MARCH 1987

COMMUNICATIONS ENGINEERING AND DESIGN
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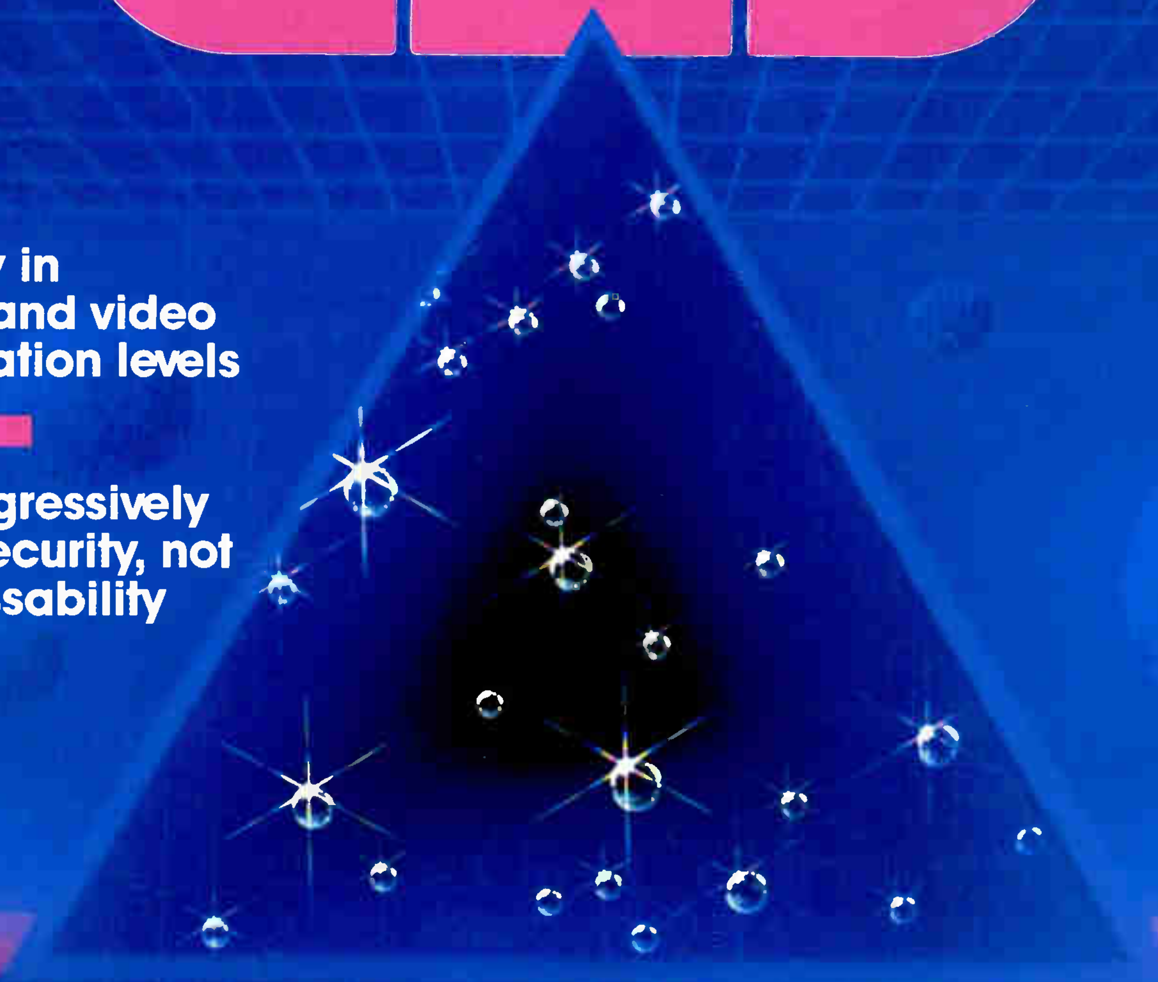
CED



A study in audio and video modulation levels

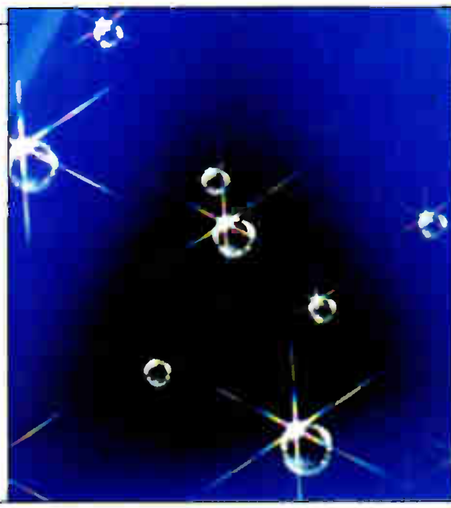
TCI aggressively after security, not addressability

Industry exclusive: NCTA's interconnection guidelines for 1987

CED

March 1987 Volume 13, Number 3

About the issue
This issue of CED *contains the first part of the NCTA's exclusive document on consumer interconnection that's been a year and a half in the making. The official guidelines were written by Engineering Subcommittee Chairman David Large. Cover provided by Japan Creates/The Stock Solution.*



