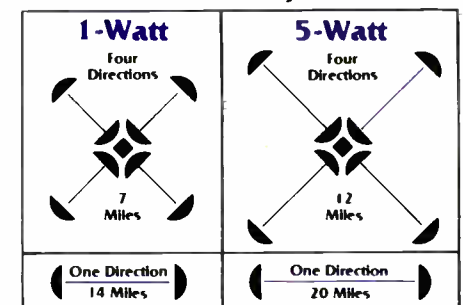
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The presence of TI at a TVRO site must be taken as a serious threat to the integrity of satellite signal reception.

scrambled signal. One method is to evaluate the different video signal parameters as indicated in the video test (described below) to ensure that they meet the minimum required specifications. In addition, call the descrambler manufacturer with the model and type of filters used at your TVRO to check if they have been successfully tested with the scrambling system and are not affecting scrambled signal data.

Of particular attention is wideband TI such as digital or video types. Non-signal-degrading filters will not be fully effective in removing such wideband interference. Interference suppression in this case must depend more on other techniques such as shielding and/or employing microwave phase cancellation methods available from respective manufacturers.

The presence of TI at a TVRO site must be taken as a serious threat to the integrity of satellite signal reception. Interference-free reception can be attained and TI proliferation in your area prevented by obtaining and maintaining appropriate licenses from the FCC and through continued monitoring of any new proposed microwave paths within coordination distance of your TVRO.

Monitoring the signal parameters

The carrier-to-noise ratio—the recommended carrier-to-noise ratio at the TVRO site is 12 dB or higher. This ratio should correspond to a video signal-to-noise ratio of approximately 50 dB or better. Higher carrier-to-noise values indicate superior TVRO performance. A slightly lower ratio is no reason for great concern, but if your carrier-to-noise falls to 10 dB or so you may want to consider some upgrade possibilities.

The video parameters—the satellite receiver output parameters should conform to the audio and video base-band parameters as set forth in the VideoCipher User Guide. If in doubt whether your satellite receiver meets these parameters, the descrambler manufacturer should be contacted for advice and further instructions. In general, video parameters should be measured at the descrambler output and should exceed the signal specifications listed

in the NTC Report No. 7 prepared by the Network Transmission Committee of the Video Transmission Engineering Advisory Committee. The measurement procedures outlined in the report should be used as a guide to undertake all pertinent measurements. Details of this report are published in the NCTA Recommended Practices for measurements on cable TV systems.

There are, however, three important and critical parameters that should be measured to ensure that your satellite receiver meets the descrambler requirements. These specific parameters should be measured on an unscrambled signal and taken from the composite video output of the satellite receiver. A brief description is outlined below:

1. Insertion gain.

The unscrambled composite video signal out of the satellite receiver should measure 1VP-P (terminated). Connect a waveform monitor to the satellite receiver composite output and measure a 1VP-P level on an unscrambled signal. Make sure the video is terminated at 75 ohms when taking the measurement.

2. Chrominance-to-luminance delay inequality.

Remember that data transmitted with the scrambled signal can be affected by excessive deviation of this parameter. The maximum allowable chrominance-to-luminance delay inequality from the satellite receiver should not exceed ± 25 ns for reliable descrambler operation, as detailed in the Descrambler Input Signal Specifications of the VideoCipher User Guide. The chrominance pulse of the Composite Test Signal is used when making this measurement. The pulse should be normalized to 100 IRE on the waveform monitor and the delay inequality computed by observing the aberration in the base of the pulse. Measurements should be taken at the composite video output of the satellite receiver on an unscrambled signal.

3. Gain/frequency distortion.

Scrambling data also can be adversely affected by excessive deviation of this parameter. The multiburst portion of the Combination Test Signal should be used to make this measurement. The amplitude of the white flag should be normalized to 100 IRE. The

peak-to-peak amplitudes of each burst frequency are measured and recorded. The satellite receiver signal parameters should not exceed ± 0.5 dB, 30 Hz to 3.58 MHz and ± 1.0 dB, 3.58 MHz to 4.2 MHz. Measurements should be taken at the composite video output of the satellite receiver on an unscrambled signal.

The audio parameters—in general, all audio parameters should be measured at the output of the descrambler: 1) Set the audio levels to their nominal levels, 2) verify that the frequency response is flat, 3) ensure that distortion and signal-to-noise are within acceptable limits and 4) evaluate audio cross-talk from both the right and left channels.

Attention should be given to the sound quality of the audio signals. Carefully listen to the sound quality associated with the scrambled signal. Any discernable pops and clicks in the program sound at normal listening levels (most prominent at the higher frequencies) indicate reception problems. Remember that the audio signals associated with the scrambled signal are carried in the same digital form as the scrambling control data information. Reception difficulties of the scrambling data can then be unveiled by detecting audio errors in the form of pops and clicks in the sound. The audio signal-to-noise now no longer bears a direct relationship with the RF carrier-to-noise. Audio noise now starts to appear as clicks and pops instead of normal random noise.

In order to ensure that the TVRO site meets its expected RF performance requirements and that the descrambled signal meets minimum required base-band parameter values, cable systems must undertake measurements at their TVRO sites and headends. Such measurements can be done by participating in the different satellite tests that are offered by some programmers for that purpose. Such satellite tests should encompass a carrier-to-noise test, scrambled audio and video tests as well as an unscrambled part of a test to allow for the evaluation of video receiver performance and to verify that the descrambler is not causing any degradations or artifacts in either the video or the audio signals. ■

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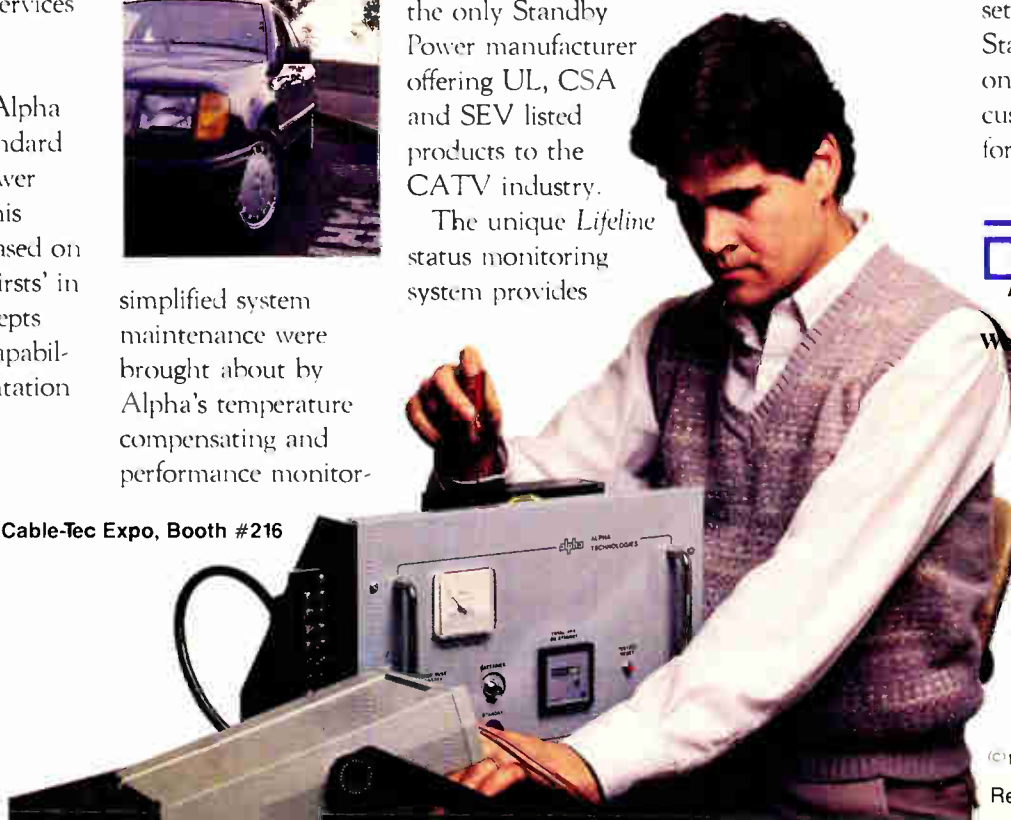
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NCTA technical sessions

This year's NCTA convention, to be held May 17 through 20 in Las Vegas, Nev., will feature 10 technical panels, 48 technical papers and 50 or so speakers. Here's a detailed schedule.

Monday, May 18, 1987

10 to 11:30 a.m. Room B1

Fiber Optics Design, Performance and Feasibility

Moderator: Jim Chiddix (ATC)

Speakers: Jack Koscinski, General Optronics Corp., "Feasibility of multi-channel VSB/AM transmission on fiber-optic links"; Mircho Davidov, Catel Telecommunications, "Fiber optic broadband systems, present and future"; Hermann Gysel, Synchronous Communications, "Properties and systems calculations of optical supertrunks for multichannel TV transmission using analog intensity modulation, single mode fibers and high deviation FM"; Albert Cutler, British Cable Services Ltd., "Fiber-optic supertrunks at 1300 nanometers."

10 to 11:30 a.m. Room B2

Design Issues in Expanded Systems

Moderator: Ed Milner, Arlington Cable Partners

Speakers: Pat McDonough, United Cable, "High frequency/high density design criteria"; Daniel Smart, British Cable Services Ltd., "Innovative aspects of a switched star cabled distribution system"; Mark Adams, Scientific-Atlanta, "Field experience with feed-forward amplifiers"; Tom Osterman, Alpha Technologies, "Improving power supply efficiency."

3:30 to 5 p.m. Room B1

"New Tech" Signal Prospects

Moderator: Brian James, NCTA

Speakers: Kenneth Quinton, British Cable Services Ltd., "Carriage of MAC/packet signals in MATV and CATV networks"; E.B. Crutchfield Jr., NAB, "Advanced television terrestrial broadcast demonstrations"; Craig Todd, Dolby Laboratories, "A compatible in-band digital audio/data delivery system"; Yves Faroudja or Joe Roizen, "Enhanced NTSC."

3:30 to 5 p.m. Room B2

Improved Plant Design and Construction

Moderator: Norman Santos, Oceanic Cablevision

Speakers: Steven Biro, Biro Engineering, "Computer assisted design of CATV antenna towers/antenna arrays"; Randall Crenshaw, General Instrument, Comm/Scope division, "New super-tough jacket"; Jack Gieck, professional engineer, "Percol: a polyurethane system to simplify laying of buried cable"; Thomas Straus, Hughes Aircraft Co., "Advances in AML transmitter and receiver technology."

Wednesday, May 19, 1987

10 to 11:30 a.m. Room B1

Security Considerations: Locking the Door to the Candy Store

Moderator: Ted Hartson, Post-Newsweek Cable

Speakers: Anthony Wechselberger, Oak Communications, "Encryption-based security systems as applied to broadcast media"; Michael Long, Zenith, "An enhanced RF television scrambling system using phase modulation"; Vito Brugliera, Zenith, "Security considerations in implementing store-and-forward technology in subscriber home terminals"; Mark Medress, M/A-Com Telecommunications Division, "Video-Cipher II."

10 to 11:30 a.m. Room B2

Stereo TV and Cable—One Year Later

Moderator: Karl Poirier, Triple Crown

Speakers: Kenneth Leffingwell, Wegener Communications, "Mutual effects of BTSC stereo and RF sync-suppression scrambling"; William Arnold, Warner Cable, "BTSC Stereo—implementation on normal and scrambled channels"; James Holzgrafe, Oak Communications, "MTS compatibility in encrypted baseband scrambling systems"; Joe Vittorio, General Instrument, "BTSC measurement in the lab and field—evaluating stereo cable equipment"; David Sedacca, Scientific-Atlanta, "Practical considerations for BTSC stereo in the CATV plant."

12:30 to 2 p.m. Room B1

Implementing Pay-Per-View

Moderator: Nick Hamilton-Piercy, Rogers Cablesystems

Speakers: Dominick Stasi, Telaction, "Selective home shopping"; Larry Lehman, Cencom Cable Associates, "Technical considerations when implementing pay-per-view"; Andrew Ferraro, Request Television, "Solving the problem of remotely changing cable controller levels without extra personnel or expensive hardware upgrades"; David Woodcock, Centel Cable Television Co., "Launching an ANI-passing impulse pay-per-view system"; Nancy Kowalski, General Instrument, "Using impulse technology to implement home shopping."

12:30 to 2 p.m. Room B2

Mid-Term Report Card on Consumer Electronics Interface

Moderator: Walter Ciciora, ATC

Speakers: Richard Merrell, Zenith, "Multi-control remote transmitter"; James Farmer, Scientific-Atlanta, "New options in subscriber control"; Walahat Husain, Scientific-Atlanta, "EIA IS-15 interface compatibility with RF sync suppressed scrambling"; Christopher Lewis, Scientific-Atlanta, "Implications of the EIA Homebus for CATV systems."

3:30 to 5 p.m. Room B1

Interactive Paths and Progress

Moderator: Graham Stubbs, Linear

Speakers: Kenneth Quinton, British Cable Services Ltd., "An overview of progress towards interactive services in the United Kingdom"; Robert Bridge, Alpha Technologies, "A remote status monitoring system for one-way cable plant"; Anthony Aukstikalnis, General Instrument, "The interactive evolution"; Richard Citta, Zenith, "Performance history in two-way cable plants utilizing a PSK communication system."

3:30 to 5 p.m. Room B2

Satellite Issues

Moderator: Norman Weinhouse, N. Weinhouse Associates

Speakers: Paul Heimbach, HBO, "FSS Ku-band satellite distribution of television signals/Ku-band program delivery to cable systems"; Andrew Setos, Viacom Networks; James McKinney, FCC, "FCC overview of satellite issues."

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Report on CEBus standards effort to the CATV industry

Consumer Electronic Bus (CEB), also known as the Homebus, is an exciting new concept being pioneered in the United States by the Electronics Industries Association. The Homebus concept provides cable television with new opportunities to solve some longstanding problems and to participate in new business, but of course we need to understand what it is before we can exploit it.

The idea got started several years ago as people realized that a lot of functions could be done, or could be done more efficiently, if various pieces of equipment could talk to each other. For example, we are painfully aware that the consumer is faced with a plethora of remote controls in his home entertainment center today. So one of the activities of the Consumer Electronic Bus Committee is to define a universal format for remote controls so that a transmitter made by one company will be able to talk to several devices (such as CATV converters, TVs and VCRs), without conflict.

When this standard is a reality and equipment supporting the format is available, the consumer will be able to purchase a remote control transmitter that will control several devices, relieving you of the headache of selling your subscriber on the idea of another remote control. (If you use set-tops with addressable remote control enable, you could still charge for remote control.) The same remote control will be able to change channels on the set-top terminal and adjust volume on the TV, without the subscriber having to worry about what is being controlled.

Another part of the plan is the inclusion, primarily in new construction, of coaxial cable with outlets in all walls of all rooms of the house. This coax would be connected to the CATV system, so that you will not have to worry about expensive installation of coax in a new subscriber's home. All you will do is connect to the "home headend," called the node zero in Chris Lewis' paper. Then the subscriber's premises, including all of his TV sets, are served by cable, and you didn't have to do the installation! When the subscriber moves his TV set, he simply plugs into another outlet as he now does for power. The system also will permit him to view his

A host of companies are committed to the development of a new generation of consumer products that will be used with this standard.

VCR, located in the family room, or the TV in his bedroom, while insuring that the kids can't see the program in that room.

Other parts of the Homebus define standards for communications on the power line, over the air and on twisted pair and fiber. The standards are currently being drafted by the committee and you can expect to start hearing more from this activity within the next year.

It's fun to think about some of the other things you can do with such a system in your house. A computer can monitor power consumption of major appliances and detect when a problem is about to happen by noting changes in current consumption. You can rearrange furniture without having to worry about getting cable to the TV or wire to your speakers. You can program your washing machine to start after the last bath of the evening, and the dishwasher to start when the washing machine is through.

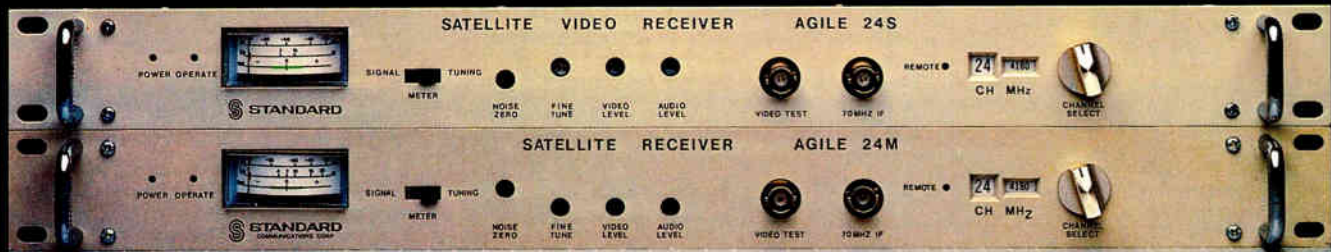
Or, if you wash clothes during the day, you can watch TV while the load is running, and a sign can flash on the TV to tell you when it is through. You can watch TV in your bedroom until you're ready to go to sleep. One command on your remote control shuts off all lights and activates the burglar alarm. You come home in the afternoon, and your garage door opener also deactivates the burglar alarm, turns on inside lights and perhaps starts the microwave oven, all before you have pulled into the garage. All of these and much more are possible with the CEB. All have been seriously proposed and in some cases stand-alone equipment is available now. The CEB can solve some problems for the CATV industry, and can provide new sources of revenue for those ready to capitalize on a new market.

James O. Farmer

The Consumer Electronics Group of the Electronic Industries Association has been working on the development of a standard which will serve to link together the diverse range of electrical products in the home. Involved in this effort are most of the major appliance manufacturers in the country, as well as a host of other companies that have an interest in a particular area of the standards development. These companies are committed to the development of a new generation of consumer products that will be used with this standard. The CATV industry needs to be aware of the development of the standard to be able to address the integration of these new products in their subscriber's homes. The Consumer Electronic Bus (CEBus) contains three subcommittees that will be used to accomplish this task. The Single Room (SRbus) subcommittee serves to link together devices that are meant to operate within the confines of a single room, such as infrared remote controls. Its also contains the Radio Frequency (RFbus), used to define primarily RF linked remote controls. The Power Line (PLbus) subcommittee uses power line carrier transmissions to provide mainly AC powering control. The Wired (Wibus) subcommittee contains three separate medium that are all under the control of that subcommittee. The Twisted Pair (TPbus) is concerned with telephone type communication and interface. The Coaxial (CXbus) deals with broadband signal delivery. The last bus is the Fiber Optic (FObus) which uses optical fiber as the transmission medium.

The intent of the CEBus effort is to provide a method of communication between devices on the bus. Additional consumer features will be available, such as the use of your TV remote control to turn on outside lights at night. You would also be able to use your downstairs VCR as a video source for the TV upstairs and be able to control that VCR through the TV's remote control. The possibilities are limited only by the extent of CEBus compatible devices in the home and the needs of the consumer. The consumer

Chris Lewis, project manager, Scientific-Atlanta



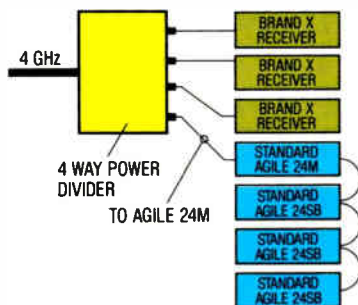
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will also be able to use non-CEBus appliances on the bus, but in order to enjoy the full capacity of CEBus, CEBus devices will eventually have to be used. It is proposed that there will be an eventual turnover of products in the home that will, over a period of time, equip the home with CEBus compatible units, at least those devices which that particular consumer has the greatest interest in. What follows is a status report on the coaxial portion of the Wired Bus part of that standard, and an explanation of how this standard may effect the future of CATV.