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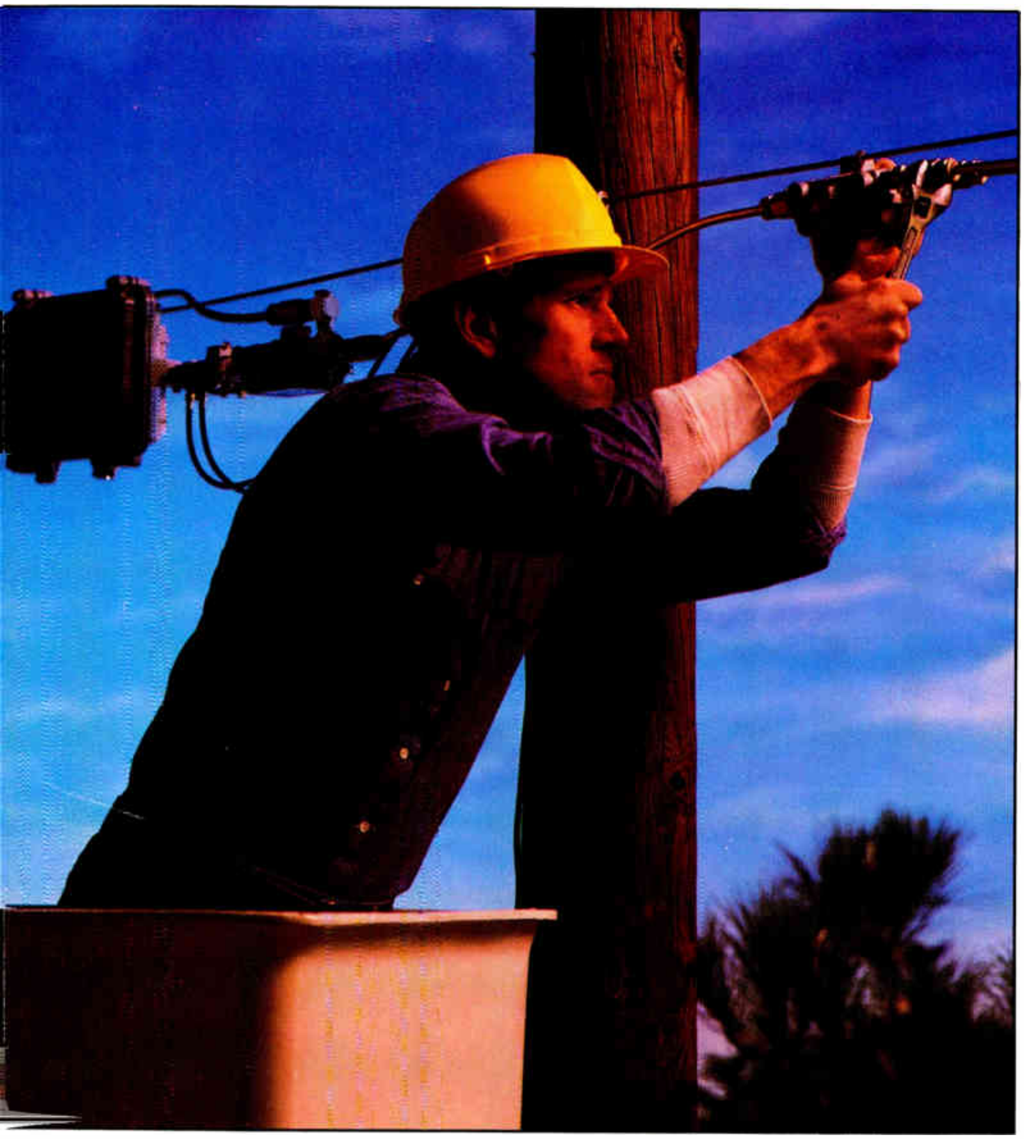
HOW TO AVOID SPLITTING HEADACHES.



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spotlight

David Large

Large calls for enhanced technical mandate by cable

If Dave Large had his way, the engineering and technical side of the cable industry would carry a much larger mandate—one that would help ensure the longevity of the industry.

"We, as an industry, do damn little technical work—and that's scary," says Large, vice president of engineering at Gillcable, operator of the 120,000-subscriber system in San Jose. Large acknowledges that cable has the NCTA Engineering Committee, a body of 50-plus people from all over the industry who come together every other month, to study problems. But what cable needs, Large says, is a full-time centralized engineering force that looks at and addresses future challenges.

The engineering committee often has no time to do any pure research, Large says, because engineers are increasingly strapped for time and, with bottom-line considerations gaining more importance daily, precious few resources. "We've forced ourselves (to look only at) the short-term" and that's going to become a major problem, he says.

Large is one of the rare breed who spent his first years out of school on the product design side of the fence. After graduating from Cal Tech in 1963 with a bachelor's degree in engineering, he became a project engineer for Eimac Division of Varian Associates. Microwave design products and authority over a telemetry transmitter for a manned moon mission fell into his bailiwick.

From there it was over to Kruse Electronics Division of Systron Donner, where he designed microwave test instruments. In 1973 he went to Avantek and designed cable test equipment. Because of the company's close association with Gill, Large came to the attention of Bob Cowart, Gill's then-VP of engineering, and in 1978 became Cowart's engineering manager.

Cowart's "soft" management style and the switch to an operations company "shocked" Large. "It took me a month to realize *I* was supposed to figure out what I was supposed to do," jokes Large. But he also believes people with product backgrounds bring a healthy, fresh approach to the operations side. "Some of the people I admire most have been on both sides. I think they bring a different perspective to the cable industry."

The best part of being an operator is the reduced intensity, says Large. When a product company fails to produce new products, it goes out of business. A cable system, however, still has money coming in every month and mistakes are evidenced only by fewer subs connecting. "I only see the first derivative changes when I do something dumb," he says. And changes can be made over time and their effects studied before fully implemented, Large notes.

Although Large has the added burden of day-to-day operational functions to consider and supervise because he is not part of an MSO, he's in the unique and enviable situation of being able to call his own shots. When Allen Gilliland first founded the system, Large says, he said the system would always strive to be the industry's best. With people like Cowart and Large in charge technically, Gillcable has been up to the task.