A great deal of emphasis has been placed lately on the integration of consumer electronic devices in the home. We are all aware of the arrival of the cable-ready TV, VCR, CD player etc. and have all seen the level of complexity rise in the average piece of electronic gear in the home. It is now time to address some of the issues that stand before the consumer. The main issue is "How do I make the most effective use of these complex pieces of entertainment gear?" There are additional non-entertainment related home integration issues that will also be addressed, such as energy management, security, appliance timing control and communication system integration, but for the near term, and for the CATV industry in general, the most significant issue is the development of the home entertainment center. The issue of how that center will be integrated into the existing CATV system, and what additional features can be offered by a MSO to allow them to derive economic benefit and customer satisfaction from this developing standard are important emerging considerations for the CATV industry.

New concepts

There are several new concepts in the industry which are consistent in principle to the work of the CEB. The CATV industry is seeking ways of becoming friendlier with the home entertainment center concept. The resultant developments may lend themselves very well to integration into the Wibus methodology. The underlying motivation with some of these concepts is to provide an increased quality of

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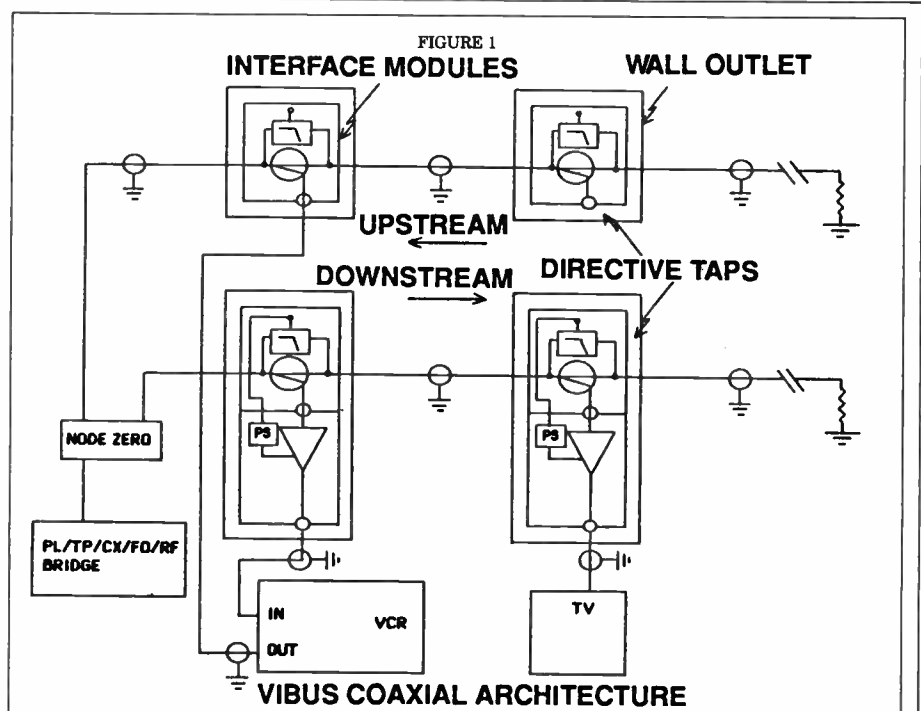


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service to the consumer and this is where there is strong alignment. One has only to look at the list of who is involved in the CEBus effort to see that the consumer electronics industry is serious.

The coaxial portion of the Wibus standard has evolved a great deal over the last 12 months. It was started with the ground rule of trying to provide a broadband delivery system to a greatly increased number of outlets in the

...the rest of us joined together to get the attention we deserve.

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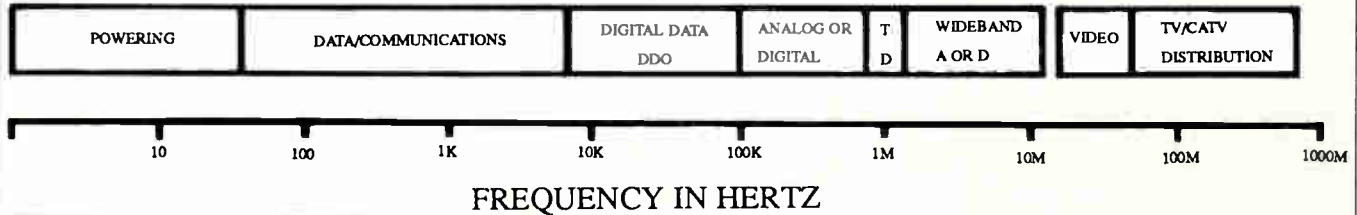
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The downstream cable is very similar to the cable which already exists in the majority of homes.

FIGURE 2

WIBUS COAXIAL FREQUENCY ALLOCATION



home, while at the same time trying to address the major issue of system installation and minimum level of system complexity required to effect a value worthy solution for the majority of consumers. Various topological approaches were analyzed including star, tree-and-branch and hybrid combinations. Two-way versus one-way was also analyzed, with the conclusion being that in order for there to be video and data redistribution in the home, some form of return capability was needed. There was also a commitment

to eliminate the need for an all or nothing approach to the minimum system. It is strongly felt that in order for these concepts to be successful, the consumer needs to be enticed to participate at some minimum level and be able to add to the system in a piece-by-piece fashion. Another important ground rule was to provide the capability to coexist, or at least be easily adaptable to existing CATV systems in such a manner as not to lose the current and future capabilities that a CATV system will provide, whether they eventually

gravitate towards embracing the WIBus concept or not.

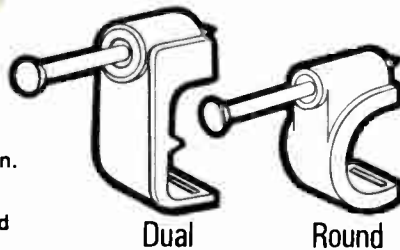
The proposed coaxial (CXBus) standard addresses these issues and represents the current state of thinking on how to offer the best overall combination of performance factors in solving the complex issues associated with the development of this standard. The topology (Figure 1) consists of a two cable approach with both runs being done in a series loop (daisy chain) fashion. The downstream cable is very similar to the cable which already exists in the majority of homes, except for the fact that the cable is tapped in a low loss fashion via a low loss directional coupler or tap. This was done to allow for many additional outlets in the home and to make possible the associated long runs of RG-59 type cable. The proposed outlet has 0 dB overall gain, the -20 dB coupler being operated in conjunction with a 20 dB integrated amplifier. Powering for the outlet would be derived from the coax, and the associated limitations and extensibility have yet to be fully defined. The frequency allocation of the cables is shown in Figure 2. In analyzing the effect of this downstream cable on the existing utilization of CATV systems, one can see that this system with its 0 dB coupling approach and its frequency allocation lends itself very well to integration to existing CATV system with very little if any pain on the part of the system operator.

An upstream cable is also available to provide a path for the collection of video and data information from the various components in the system. This additional cable was proposed instead of a two-way plant with the associated diplexers for several reasons. The first was system complexity. Although this approach contains an additional cable,



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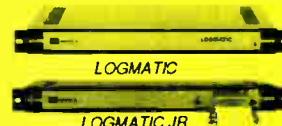
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The LOGMATIC contains a 4000-event memory and interfaces to an 80-column printer or to a PC for data retrieval. The LOGMATIC JR. has a built-in 20-column printer and real-time clock. It prints the event record as the event occurs. Both loggers feature automatic operation, and they record insertions on four channels.

Call or write for more information. You don't have to lose money for unverified spots. Channelmatic, Inc. 821 Tavern Rd. Alpine, CA 92001. (800)231-1618 or (619)445-2691.

NETWORK SHARE SWITCHER

- Inserts ads into four networks from one ad source.
- Inserts ads one network at a time on a first come, first served basis.
- Four Digital DTMF cue tone decoders.
- Four preroll delay timers one for each network.
- Composite sync out put to facilitate vertical interval switching.
- Cue tone decoder disable switches.
- Power fail relay bypass.
- Inputs and outputs for controlling ad insertion devices.



NSS-4A NETWORK SHARE SWITCHER

CHANNELMATIC, INC. 821 Tavern Rd. Alpine, CA 92001
(800)231-1618 or (619)445-2691

LIKE GETTING YOUR MONEY FOR NOTHING AND YOUR CHECKS FOR FREE

Make Money the Easy Way — Put either SPOTMATIC JR.™ or LIL MONEYMAKER™ to work for you now. They are the lowest-cost tools you can use to automatically insert local ads into cable TV programming. You have one unit controlling one VCR to put ads on one channel. Equipment overhead is very low. Switching occurs during the vertical interval for broadcast quality transitions. Once the system is programmed by the operator, it operates automatically.

The SPOTMATIC JR. has a built-in printer for verification records; however, both the LIL MONEYMAKER and SPOTMATIC JR. inserters connect easily to a LOGMATIC™ logging and verification system. With optional software, this enables computerized data retrieval and automated billing and report generation. Write now to see just how little it takes to get into automatic ad insertion.

Channelmatic, Inc.
821 Tavern Rd., Alpine, CA 92001
(800)231-1618 or (619)445-2691

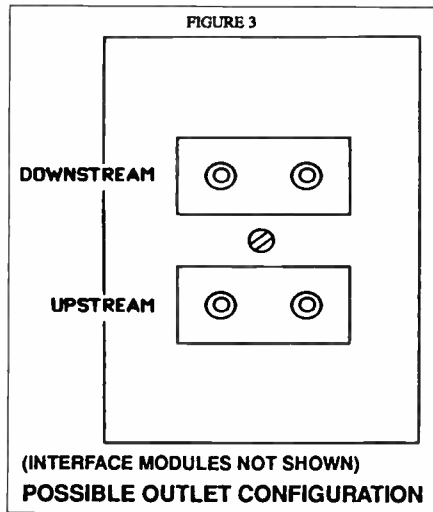
Does the high cost of monitor switchers have you behind the eightball? Then you need to

PUT AN EIGHTBALL™ UNDER YOUR MONITOR— 8x1 Very Low Cost Switcher

It is an integrated circuit-based monitor switcher featuring broadcast quality stereo audio and video switching. Lighted momentary contact pushbuttons are field-legendarable. Its cost is far less than any other comparable unit on the market. Write or call for information today.

CHANNELMATIC, INC. 821 Tavern Rd. Alpine, CA 92001
(800)231-1618 or (619)445-2691

The intent of the committee is to address the definition of a new generation of consumer products.



it is believed that it will be less complex from an installation and maintenance standpoint than a reduced spec two-way plant. Secondly, there is a need for redundant frequency spectrum usage and this cannot be accomplished without a physically separate cable. Thirdly, this second cable is really physically no different than the other, although the intention is to limit its upper bandwidth. It is conceivable that it could have the same level of utilization in the future and therefore it may not be prudent to limit its future capability. Lastly, this approach provides the capability for common routing of the cables, but it does not constrain this to be so. It will be possible to have diverse routing if the situation requires it. This would not be possible with a two-way plant.

The physical mechanism for access to and from the CXBus is an outlet into which the device to be used is plugged in. This outlet (Figures 3 & 4) can be jumpered, or it can contain an interface module which provides the means for tapping the appropriate cable. Outlets are run only where needed, or they may be placed where there is an anticipated need, and in that case a jumper would be initially used. The two cables do not have to be accessed at every outlet, it is really up to the needs of the consumer.

Essential catalyst

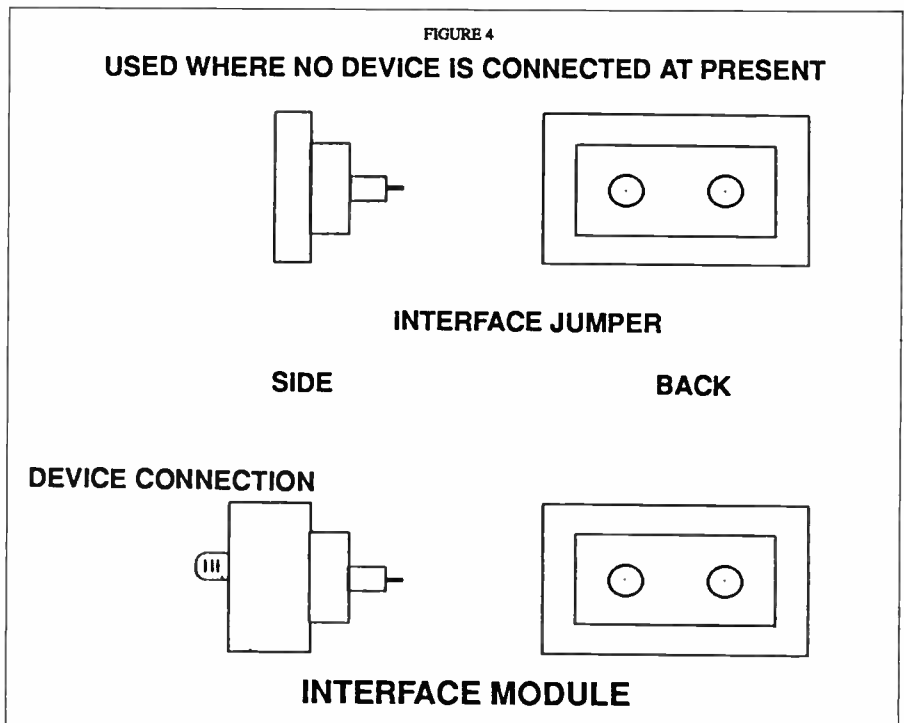
The essential catalyst for the system

to work is the Node Zero. It is *not* a digital controller. In its minimum function it contains the power supply for the cables, the isolation amplifier to link the up and downstream paths and some form of RF level management which may be as simple as a variable pad. It is here that the existing CATV system would be interfaced to a CXBus system. A directive injection point would be provided, and a low-cost amplifier would probably be required to increase the available level from the CATV system so that there would not be a feeder redesign required. The interface would be simple, low cost and would provide the consumer with the same capability that he gets today from his cable system, plus the added benefit of the CEBus products that he has purchased and for which he has paid to have the CEBus installed.

The intent of the committee is not to link together today's devices but rather to address the definition of a new generation of consumer products that will be CEBus centered. Interface capability to the 1986 VCR etc. will be provided, but that is not the primary focus. The CEBus devices will be able to stand alone, but they will be at their

best when connected to the appropriate bus, and are able to communicate with other CEBus devices. The intent of the CXbus subcommittee is to provide the capability for a simple interface to the existing CATV system in a CEBus wired home. It is possible that future homes wired for CEBus will not have to be wired by the cable operator. This approach is consistent with the movement in the industry to provide a service drop to the home similar in concept to the phone company service now provided.

The CEBus standard is coming. MSOs need to be aware of the progress of standard development and to understand that the standard is the consumer electronics industry's effort to provide the best compromise solution to a very complex problem. Those MSOs who understand the standard and adopt appropriate portions that fit into their future business plans will gain in their success. Those who reject at least the coexistence of the standard with their current business plans will have created for themselves an additional issue even more complex than the evergrowing VCR/cable-ready TV issue. ■



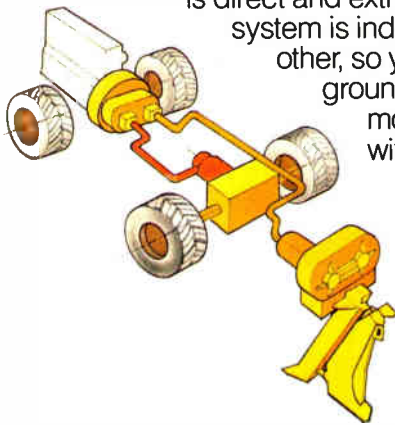
Your next trencher.

If it isn't a Case,

here's what you'll be missing.

Total control.

Case offers you standard dual hydrostatic drive — one to power attachments, one for ground drive. Power metering for both functions is direct and extremely precise. Each system is independent of the other, so you can vary ground speed to accommodate soil conditions without disturbing your plow or chainline speed — or vice versa.

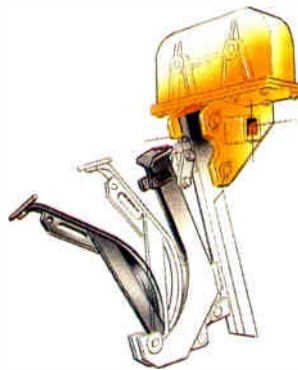


Hydraulically articulated steering lets you maneuver easily, too.

The other half of the warranty.

Most manufacturers back their trenchers with a ninety-day warranty on parts only. But the warranty on Case trenchers covers both parts *and* labor for six months. Your Case dealer also offers one-stop service.

Isolated plow vibration.



Our unique eight-point suspension and hinged drop chute with removable gate isolate vibration from the machine and cable. Service loops can be restrung without cutting or splicing. And only Case offers a front trencher, rear plow combination.

Underground versatility.

Your Case trencher is more than just a trencher with our backhoe, Hydra-borer® or cable layer attachments. Case versatility also lets you mount most of these primary tools front or back. Maneuverability. Warranty. Faster restringing. Attachments. Four Case advantages.

See your Case dealer today and get the trenching edge that comes with a Case.

JI Case
A Tenneco Company



700 State Street Racine, WI 53404 U.S.A.

Building On Quality™



760



DH4B



TL100



TF300



Reader Service Number 37

Transient problems vary considerably in different systems and in various parts of each system.

Continued from page 22

Fuses—

1. Protect circuit devices such as rectifiers, transformers, etc. but not transistors.
2. Slow acting. Slow blow fuses are

- used to prevent nuisance tripping.
3. Firing time is in the order of 1 to 5 milliseconds to ½ second.
- Thermal breakers (Sylvania P/N ESB710E3A)—**
1. Used in bridger legs in series with

fuses to prevent nuisance fuse outages due to momentary shorts during tap installation.

2. Has been used in place of fuses. Has a slightly lower firing time. Contact could weld shut. Series fuse should be used.

3. Cycling on permanent short can affect other bridger legs.

Crowbar circuit—

Used in the amplifier D.C. power supply to sense D.C. overvoltage which may be caused by transients. Zener fires an SCR which clamps DC voltage to low level and blows DC fuse.

Thyrite pellet arrestor—

Used across primary power supply to reduce transient load on primary. Basically a high current device.

Time delay relay—

1. Used across power supply to sense overvoltage and take power off cable system for fixed delay time and until transient has passed. 10 to 20 seconds.
2. Mechanical device.
3. Slow acting on initial transient.
4. Has proved effective.
5. Transient clipper should be more effective.

Coupling capacitors—

1. On amplifiers, smallest capacitance value usable as a blocking capacitor will limit transients.
2. On passives, 500 volt capacitors are preferable. Actual breakdown and test voltages of capacitors are compared below:

Life rating	Test voltage	Actual Break-down Voltage
200V	600V	2100
500V	1500V	2500

Conclusion

Transient problems vary consistently in different types and in various parts of each system. An exact analysis is difficult due to the expensive instrumentation task which would be necessary.

An upgrading of the grounding system, use of transient clippers, surge suppressors and proper coupling capacitors should solve the majority of transient problems. ■

Finally, At Last, Just In Time!

PROLINK 500 LASER

The need for another headend, dish, receivers and costly labor can be eliminated. Install the Graycor Prolink in less time than you could imagine saving thousands of dollars. No FCC permit, no easement permits to complicate your life. Capacity up to 42 channels with excellent carrier to noise at distances that will astound you. The Graycor

500 was chosen recently in a shoot-out against another brand (that resembles a stove pipe) by one of the nation's major MSO's. Visit our booth #531 at Cable-Tec Expo April 3rd & 4th in Orlando. See the prolink in action. Delivery is limited so inquire now at Midwest Corporation operating since 1950 with a 1987 product line for the future.