Large is a driving force on the NCTA Engineering Committee, having recently completed a lengthy document on consumer interconnect issues. He also authored a study that examines the effects of mandatory A/B switch usage and the leakage problems the rule would cause.

As if he doesn't sound busy enough already, that's only half the picture. Although he professes immunity from the esoteric pursuits many Cal Tech graduates have made famous, Large simply cannot avoid tinkering. His interests in classical music and ham radio operation are cases in point.

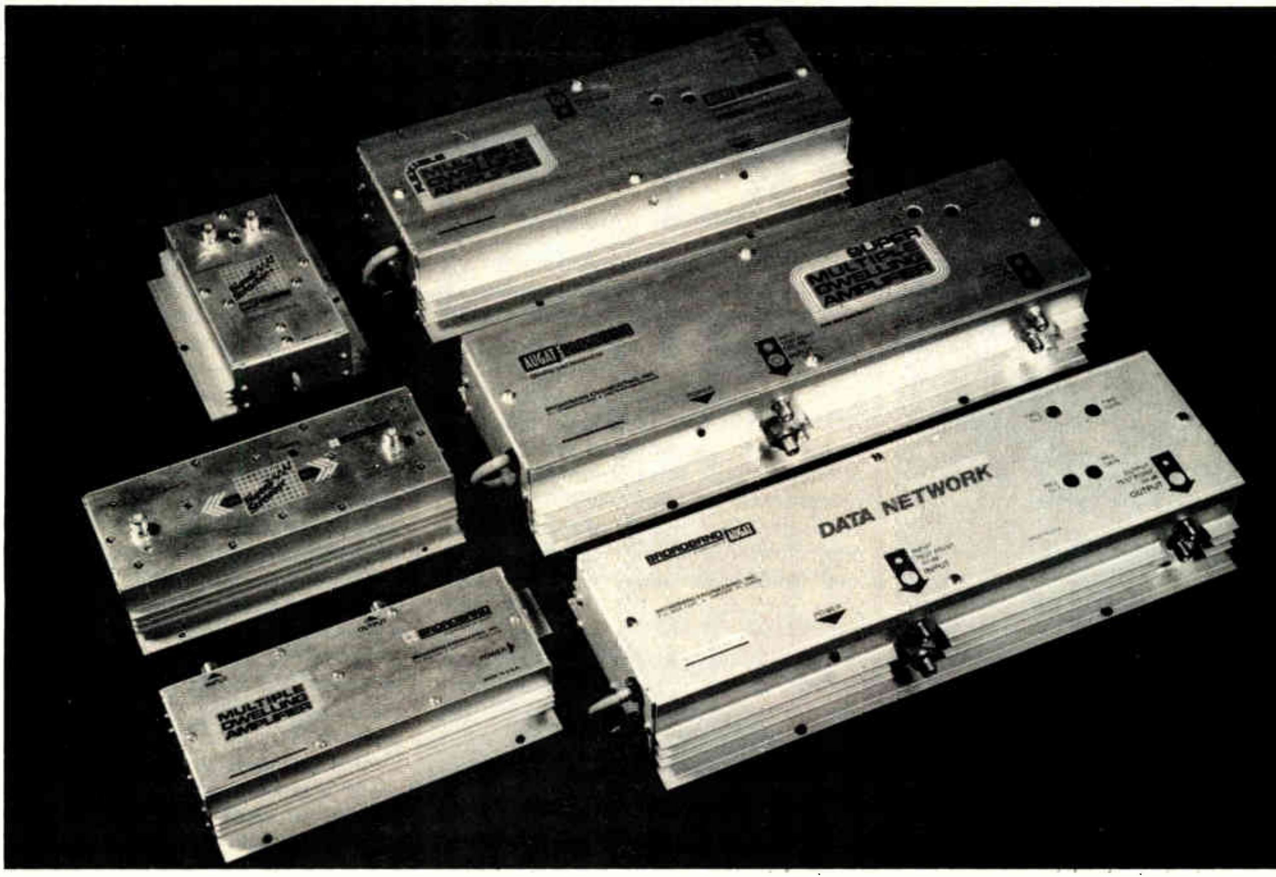
Self-described as "a person who cannot resist building things," but admitting that the projects are often "bigger than I can get done," Large has spent vast amounts of time and money building a radio receiver and electronic organ. "I had to build the world's best (ham radio) receiver and after years and years, I never had a receiver that was done, therefore didn't do much operating. I got into building a classical electronic organ and I put six years and $6,000 worth of parts into it. I always had a wonderful project but never had a musical instrument."

Also listed among his hobbies is his house, which after 10 years still isn't done, either. "It's hardly what one would've picked for a first wood project, which was essentially what it was," says Large. "But you learn very quickly it's quite possible to do everything" like the plumbing, electrical and concrete work. After 10 years, one would think his wife, two kids, two horses, two birds, eight cats, one dog and assorted fish would be tired of all the construction activity.

Considering that both Large and the cable industry are in a constant state of flux, it's difficult to say what the future holds—for both parties. Large says consumer interfacing and various legal issues threaten cable in the short-term, while Ku-band direct-to-home transmission will be the one to beat in the long-term.

After changing jobs every five years after college, Large has seemingly grown roots at Gill. But he's by no means bored there; there's still work to do with stereo, PPV and system testing. "There's never been a lack of challenges out there and I assume there will continue not to be," says Large. But if the industry doesn't heed his warnings, it might be a rocky road.

—Roger Brown



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return path

Disagreeing with Colquitt

Re: "HRC, feedforward or both?" December 1986, January 1987) *CED*.

One of Colquitt's conclusions is:

> "Using HRC channel assignments in a feed-forward distribution system is redundant; there is no need to mask triple beats that have already been reduced to acceptable levels."