YOUR EXCLUSIVE PROLINK SOUTHEAST DISTRIBUTOR

MIDWEST CORPORATION

CATV DIVISION

6 4 3 - 2 2 8 8

1-800-MID-CATV

Reader Service Number 38

SAMIII.E. 600 MHz

The industry's best signal analysis meter just got better.

Introducing the SAMIII E 600. Everything the SAMIII is, and more. A frequency range of 4 to 600 MHz. Microprocessor controlled. Soft-touch keypad. Preprogrammed Video/Audio frequencies and channel assignments in Standard and HRC formats. "NEXT" key for automatic incremental up-channel tuning. Internal reference for temperature variations.

The SAMIII E 600 quickly measures Hum modulation, and can accommodate spectrum analyzer display on an associated X-Y oscilloscope.

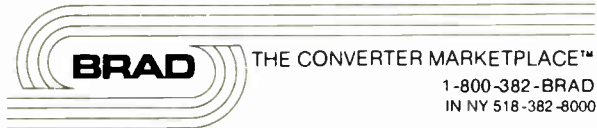
For the CATV system engineer looking for the best signal analysis meter, there's only the SAMIII E 600.

For more information call us toll free, 1-800-622-5515. Or write Wavetek Indiana, 5808 Churchman, P.O. Box 190, Beech Grove, IN 46107.



product profiles

Converter repair



Robert Price
Senior Vice President

1023 State Street, Schenectady, NY 12301

TELEX: 650 262 1964 (VIA-WUI)
Tampa, FL • Cherokee, NC • Fife, WA

Brad Cable Electronics Inc.

1023 State Street
P.O. Box 739
Schenectady, N.Y. 12301
(518) 382-8000
(800) 382-BRAD

SERVICE CENTERS: 5906 Breckenridge Parkway, Suite I, Tampa, FL 33610, (813) 623-1721; 4630 Pacific Highway East, Suite B-7, Fife, WA 98424, (206) 922-9011; Highway 19, Old Socco Road, Cherokee, NC 28719, (704) 497-5314.

DESCRIPTION: Brad Cable Electronics Inc. is a major service center for converters and CATV equipment. Brad also purchases used and excess converters and CATV equipment. Brad is a major supply house for both converters and CATV equipment. Brad has the capacity to service 12,000 converters at all four locations. Brad celebrates its tenth anniversary Oct. 1, 1987.

C & C CATV Service Co. Inc.

39B Mill Plain Road
Danbury, CT 06811
(203) 748-4488

CONTACT: Gail Verna

DESCRIPTION: C & C CATV Service Co. are specialists in converter repair.



Cable Converter Service Corp.
54 East Market St.
Spencer, Indiana 47460

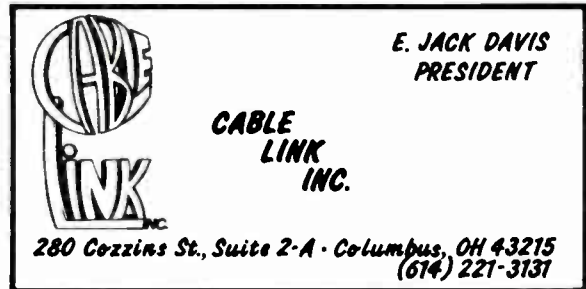
Cable Converter Service Corp.

54 East Market Street
P.O. Box 407
Spencer, IN 47460
(812) 829-4833

PERSONNEL:

John Wright, President

DESCRIPTION: Founded in 1977, Cable Converter Service Corp. buys, sells and offers a full-service repair facility for CATV equipment including converters and line equipment. Repairs: Scientific-Atlanta, Jerrold, Oak, RCA, Hamlin, Sylvania, Theta Com, Texscan, Pioneer and more. Locations nationwide.



Cable Link Inc.

280 Cozzins Street
Suite 2-A
Columbus, OH 43215
(614) 221-3131

PERSONNEL:

E. Jack Davis, President
Bill Holehouse, Director Sales
Scott Heeter, Sales Rep
Fritz Juskalian, Sales Rep
Vonna Richardson, Sales Rep
Mark Romero, Sales Rep
Jon Schatz, Sales Rep
Stan Smith, Sales Rep
Keith Striblin, Sales Rep
Charles Hanchett, Chief Eng.
Quin Williams, Prod. Mgr.

SERVICE CENTERS: 2439 Northeast Loop 410, Suite 1404, San Antonio, TX 78217, (512) 650-3132; 2582 Tuson Drive #2C, Drayton Plains, MI 48020, (313) 673-0818.

DESCRIPTION: Sales of new and refurbished converters, distribution electronics, passive devices and hardware. Large, centrally located refurbishing facility for converters, distribution electronics, headend and test gear. Manufacturers serviced: Arcom, Blonder Tongue, C-COR, Eagle, Hamlin, Jerrold, Magnavox, Oak, Pioneer, RCA, Scientific-Atlanta, Standard Components, Texscan.



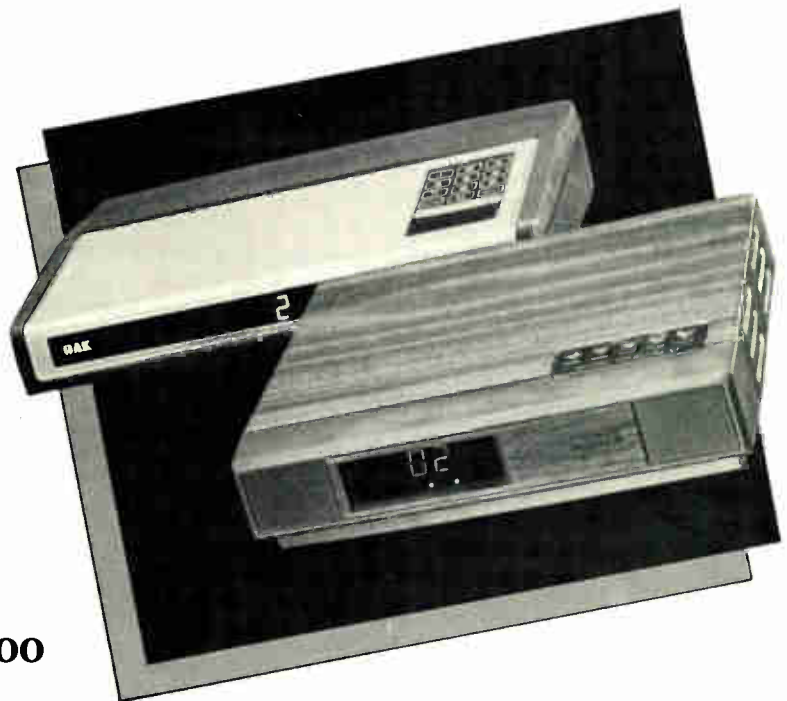
For the next ten years, our standards will remain the same...

- **High Quality**
- **Competitive Prices**
- **Good Customer Service**

While keeping up with the rapid changes in technology, and growing to better service your needs... we will never lower our quality standards or the emphasis on serving you, our valued customer.

So thank you for helping BRAD become the largest independent sales and service facility of its kind. We look forward to another challenging decade.

Call: 1-800-382-BRAD
In NY, Call: 1-518-382-8000



Corporate Headquarters. 1023 State Street, Schenectady, NY 12301, 518-382-8000
5906 Breckridge Pkwy., Suite 1, Tampa, FL 33610, 813-623-1721
4630 Pacific Hwy. East, Suite B-7, Fife, WA 98424, 206-922-9011
Highway 19, Old Socco Road, Cherokee, NC 28719, 704-497-5314

CLEARLY BETTER



SEE US AT THE NATIONAL - BOOTH 1719

converter repair



L.R. Don Quinton
*President
 Chairman of the Board*

Cable Television Services, Inc.
 120 Erbbe N.E.
 Albuquerque, New Mexico 87123
 505-292-7766
 505-298-1891

Cable Television Services Inc.
 120 Erbbe N.E.
 Albuquerque, N.M. 87123
 (505) 292-7766
 (505) 298-1891
PERSONNEL:

L.R. Don Quinton, President

DESCRIPTION: CTS provides thorough refurbishment inside and out on all converters. Failure analysis available for each repaired and refurbished unit. All unit updates and modifications offered by original manufacturers are available through CTS.

Compu-Trace Inc.
 8803 Shirley Avenue
 Northridge, CA 91324
 (818) 886-3551

CONTACT: Julie Kim

DESCRIPTION: Converter repair service for Jerrold, Oak, Pioneer and Hamlin.

Electrodyn Corp.
 917 South Rogers Street
 Bloomington, IN 47401
 (812) 334-1023

DESCRIPTION: Electrodyn repairs all makes and models of cable converters, tuners, VCRs, satellite receivers, actuator arms, down converters, MATV amplifiers and commercial satellite receivers.

INDEPENDENCE ELECTRONICS INC.

**CONVERTER SPECIALIST
 -REPAIR-
 BUY/SELL USED EQUIPMENT**

DOUG JONES, President
 (816) 836-1094

**117 S. Main
 Independence, MO 64050**

Independence Electronics

117 East Alton
 Independence, MO 64055
 (816) 836-1094

PERSONNEL:

Doug Jones, Owner

DESCRIPTION: Converter repair at quantity discounts. Certain repairs as low as \$5.50 plus parts. Independence Electronics also manufactures and sells woodgrain overlays.

This
 could
 be
 your

Last issue of **CED**

Unless you send us back the qualification card on the cover. No kidding. Our auditors demand that you specifically request the continuation of your subscription in writing at least once a year. Do it now, please.

600 Grant Street, Suite 600
 Denver, CO 80203

How to buy, sell and repair converters.

Managing your converter inventories for profit may require turning old converters to cash, purchasing new and used equipment as well as repairing existing inventories.

All makes, all models.

Where do you look for the buyers and sellers of each converter make and model? Service reps at PTS/Katek talk to more system managers everyday about converter



needs than anyone in the business. PTS/Katek buys all makes, all models and sells only to authorized cable systems. If it's not in stock, PTS/Katek knows where to find it.

New Jerrold equipment in stock

Many distributors only want your big orders and work from manufacturers' inventories. PTS/Katek has one of the largest private inventories. Plus they ship every in stock order, large or small, within 24 hours.



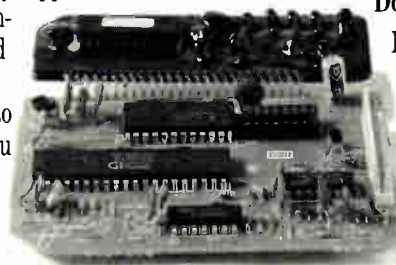
All repair is not the same.

Your repair company should work closely with manufacturers. This assures trained technicians with factory support. Consider parts availability, turn-around, warranty, and quality in addition to price. It's important to know the company you ship your converters to will be in business tomorrow.

repairs more addressable than all repair companies combined.

Do it yourself.

If you have an existing in house repair program, you'll find it economical to sub-contract sophisticated repair such as tuners, RF, IF, and decoder modules. Talk to PTS/Katek.



Writing the book on addressable repair.

New chapters are being written on addressable repair every month. One company has consistently been the leader in this area. PTS/Katek

Call toll free today.

Talk to the converter specialists. If you want to know more about buying, selling or repairing converters call 1-800-441-2371.



PTS Katek
The Converter Specialists

Bloomington, IN Arvada, CO Detroit, MI Indianapolis, IN Jacksonville, FL Jupiter, FL Longview, TX
Newbury Park, CA Norfolk, VA North Highlands, CA Pittsburgh, PA Westfield, MA Yeadon, PA

converter repair

INTRASTELLAR ELECTRONICS

KATHLEEN CLARK
Sales Manager
Repair Division

"Quality Converter Repair"

PAM MORGAN
Sales Manager
Brokerage Division

(312) 658-0300
200 Berg St.
Algonquin, IL 60102



MAI Communications, Inc.
MAI CATV, Inc.
141 Shreve Avenue
Barrington, NJ 08007
(609) 547-1600
(800) MAI-CATV

TOM GIRARD
President

**CONVERTER REPAIR
EXPERTS**

Intrastellar Electronics Inc.

200 Berg Street
Algonquin, IL 60102
(312) 658-0300

DESCRIPTION: Intrastellar services Jerrold, Sylvania, Hamlin, Pioneer, Scientific-Atlanta, RCA and Oak converters.

MAI CATV Inc.

141 Shreve Avenue
Barrington, NJ 08007
(609) 547-1600
(800) MAI-CATV

DESCRIPTION: MAI CATV offers converter repair, strand mapping, drafting, as-built splicing and system actuation.



BUYS NEW & USED SURPLUS EQUIPMENT

(CONVERTERS, LINE GEAR, HEADEND, PASSIVES, TRAPS, ETC.)

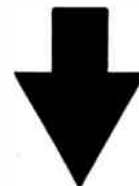
CALL (614) 221-3131

Sales and Repair of CATV Equipment

Reader Service Number 42



Please allow 4-6 weeks for your change of address to take effect. Send your new address, along with a CED mailing label showing your old address, to:



CED Circulation
600 Grant Street, Suite 600
Denver, CO 80203

converter repair

PTS Katek
Cable Services Division
Corporate Headquarters
5233 South Highway 37
P.O. Box 272
Bloomington, IN 47402
(812) 824-9331
(800) 441-2371

PERSONNEL:

Gary Wilson, Cable Product Mgr.

SERVICE CENTERS: 4941 Allison Street, Arvada, CO 80002, (303) 423-7080; 14745 West Eight Mile Road, Detroit, MI 48235, (313) 862-1783; 8492 Brookville Road, Indianapolis, IN 46239, (317) 353-6668; 1919 Blanding Boulevard, Jacksonville, FL 32238, (904) 389-9952; 150 Venus Street #7, Jupiter, FL 33458, (305) 747-1808; 110 Mopac Road, Longview, TX 75601, (214) 753-4334; 828 Mitchell Road, Newbury Park, CA 91320, (805) 499-8702; 2476 Alameda Drive, Norfolk, VA 23513, (804) 853-5844; 6131 Watt Avenue, North Highlands, CA 95660, (916) 334-2012; 701 Parkway View Drive, Pittsburgh, PA 15205, (412) 787-3888; 300 Union Street, Westfield, MA 01086, (413) 562-5205; 548 Penn Street, Yeadon, PA 19050, (215) 622-0450.

Teletronics Inc.
Route 20
Esperance, NY 12066
(518) 875-6101
(518) 875-6102

PERSONNEL:

Rudy Moentmann, Sales Manager

Tom Johnson, Sales Rep

DESCRIPTION: Repairs Jerrold, Oak, Hamlin and Regency CATV converters. Also manufacturers stock parts for Jerrold and Hamlin.

Western Services
3430 Fujita Avenue
Torrance, CA 90505
(213) 539-8030
(800) 641-2288 in Calif.
(800) 551-2288

DESCRIPTION: Repairs Oak, Jerrold, Hamlin, Scientific-Atlanta, Pioneer, Texscan, Eagle, Magnavox, Sylvania,

If you would like your company listed in the next converter repair callbook, contact Cathy Wilson at CED, 600 Grant St., Suite 600, Denver, CO 80203, or call (303) 860-0111.

Goodbye Templates...

Lettering Guides... Sticky Tape... Cut & Paste and Transfer Letters...



Hello A.D.S./LINEX...

HERE'S THE LINEX SCRIBER...No matter what your discipline, the most time-consuming aspect of drafting is the application of lettering, notes, symbols, title blocks and tables. The Linex Scriber is the perfect tool for these tedious tasks. And much faster than any of the above techniques!

THE STEP BETWEEN MANUAL DRAFTING AND CADD...The Linex Scriber provides a highly cost-effective alternative without the large investment in money, time or people required by CADD. If you are already using CADD, you know manual work is still required. The Linex Scriber is here to help.

SIX MONTH PAYBACK...With the increased speed and productivity gains, the Scriber can pay for itself within six months. Customers have documented justification in only 79 days.

Please call today for more information or a no-obligation demonstration.

System Starting at

\$2,900.00

A.D.S./LINEX, INC.

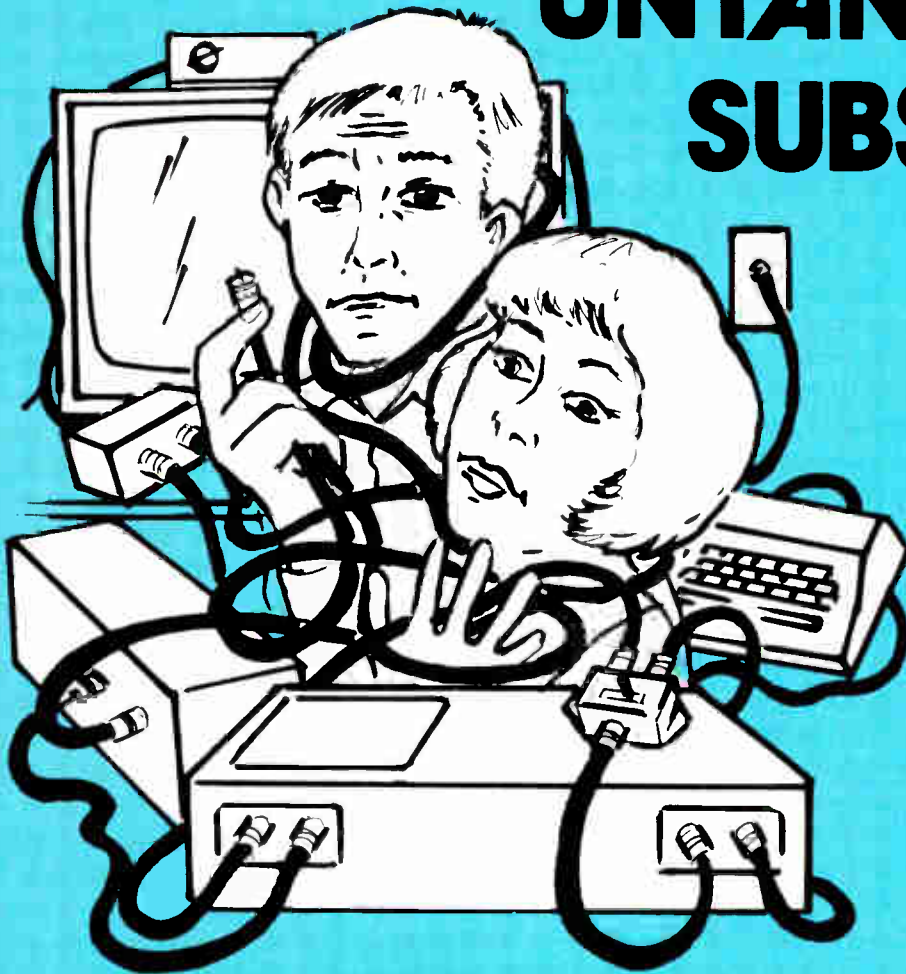
AUTOMATED DRAWING SYSTEMS

3130 Gateway Drive • Suite 400

Norcross, GA 30071 • 404/448-0977

Outside Georgia 800/241-3675 • Telex: 54-3602 ADS ATL
Reader Service Number 43

UNTANGLE YOUR SUBSCRIBERS!



No more tangled cables.
No more bulky switches.
No more confusion with
changing connections.



GIVE YOUR SUBSCRIBERS PUSH-BUTTON VIDEO SELECTION CONVENIENCE...