I disagree. System designers usually allocate overall allowable system noise and distortion so most of the allowable distortion (intermodulation (IM) and crossmodulation (XM)) is allocated to the bridger and line-extender (LEX) amplifiers. A variety of techniques—single or in combination—can be used to bring trunk distortion down to negligible levels while still maintaining acceptable signal/noise performance. Use of feedforward amplifiers (FF) is one technique. Reducing amplifier cascades is another. Cascades can be reduced by use of lower-loss cables or extensive supertrunking. A trunk which achieves the low distortion and noise levels usually required would not need additional transmission "edge", but a low-distortion trunk is usually connected to a feeder system which operates at the highest possible level which will still meet overall distortion objectives. These feeders (bridger followed by several LEXs) generate virtually all of the distortion allowed for the headend to subscriber path. High feeder signal level pays off in significantly reduced plant costs. A system designer will therefore seek to push feeder levels as high as possible and will balance the cost of available transmission improvement techniques against the benefits. The techniques available include:

- output tilt
- coherent channeling (HRC or IRC)
- video synchronization
- low-loss cables
- enhanced-performance amplifiers
  - feedforward
  - power-doubling
  - quad-power

Suppose we design for an acceptably low distortion level at a particular output level with a particular combination of amplifiers, output tilt, and feeder cables. Distortion would presumably be just below the perceptible level allowing some head-room for the various factors that cause actual system performance to vary from calculated performance. Why use coherent channeling? Because it allows an increase in feeder level without a perceptible increase in picture degradation. For HRC this increase in feeder output level will usually be 2 to 3 dB. This increase in feeder output level is worth a lot of money in terms of reduced feeder cost. It can mean a smaller cable size and/or higher value taps, etc. Unless coherent channeling creates other problems why not use it? It costs very little.

A one-time investment of about $500 per channel at the headend produces this transmission benefit throughout the entire system. The trunk benefits (it could be raised in level to produce even better system S/N)/ The feeder system benefits. Even the subscriber's converter benefits. System designers often overlook the converter as a contributor of noise and distortion. A "high channel count" cable system needs everything going for it that system economics justify. Coherent channeling (HRC or IRC) is just about the cheapest way there is to improve system performance.

I have used the generic term "coherent channeling" with reference to HRC (Harmonically Related Carriers) and IRC (Incrementally Related Carriers). Ordinary TV picture carriers in a cable-TV system are "incoherent", i.e. they have no fixed phase relationship. The carriers are generated from a combination of individual crystal oscillators. A typical headend modulator has a 45.75 MHz crystal to generate the IF picture carrier and another crystal to generate the up-conversion local oscillator. A typical headend heterodyne processor has two individual, independent local oscillators for up and down conversions. The original transmitter crystal oscillator(s) also contribute to the output frequency characteristics of the heterodyne processor. The combined multichannel output is composed principally (ignoring the low-level sound carriers and FM radio carriers) of TV picture carriers that have random phase relationships.

There are two aspects to understanding how HRC works to benefit multichannel transmission. The first is the "masking" effect. In an HRC system all picture carriers are integer multiples of a master 6.000 MHz oscillator:

HRC-2 is not just 54.000 MHz—it is the 9th harmonic of the headend master 6 MHz oscillator. If the master oscillator happens to be 6.000001 MHz, HRC-2 will be 54.000009 MHz. HRC channels can be offset as a group (although not individually) by adjusting the master oscillator. The FCC has recommended a particular master oscillator offset for HRC systems that results in an offset of about 12.5 KHz in the VHF aeronautical band, placing the picture carriers in this part of the cable spectrum half-way between the 25 KHz spaced aeronautical channels (at the band edges of the aeronautical channels). Since HRC picture carrier accuracy and stability depends entirely on the master oscillator it is easy to control the accuracy and stability of all picture carriers by careful selection and maintenance of the master oscillator (and its backup oscillator).

In an HRC system all intermodulation products of every order (2nd order, 3rd order and higher) fall zero beat with all picture carriers. This effect is independent of the master oscillator. The master oscillator can drift and this "zero beat" condition is always maintained (so long as the headend modulators and processors retain lock to the reference comb). Since all intermodulation products are "zero-beat" their visibility is considerably reduced. We can accept a higher level of intermodulation in an HRC system than in a non-coherent system. It is instructive to remove a picture carrier in the middle of a multi-channel line up and observe the underlying beat with a spectrum analyzer. The relative intermod' level would be quite destructive if it was not "zero beat." The

Correction

In our rush to bring *CED* readers David Large's article on A/B switches, (February 1987) the formulas were not printed correctly. We wish to apologize both to Mr. Large and to *CED* readers for the errors.

Anyone wishing a copy of the formulas that should have appeared should contact David Large directly at 234 E. Gish Road, San Jose, Calif. 95112.

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Reader Service Number 7

intermod' level would be quite destructive if it was not "zero beat." The underlying intermod' products become visible as a form of crossmodulation when the level of intermodulated modulation sidebands become high enough to interfere with the "desired" modulation sidebands. Remember that intermodulation "arithmetic" can be extended to include modulation sidebands. The effect is that with HRC we can "push" amplifier output higher by 2 to 3 dB for the same visual impairment as with non-coherent carriers.

There is a second aspect of coherent carrier operation, particularly HRC, that actually reduces distortion, not just masking it. A HRC system is a set of harmonics of a "fundamental" (6.000 MHz) frequency. If we consider the amplitude and phase of these harmonics we have the "Fourier Series analysis" of a repetitive waveform whose fundamental frequency is 6 MHz (the HRC master oscillator). This 6 MHz repetitive waveform can indeed be observed with a suitable oscilloscope. I have published photographs of such wavforms as observed on a 500 MHz oscilloscope.