4 RF Inputs to a TV Set (Cable TV, Outdoor Antenna, Satellite Receiver, VCR, Video Disc Player, Video Game, Computer). View a scrambled channel while at the same time record an unscrambled channel, or vice versa. TV Set Remote Controls can be used.

RMS GIVES YOU TWO VIDEO CONTROL CENTERS!...

Model VCC-1, and Model VCC-11A Amplified.

For more information— contact your RMS Account Executive...

RMS ELECTRONICS, INC.

50 Antin Place, Bronx, N.Y., 10462

CALL COLLECT: (212) 892-1000 (New York State Only)

TOLL FREE: (800) 223-8312 (Continental U.S.A., Puerto Rico, U.S. Virgin Islands)

New senior members, meeting groups

Six new SCTE members have attained Senior Member status: **Steve Bell**, president, Video Cable Systems, Delta Video Cable and Piggott Video Cable; **Gary Donaldson**, staff engineer, Wometco Cable; **Larry Masaglia**, western regional engineer, Gilbert Engineering; **Jonathan Ridley**, applications engineer, General Instrument; **Gary Selwitz**, assistant chief engineer, Warner Cable; and **Michael Smith**, division engineer, Warner Cable. Requirements for senior membership include at least 10 years experience, five of them in CATV, and significant contributions to the industry.

Three new meeting groups also have formed, bringing the total of SCTE chapters and groups to 33 nationwide. The new groups are the **Gateway** meeting group, St. Louis, Mo.; **Iowa Heartland** meeting group, Des Moines, Iowa; and the **Cascade Range** meeting group, Portland, Ore./ep/Officers for the Gateway group include Larry Lehman, Cencon Cable Associates, president; Tom Jokerst, Continental Cablevision, first vice president; Pierre Cabbage, Mega Hertz Sales, second vice president; Mike Cowley, Cyntec Engineering, secretary; and Mike Ayres,

Cencom Cable Associates, treasurer.

Contacts for these new groups are: Gateway, Larry Lehman, (314) 576-4446; Iowa Heartland, Dan Passick, (515) 266-2979; and Cascade Range, Dave McNamara, (503) 667-9390.

The **Chesapeake** meeting group has also held its first meeting. Elected officers are Tom Gorman, Comcast, president; Phil Hopkins, Prime Cable, first vice president; John Thompson, Storer Cable, second vice president; Jack Anderson, United Cable, secretary; and Carl Mathews, Sojourners College, treasurer. Roy Ehman, Storer Cable, was the keynote speaker. Jim Higgins, FCC electronics engineer, also was on the program. Demonstrations of leakage control equipment were given by Bob Jackson, Texscan; Lee Stump, Comsonics; and George Ornallis, Vitek. Contact Tom Gorman, (301) 321-6093.

The **Dairyland** meeting group also has new officers. Barry Nelson is president; Neal Mclain and Bruce Wasleski are vice presidents; and David Devereaux-Weber is secretary/treasurer.

SCTE will co-sponsor the June 15-17 **Northeast Cable Television Technical Seminar** in conjunction with the



Mike Aloisi of Showtime/The Movie Channel speaks to members of the Chattahoochee Chapter during a recent seminar sponsored by the chapter and SCTE National in Atlanta. The seminar focused on leadership skills.

New York State Cable Television Commission. The agenda includes June 16 sessions on customer satisfaction, lead by Larry Pestana, Paragon Cable; subscriber interfaces, lead by Vince Pombo, TCI; BTSC stereo, lead by Steve Fox, Wegener Communications; pole climbing and ladder demonstrations, lead by Atlee Cullison, Atlee Cullison Training School; and BCT/E exams.

Sessions on June 17 include designing for 550 MHz, lead by Harry Perlow, Gilbert Communications; operating at 550 MHz, lead by Roosevelt Mikhail, Warner Communications; and equipment for 550 MHz. For details call (518) 474-4992.

A satellite tele-seminar program on **digital TDRs** will be aired April 28 from 1 to 2 p.m. EST on Satcom IIR, transponder 7. A program on **RF field strength measurement principles** will broadcast on May 26, also from 1 to 2 p.m. EST on Satcom IIR transponder 7.

The **Community Antenna Television Association**, meanwhile, has endorsed the Broadband Cable Technician/Engineer (BCT/E) certification program.



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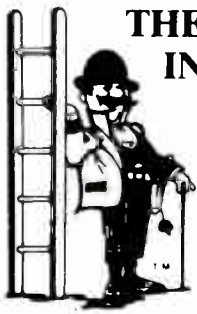


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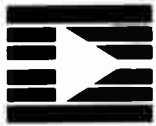
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Viacom moves, but to Galaxy III

MTV Networks will be moving its programming to a new C-band bird, but not to Telstar 303, as originally projected. Instead, Viacom's programming is moving to Galaxy III, located at 093.5 degrees west. Viacom's move to create a new CATV bird is the result of its thinking in several areas. C-band vs. Ku-band technology is one consideration. Without question, Viacom has reservations about Ku-band technology. It isn't so much the rain fade issue, although that's a factor. The larger question is "what does Ku do that C-band doesn't already do?". Ku proponents cite the lack of TI as an advantage, but Viacom argues that with frequency coordination already in place, TI isn't that big an issue for C-band receive dishes. Nor is antenna size that big an advantage. The reflectors a CATV operator would use at Ku frequencies aren't that much smaller than existing C-band reflectors, Viacom argues.

The Ku adherents say C-band has a limited lifespan, considering the aging of existing satellites and the shortage of launch capability. Viacom counters that existing C-band birds still have eight or nine years of life left. Furthermore, the industry already has a huge investment in C-band technology and the launch capability situation could change at any time. Not that Viacom has written Ku-band off. It's more a matter of going with what works now and reserving final judgment for a later date.

Having chosen C-band, there's a secondary issue of which bird to be on. Galaxy III has a couple of advantages. It offers better signal protection capability and better back-up. Also, since Galaxy III is the newest C-band bird, it has the longest lifespan. Why Galaxy III instead of Telstar 303? Price, mostly. Viacom simply got a better deal.

A few logical antenna vendors should be happy about the move, because the possible result, industrywide, is as many as 4,000 additional antennas at operator receive sites. But operators shouldn't be adversely affected. Viacom, we're certain, is working on a program to provide antennas to operators who

need them to look at the new satellite. We don't have the details yet, but would guess it's going to be an expensive proposition for Viacom, since free or reduced-price dishes would likely be involved. Dual-beam feeds might be an alternative for a small number of operators who already are looking at Satcom IV and don't have the real estate to put in another antenna.

The FCC, meanwhile, recently released a report showing that 30 percent of the 500 or so transponders now aboard the 25 or so active U.S. domestic communications satellites are completely idle. Another one-third of the 524 transponders—154—are used only part-time. Leading the list with transponder vacancies are owners Comsat General Corp. (24); GTE Space-net with 23; RCA American with 44. Hughes Communication, owner of the Galaxy series, has a "no vacancy" sign out.

A **Multiport (IS-15)** test site now is operating at ATC's Denver headquarters with two receivers (Quasar and Sony) and two scrambling systems (Oak and Scientific-Atlanta). Tocom is about ready to test its baseband system and Zenith also could be ready soon. Jim Chiddix, ATC VP, engineering and technology, is supervising the test facilities. "Cable '87", the 36th annual National Cable Television Association convention, will be held May 17 to 20 in Las Vegas, Nev. A full technical program is planned, featuring 10 sessions, 48 papers and 50 or so speakers. Among the sessions are two-way plant, chaired by **Graham Stubbs**, consulting engineer; improved plant design and construction, moderated by **Norm Santos** of Oceanic Cablevision; and CATV security considerations, lead by **Ted Hartson**, Post-Newsweek Cable. Also on the agenda are a look at implementing pay-per-view, chaired by **Nick Hamilton-Piercy**, Rogers Communications; new developments in CATV's consumer electronics interface, put together by **Walt Ciciora**, ATC; and a look at new TV signal formats, moderated by **Brian James** of NCTA.

Jim Chiddix, ATC, takes a look at

fiber optics; **Karl Poirier**, Triple Crown Electronics, examines stereo over cable. **Norman Weinhouse**, Norman Weinhouse & Associates, leads a discussion of C-band vs. Ku-band signal delivery while **Ed Milner**, Arlington Cable Partners, leads a group looking at design considerations for expanded bandwidth systems. Four of the sessions will be held on May 18; six sessions will be held on May 19. For registration information or details contact NCTA, (202) 775-3606.

Hughes Aircraft's Microwave Products Division has applied for FCC approval for two new products: the model AML-FFA-160 microwave feed forward amplifier and the model AML-HPOLE-112 microwave line extender. The FFA-160 boosts levels as much as 10 dB compared to the model AML-OLE-111 without material degradation of noise and distortion performance, the company says. The improvement applies to both single-channel and multi-channel applications.

The new line extender offers about 5 dB improved output compared to the model AML-OLE-111. The new unit uses enhanced amplifier technology but is essentially identical to the older AML-OLE-111 in other respects. Call (213) 517-6233 for details.

LanTel Corp., the Norcross, Ga.-based manufacturer of point-to-point broadband voice and data modems, has four new products, all designed for operation at subsplit frequencies. The frequency-agile Series 900 modems are channel-selectable in 50 kHz increments from 23.75 MHz to 41.75 MHz, opening up an additional 18 MHz of operating bandwidth for data network managers and allowing point-to-point data and voice transmission on two-way subsplit systems. The model 900A carries asynchronous data up to 9600 bps; the model 900S carries either synchronous or asynchronous data up to 19.2 kbps; the model 900T is used for voice communication; the 900 BPT is a portable voice modem; and the 900DC functions as a telephone-to-PBX link or off-premise extension. Call (404) 446-6000.

Wavetek, meanwhile, has introduced a new SAM IIIIE 600 signal analysis meter with 600 MHz tuning range. The portable meter makes quick C/N and

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hum measurements. Call (317) 783-3221.