This waveform has an RMS value which is the sum of the RMS values of the individual carriers. The peak-to-peak voltage and the actual "shape" of the waveform depends on the phase relationship between the component carriers. In a non-coherent system the phase relationship cannot be predicted or controlled (although some conclusions can be drawn about the "time-statistics" of p-p voltage) so the composite waveform can frequently experience rather high p-p voltages. Higher p-p voltages mean that the amplifier transistors operate further out toward the non-linear portion of the input/output transfer curve, generating more distortion than if p-p composite (or "sum") voltage can be controlled to lower levels. Coherent carriers have a phase relationship which can be controlled (and adjusted if desired) at the headend and which will change very little in transmission through a broadband cable system. Ideally, distortion effects in a broadband amplifier would increase in a 10 Log N manner (where N is the number of channels). In a non-coherent system the channel loading effect is closer to 20 Log N because

An IRC headend is an HRC headend that has been shifted upward by 1.25 MHz.

high p-p voltage peaks can occur. HRC assures low p-p voltages and keeps channel loading effects closer to the ideal 10 Log N.

I have tried to calculate the phase relationships which minimize p-p voltage. I have had very competent professional mathematicians study the problem of "optimum HRC phase." They conclude that the problem is intractable, i.e. not solvable by ordinary mathematical analysis. We have used computer simulation to study phase relationships in HRC systems and learn something about its effects. The phase relationships for minimum or near-minimum p-p voltage are not critical. The phase relationships for maximum p-p are quite critical. I have deliberately adjusted an HRC headend for "worst case" (highest p-p voltage) to demonstrate the condition and then adjusted it away from worst case by replacing the jumpers to the combining networks. Phase adjustments in HRC headends are made most easily by adjusting the relative lengths of the jumpers from the processor/modulator output to the combining network. HRC systems do more than mask distortion—they actually reduce it!

An IRC headend is an HRC headend that has been shifted upward by 1.25 MHz so that all picture carrier frequencies (except channels 5 and 6) are at nominal "FCC frequencies." The picture carriers are no longer harmonics of the master oscillator but they are all spaced by the master oscillator frequency. This means that most third-order intermod' products will fall zero beat. All third order products with "alternating sign" will fall zero beat. F1 + F2 + F3 and F1-F2-F3 will not fall zero beat but F1 ± F2 ± F3 (if signs alternate) and 2F1 ± F2 will fall zero beat. This provides a worthwhile masking effect but the distortion reduction effect is not as effective as with HRC. The "harmonic numbers" in an HRC system are relatively low (N = 90 for 540 MHz) whereas the harmonic numbers in an IRC system are much higher because an IRC system is effectively based on a 250 KHz master oscillator. If the 1.25 MHz shift from the HRC is introduced by a coherent local oscillator there will be a harmonic relationship to a 250 KHz reference. If the local oscillator is incoherent there will be no harmonic relationship. The very high "harmonic" numbers in an IRC system minimize the distortion reduction effect although most of the masking effect is retained. IRC can often be used when HRC cannot (for reasons discussed further in this letter). It is relatively cheap to implement and should be used much more often than it is. Why not get the benefits when IRC has so few disadvantages and costs so little?

I'll deal with the system problems that Mr. Colquitt raises. An HRC channel cannot be phase-locked to a local VHF channel. Phase-locking will often salvage or at least improve the utility of a "local channel." Very few

An IRC system can be locked to as many as three local VHF-TV transmitters.

cable systems of any economic significance operate 12 channel "basic" services to be received by "non-cable-ready" 12 channel TV sets. Economically important cable systems offer more-than-12 channel services to be received by a well-shielded converter or a well-shielded cable-ready TV set or VCR. In larger systems it is almost impossible to maintain the degree of system sheilding integrity required to effectively use "local channels" whether we use HRC channeling or not. We write off these channels anyway. Most cable-ready's will tune HRC although Mr. Colquitt correctly points out that there might be some problems when sets are changed back and forth between HRC cable and off-air reception. These problems must be weighed against the substantial, very low cost, transmission advantage that HRC offers.

Incidentally, many 12 channel TV sets will tune HRC. They have enough fine tuning range to reach the 1.235 MHz over to the HRC channel. My first HRC system (1972) served about 10,000 12-channel TV sets. All but about 300 of them tuned HRC channels very nicely. I will admit that these 300 subscribers were enough problem to cause us to switch back to conventional channeling and I have since recommended HRC only for systems that were predominantly converter or cable-ready equipped.

I believe that Mr. Colquitt gives HRC a "bum rap."

I. Switzer
Cable Television Engineering

Thanks and kudos

Dear Editor:

I wish to thank you and the nominations committee for the honor of being named your magazine's "Man of the Year." 1986 has certainly been a banner year for SCTE and I hope everyone realizes that it could not have been accomplished single-handedly. The guidance of the Society's board of directors and committees created by the board, plus the leadership of Andy Devereaux, Sally Kinsman, John Kurpinski, Bob Luff and Tom Polis who comprise the Executive Committee, have been invaluable in implementing SCTE programs.

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Reader Service Number 11

Setting and maintaining modulation levels...

...are two problems facing the user of television modulators.

We deal here with two related problems faced by the user of television modulators: the problem of initially setting modulation and the problem of maintaining it over a long period of time. Actually, we have four problems here, because the same problems exist for both audio and video. Failure to maintain correct video modulation may result in loss of sync, a washed out picture, and weak color in the case of undermodulation. Overmodulation can result in poor detector, amplifier, and kinescope linearity, causing problems with the intensity and tint of picture highlights, and can cause excessive sync buzz in the audio channel. Undermodulation in the audio channel results in weak audio and poor signal-to-noise ratio. Overmodulation of the audio can result in distortion. Any errors in setting modulation levels are particularly annoying when changing from one channel to another. Signal processors will generally not alter the modulation level of off-air stations, though frequency response errors will cause an apparent change in video modulation depth at higher video frequencies.

Let's first consider the problem of setting (i.e., measuring) the video modulation level, then we can consider the problem of maintaining it. After that, we will do the same for the audio level.

Measurement of video modulation

Video is transmitted by being amplitude modulated onto an RF carrier. After modulation, one sideband is partially eliminated in order to conserve spectrum. The modulation format is such that sync tips correspond to the maximum carrier. Because of this arrangement, we refer to the depth of video modulation, defined as the percentage of the total amplitude change of the carrier, as the signal progresses from sync tip to white. Standard video modulation requires that 87½ percent of the total range of the carrier envelope, from full carrier to no carrier, contain the signal. That is, during sync tips, the carrier is at maximum amplitude, and when a white portion of the scene is encountered, the carrier amplitude is reduced to 100 - 87½ percent = 12 percent of the maximum.

The simplest (and least accurate) method of determining video depth of modulation, is to display the modulator output on a TV set, and adjust the modulation control until the picture looks good. Comparison with an off-the-air signal helps provide a reference. Unfortunately, this method is very subjective and will not yield very accurate results. It should only be used in an emergency, when no other method is available.

A second method of measuring depth of modulation is to connect a high frequency oscilloscope to the modulated IF signal and view the RF envelope directly. Under certain conditions, this yields a reasonably accurate measurement, but several circumstances can lead to wrong conclusions. For example, if the spectrum of the IF signal being examined has been passed through a vestigial sideband filter to eliminate part of one sideband, then high frequency information (primarily color information) will not be shown at the correct amplitude. This can be overcome by examining the signal before the vestigial sideband filter at the modulator, or after the Nyquist slope filter in the demodulator. Unfortunately, if harmonics of the IF signal are present at the point of measurement, these can render the oscilloscope display meaningless. Another drawback to the IF monitor approach is that the display presented is relatively difficult to interpret, especially for a color signal. Also, this requires a rather expensive oscilloscope to obtain the required 50 MHz flat response.

The method of measuring video depth of modulation most often found in CATV practice, is the use of a modulation meter. This is a meter that measures the peak-to-peak amplitude of a video signal, and expresses the result as depth of modulation. The video signal may be obtained prior to being applied to the modulation circuit, or it may be obtained by demodulating a sample of the modulator output. Although more expensive, the latter approach is preferred because accuracy will not be affected by variations in modulation sensitivity. Also, by demodulating the signal for metering purposes, a failure in the modulation circuit would be readily seen.

A modulation meter is reasonably good for routine checks, but it has several drawbacks that limit its usefulness. For example, the frequency response of the metering circuit may not be flat over the entire range of video spectrum. The meter depends upon the operation of a peak detector which must accurately detect very short peaks, and must hold that peak over at least one field of the picture. A fairly complex (and expensive) circuit is required to do this. Another drawback of using a meter to measure video modulation is that some types of distortion which may accompany the modulation process are masked. These include sync

James O. Farmer,
Scientific-Atlanta Inc.

Cable Classics

Is there a cable engineer anywhere who hasn't at some time been frustrated by the difficulties of setting and maintaining video and audio modulation levels? Are you familiar with the application of a zero-chopper to provide a video modulation depth reference? Do you know what factors are involved in maintaining a fixed peak modulation depth? Do you include chroma peaks? How do you maintain required audio deviation when audio is inherently so variable in amplitude?

These are the kinds of questions addressed by Jim Farmer's 1977 article "Setting and Maintaining Modulation Levels."

Engineers struggling to set and maintain BTSC stereo modulation levels will relate to Jim's final comment, "No amount of electronic wizardry will replace a sharp technical person, who knows what techniques to apply where."

Graham S. Stubbs,
Consulting Engineer

The most satisfactory method of measuring video modulation depth is through use of a demodulator having a zero chopper.

compression and incorrect operation of the peak white clipper.

The most satisfactory method of measuring video modulation depth is through use of a demodulator having a zero chopper. The zero chopper periodically switches off the picture carrier to simulate 100 percent modulation. This level and the sync tip level, representing 0 percent modulation, provide the scaling required to measure depth of modulation. By setting the sync tips on the 0 percent line of a figure and the chop pulse on the 100 percent line, the actual depth of modulation can be read directly from the scale. If such a graticule is not available, a regular oscilloscope may be used. If the sync pulse and the zero chop pulse are set eight units apart, then each unit will represent a modulation depth of 12½ percent. Normal modulation depth will then be represented by seven divisions.

By measuring depth of modulation with a demodulator, other modulation faults, such as sync compression and improper operation of the peak white clipper, are apparent. Of course, the demodulator is also available to make many other measurements of modulator performance, as well as of off-air signals.

To avoid the necessity of purchasing input converters for each channel to be monitored, the demodulator may be configured to accept an IF signal. The modulator IF output, taken just before the output converter, may be used for demodulator input.

Unfortunately, the zero chopper may itself exhibit errors in measuring depth of modulation. These errors are related to the non-ideal transfer function of the detector diode in an envelope detector. Designers have used several techniques to overcome this problem, including operating the diode at very high signal level, switching a calibrating signal to the video amplifier during a chop, and biasing the detector diode. Detector problems may be overcome completely by using a synchronous detector. Here the injected carrier is used to overcome problems with the diode response. If an envelope detector demodulator is used for measuring modulation, then its response should be first calibrated using an alternate measurement.