New from **Pico Macom Inc.** is a model PMI-6210 stereo decoder, an adapter providing stereo output from a channel 3 BTSC type input. A switch provides selection of stereo, monaural or SAP formats. Call (818) 897-0028 in California or (800) 421-6511 outside of California.

Barco Industries of Los Gatos, Calif. has a new line of VSD 1000 television demodulators and a VSBM 1000 line of television modulators. The demodulators come in three versions, two of which offer five presettable channels, the last of which offers a single channel between 5 and 890 MHz. Single unit prices start at \$2,630 for the demodulators. Call (408) 370-3721.

Lectro Products, meanwhile, has introduced an improved version of its Sentry II standby power supply, incorporating the company's "Super Ferro" technology, which the firm says offers 92 percent efficiency. Call (404) 353-1159.

New from **Belden Wire and Cable** are new cables for long distance direct burial and aerial use. The 1160A and 1161A cables are low attenuation, enlarged versions of the company's RG-6 cables, but are smaller and less expensive than Belden's RG-11/U cabling. The 1160A is flooded; the 1161A has a galvanized steel messenger and PVC jacket. Also new is the 1163A flexible 75-ohm cable. Call (800) BELDEN-4.

Riser-Bond has a new model 525 cable designator, a test set containing a receiver and transmitters allowing operators to identify up to 10 cables at a time. The test set containing one

receiver, five transmitters, manual and carrying case sells for \$395. Call (402) 694-5201.

ABC Cable Products is the new marketing arm for **Cable Exchange's** line of remote control units, which includes Jerrold compatibles (DRX, LCC, DRZ, Starcom VI), Scientific-Atlanta model 8550 and Tocom model 5503 compatibles. Call (303) 694-6789 or (800) 422-2567.

A second-generation FMT633 stereo modulator is new from **FM Systems**. The FMT633 uses the National Semiconductor "DNR" noise reduction system and is BTSC-compatible, although not BTSC format. Call (800) 235-6960 outside of California or (714) 979-3355 in California.

A variety of new filters are available from **Microwave Filter Co.** The model 5255 channel deletion filter removes one data channel and allows reinsertion of another. Designed for LAN applications, it sells for \$425. The model 5620 low pass filter fits on the input of an AMDAX data translator to reduce bandwidth used for point-to-point data on a broadband system. It sells for \$675. The model 5427 bandpass filter provides isolation for a four-channel segment of the superband. It sells for \$1,425. The model 5375 bandpass filter isolates single channels in multi-vendor LANs. It sells for \$792. The model 4754A filter network deletes all low and high band channels in a CATV or SMATV system so other channels can be reinserted. It sells for \$2,200. The model 5531 double micro-notch identifies and suppresses two interfering frequencies or provides deeper suppression on one satellite frequency. It sells for \$575. The model 5246 waveguide bandstop filter protects CARS band C-group reception from interference caused by nearby transmitters. It sells for \$925. Call (315) 437-3953.

A new catalog detailing cable pulling reels is available from **General Machine Products Co.** Call (215) 357-5500.

At **Tocom**, **Richard Brown** is new manager, marketing for Tocom systems. Brown was formerly manager, new business development for Tocom.

Michael Pieson, maintenance technician, **Group W Cable**, Prescott, Ariz.;

and **Billy Williams**, line technician, **McCaw Cablevision**, Clovis, N.M., are new recipients of the SCTE Technical Scholarship for January and February 1987.

Dennis Coslo is new production manager with **Broadband Networks**, the broadband LAN component company headed by Joe Preschutti. Coslo will oversee all manufacturing operations. Call (814) 237-4073.

George Butts Jr. is new sales engineer, data, for **C-Cor Electronics**. He will provide technical sales support for C-Cor's LAN products in the East. He can be contacted at (215) 259-3153. Also, **Robert Beury** is new manager, data market, charged with responsibility for developing C-Cor's LAN marketing plan. **William Margiotta** is new regional account executive for the Southwest. He can be reached at (619) 576-0808.

At **Midwest Corp.**, **Wayne Daniels** and **William Brokhiser** are new sales engineers while **Bruce Furman** is new sales representative for the Northeast.

And **TRW Information Networks Division** has a new director of marketing and sales—**Wayne Martson**. IND is the division responsible for the TRW Concept 2000 line of broadband, baseband and PC LANs.

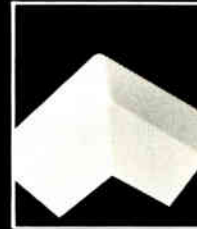
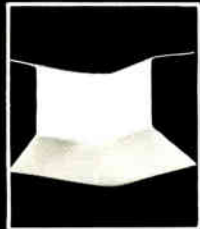
Jerrold will hold a two-day technical seminar on broadband LAN technology in Washington, D.C. at the end of April, although the precise date hasn't been set yet. Tuition for the seminar is \$195. For details call Lori Waddle, (800) 847-0721.

A seven-cassette tutorial on local area networks is available from the **Association for Media-based Continuing Education for Engineers (AMCEE)**, a consortium of engineering universities. The series rents for \$875 and has a study guide for \$36.50. Call (404) 894-3362.

Jerrold's 1987-88 cable technical seminar schedule has been set. The dates and sites are: June 16-18, Chicago; July 14-17, Philadelphia; Aug. 18-20, Atlanta; Sept. 15-17, Kansas City, Mo.; Nov. 17-20, Philadelphia; Jan. 12-14, 1988, Los Angeles; Feb. 9-11, 1988, Orlando, Fla. For details call (215) 674-4800, ext. 4189.

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Stereo television on cable is here and is gaining more adherents.

Continued from page 36

These amplitude pulses are ideally stripped in the TV limiter, and do no harm. In practice, however, the TV sound system exhibits some degree of AM to FM conversion, so an artifact from the scrambling process appears on the audio. Since the BTSC pilot carrier and the scrambling-related pulses are both locked to the video line rate, the artifact introduced will be equal in frequency but at an arbitrary phase with respect to the pilot carrier. This causes some phase shift in the pilot seen by the decoder, which in turn causes some loss of separation.

The degree of separation loss is a function of the amplitude of the resultant pulses (some systems overlap the two and others space them), and of the amount of AM/FM conversion in the TV receiver. Tests to date indicate a reduction in the separation when scrambling is employed. Since the reduction is partially a function of the receiver,

we are reluctant to quote numbers, except to say that it is adequate. Stereo television on cable is here and is gaining more adherents. In most cases the system works, or can be made to work with minor changes. The most severe problem is that systems using baseband converters will have to find a way around their inability to pass stereo. Baseband converter manufacturers are supporting this need, though volume control presents a conflict in subscriber services. Since changes only have to be made at the homes of subscribers requiring delivery of BTSC stereo, the changes can be phased in over several years.

Acknowledgements

Much of the material in the paper was initially developed by Messrs. C. Bowick, L. Rovira, D. Secacca and W. Woodward, whose efforts at improving the quality of signals in cable systems

are gratefully acknowledged.

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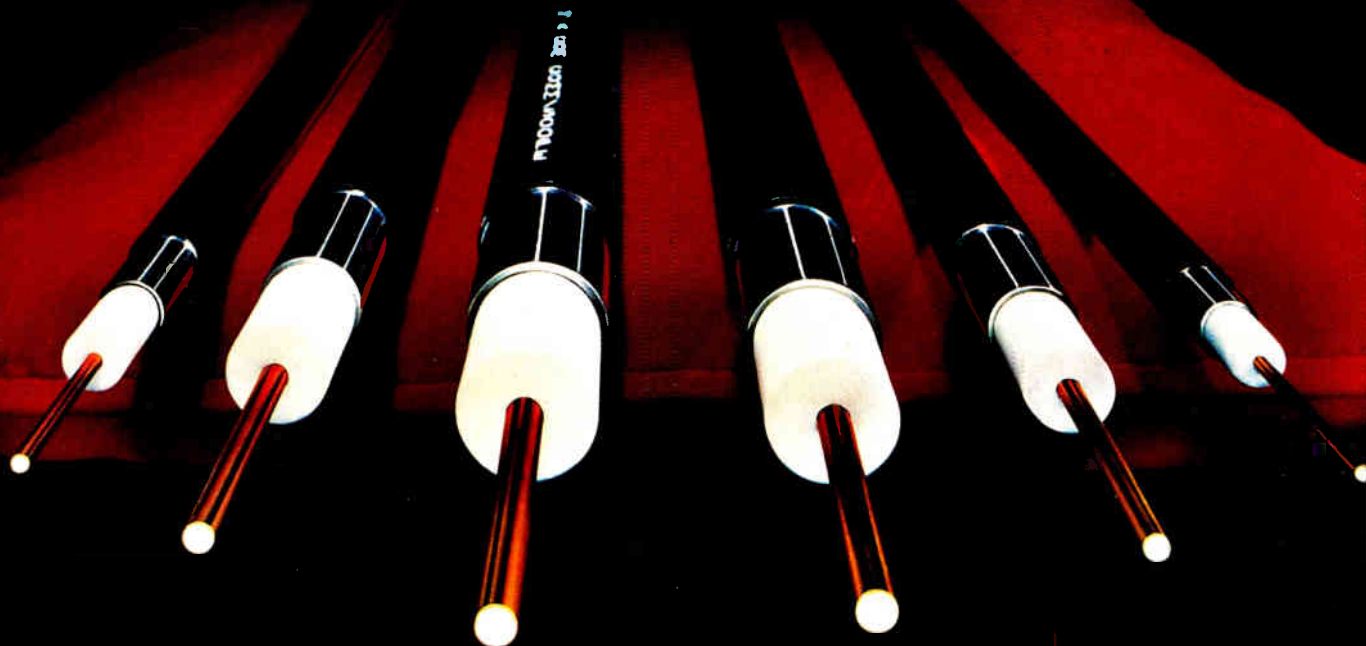
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