While we are on the subject of measuring depth of modulation, one more question merits attention. This is the question of whether the normal 87½ percent modulation depth should or should not include the color subcarrier. Often this is a moot point because most objects of high luminance have relatively little color saturation, resulting in little color subcarrier at the white level.

However, exceptions do exist and must be dealt with. The author is familiar with one such exception. We call it the Big Bird Syndrome, named after the bright yellow character of

THE LITTLE FARMER & THE GIANTS

A MODERN CABLE FABLE

Once upon a time, in a not-so-far-off land, the grain the people used to make their daily bread was grown by four huge giants–and one small independent farmer. For years, all five grain producers co-existed peacefully, in an atmosphere of healthy competition.

But then one day, the four giants entered into a battle for control of the grain market. When the battle ended and the dust cleared, only two giants were left. And, of course, the little independent farmer.

Then a strange thing happened. Overnight, the competitive situation changed. And the people began to worry. "Now that there are only two giants," one person said, "what's to stop them from charging higher prices for their grain?" "If they do, we won't be able to make as much bread as before," cried another.

But the little farmer overheard the people talking. And he cleared his throat and took a step forward. "My friends," he said, "you're forgetting about me." "You," snorted a man at the front of the crowd, "what can you

do against such giants?" "I can do just what I've always done," the farmer replied, "supply the finest grain and the best service in the land–at a very competitive price. As long as I'm around the giants can't take complete control of the grain industry–if you'll all think of me and include me in your business."

There was a general chorus of "that's right," "we didn't think about the little farmer." And so, after the farmer pledged to maintain his independence and to remain in the land for many years to come, the people went back to baking their bread, greatly relieved. And they all lived happily, and competitively, ever after.

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The moral of this tale is that variety & competition in almost every industry are good for the consumer. Like the farmer, we at Capscan, the only full service, independent coaxial cable company remaining in the U.S.–promise to maintain our autonomy. And to continue providing the best quality products and service in the business. We invite you to call us for a competitive bid on your next project.

Reader Service Number 14

Having discussed the measurement of modulation depth, we turn now to the problem of maintaining that modulation.

Sesame Street fame. A case developed where trouble was observed in a broadcast transmitter, but only when Big Bird was on the set. The problem was finally traced to a video processing amplifier which clipped the peaks of Big Bird's chroma signal, generating second harmonics that were not filtered by the vestigial sideband filter. These second harmonics caused adjacent channel interference.

Broadcast engineers don't seem to be in agreement about whether or not to limit chroma peaks to 87½ percent modulation depth. The author's feeling is that modulation should be limited to 87½ percent including chroma. This minimizes TV set differential gain and phase problems, and avoids having chroma amplitude reduced, with a corresponding drop in luminance level, by the modulator peak white clipper.

Maintenance of video modulation

Having discussed the measurement of modulation depth, we turn now to the problem of maintaining that modulation. If the amplitude of the incoming video signal remains fixed, and if the modulator is stable, then no problem exists. However, video levels may vary from time to time. The broadcast industry has developed several techniques for dealing with this problem, which find application under different circumstances. If the problem is one of maintaining constant output from one or more cameras in the studio, then it is desired to monitor both the black and white signal levels, forcing them to be consistent. This may be done with a video clamp to maintain a constant black level, and means to vary the white level. White level adjustment might be accomplished at the camera by varying the iris, or might be done electronically by varying video gain. Of course, the above signal must not include sync, and the sync must be added in after adjustment. This technique is best left as a studio tool, because it is inappropriate for some programs. For example, if automatic level correction was used on a night scene, the circuitry would attempt to make it a day scene.

If it can be assumed that at some point the ratio of video to sync has been properly established, and that this ratio has not been altered by subsequent video processing, then another technique can be used. The sync pulse amplitude is examined, and the amplitude of the composite video signal is adjusted to maintain proper sync amplitude. This will assure that the video modulation depth remains as intended, regardless of the maximum or minimum luminance level in a particular scene. This technique is sometimes

Several requirements are placed on the meter used to measure audio deviation.

used at a modulator following a microwave link used to import a distant signal. Should the video amplitude provided at the output of the microwave receiver vary, consistent modulation depth could be restored. Another application might be in normalizing the output level from different video tape players, or from one tape to another. In this case, one must assure that the tape player does not regenerate sync pulses.

A third method of control being used at some broadcast installations involves tagging the program with a reference signal at the point of origination. This vertical interval reference signal (VIRS) is theoretically transmitted through the entire transmission path, receiving the same alterations as the video signal. It may then be used to control several parameters of the transmitting equipment, including depth of modulation. While theoretically an excellent (though relatively costly) technique, the author has been told that it doesn't yet live up to its promise because the video amplitude is not always established correctly at the point of origin, and because some points in the transmission path may inadvertently strip off incoming VIRS and retransmit a second VIRS not necessarily related to the first.

Measurement of audio deviation

Let us now turn from the problems of measuring and controlling video modulation to the like problems in the audio channel. Again, the problem is one of holding as close as possible to an established standard, in our case the FM deviation of 25 kHz, which should not be exceeded at any frequency.

If this deviation is exceeded, the signal will sound excessively loud and distorted. In addition, excess deviation can cause the sound carrier to rise out of the video path sound trap in the receiver. This in turn can cause the generation of 920 kHz beats in the picture, which will appear with every excess modulation peak. Underdeviation of the audio subcarrier will result in weak audio and a poorer audio signal-to-noise ratio. Several requirements are placed on the meter used to measure audio deviation. Obviously, the first requirement is that the meter must have good static accuracy: i.e., when a single tone is applied to the modulator input, and the modulator is adjusted for an indication of 25 kHz deviation, then the carrier must actually be deviated 25 kHz. This can be established by measuring the sound subcarrier with a calibrated deviation meter. An alternate technique makes use of a spectrum analyzer. The modulator is supplied with a tone of known frequency, and the deviation control adjusted until the spectrum analyzer indicates that the carrier amplitude has dropped to zero. The lowest devia-

Considerable effort has been expended toward the goal of measuring audio signal level.

tion at which this happens is that for which the modulation index (ratio of peak deviation to modulating frequency) is 2.4.[1] Since the modulating frequency is known, the deviation may be calculated.

As in the case of video metering, the signal for deviation metering may be taken either before the modulation process, or may be obtained by demodulating the audio subcarrier. The latter technique would be preferred, as variations in modulation sensitivity will not affect accuracy. In either case, though, the signal used for metering the audio should receive the same pre-emphasis that the signal supplied to the modulated stage receives. Failure to do so will result in loss of accuracy if the highest amplitude signal component has a frequency greater than about 2 kHz. (With the 75μs pre-emphasis time constant used in North America, the signal gain is raised by 3 dB at 2.122 kHz, and is raised by about 17 dB at 15 kHz.)

To this point, we have concerned ourselves only with the static properties of the audio deviation measurement. However, the dynamic properties of the meter are quite important. Considerable effort has been expended toward the goal of measuring audio signal level in a manner such that all audio sources that measure the same, will sound equally loud to the listener. The conventional VU meter widely used today, is one such attempt. However, it falls short of this goal.[2] Also, in measuring the deviation of the audio modulator, our goal is not just to meter sound for consistent loudness, but to achieve the maximum possible deviation without exceeding 25 kHz. This requires a meter whose dynamics are such that the peak level will be displayed.

Since this peak level will exist for only a short time, an impractically fast response time is required from the meter. This means that the meter must be driven from an electronic circuit that compensates for the necessarily slow response of the meter movement. The required circuit rectifies the audio waveform and holds the peak value long enough to permit the meter movement to rise to indicate the correct value. This gives rise to a meter movement whose characteristics differ considerably from those of a conventional VU meter. Upon application of modulation, the meter begins moving toward the appropriate indication. When the modulation amplitude begins dropping, the meter will follow, but with a sluggish response. A peak reading meter has been adopted as standard in the European Broadcast Union. Schmid in the United States has compared its performance to that of a VU meter.[3] He has found it to permit much more accurate modulation monitoring.

One additional requirement placed on the dynamics of the audio modulation meter is that the overshoot exhibited be low. That is, when the meter reaches the final reading, it should stop quickly. All meter movements will exhibit some overshoot, but the amount should be minimized by proper meter selection and by proper matching to the electronic driver.

The above dynamic properties may be explored on a given modulator by supplying the output of an audio signal generator (usually set to 400 Hz) to the audio input on the modulator, with a telegraph key in series. The key may be one of a number of hand keys used by amateur radio operators for code transmission. When the audio is chopped into a series of short bursts ("dits"), the meter should read the same as when the key is held down. If the key is suddenly depressed and held for a few seconds, the overshoot exhibited by the meter may be studied.

A somewhat more complex test was performed on several modulators sold to the CATV industry, and also on a distortion analyzer whose meter dynamics agreed with the standard VU characteristic. All modulator inputs were connected in parallel. An oscilloscope and the distortion analyzer were supplied audio through a pre-emphasis

Audio processing generally falls into one of three classifications: compression, modulation limiting, and clipping.

network. Tapes used were recorded from commercial radio broadcasts in Atlanta, and were spliced into endless loops so that the same segment could be studied on each indicator. First, a 400 Hz tone from an audio oscillator was supplied to all indicators, and levels were adjusted so that all modulators indicated 25 kHz deviation, the distortion analyzer indicated 0 dBm, and a reference trace was established on the oscilloscope.

The output of the tape recorder was then substituted for the oscillator. Only the recorder output level was adjusted in the tests below, so all indicators received the same peak signal. For every test tape, the recorder output was adjusted for the same peak output, as indicated on the oscilloscope. On subsequent passes of the tape, each modulator meter and the distortion analyzer (with VU meter characteristics), were checked to see what deviations were indicated. The results are tabulated in Table 1. Errors in deviation have been translated to decibels.

Maintenance of audio deviation

We come now to the final topic to be discussed in this paper: techniques used to maintain the maximum permissible deviation without exceeding 25 kHz. If the object is to maintain the highest possible deviation, then automatic modulation adjusting equipment must take into account the pre-emphasis of the modulator. When we see audio processing equipment designed for FM, this is usually the reason: The equipment first pre-emphasizes the signal, processes it, then de-emphasizes. Thus, the signal is processed with the same pre-emphasis that it will receive at the modulator.

A precaution which must be observed when using audio processing equipment that is separate from the modulator, is the introduction of group delay between the processor and modulator. Group delay can shift the relative phase of different frequency components of a complex waveform, so that the peak amplitude of the signal could be changed after processing. This is of concern primarily to the stereophonic FM broadcaster who employs a 19 kHz trap in the input to the stereo exciter. However, it is mentioned here as a precaution should a selective filter ever be necessary between an audio processor and a modulator.

Having taken the above detour, we return to the question of audio processing to maintain maximum legal deviation. Audio processing generally falls into one of three classifications: compression, modulation limiting, and clipping. Within each of the first two categories, we can talk about several variations. These techniques and variations appear to comprise the various audio processing approaches available. Compression is the term generally applied to the reduction of the entire dynamic range of the program material, i.e., "riding the gain" automatically. The object is to maintain either a reduced dynamic range, or no dynamic range, in the output level. This technique is quite proper and popular for processing speech, where it can reduce such problems as level changes when a speaker turns away from a microphone, or when a new speaker begins talking. Compression is also used with rock music and other music formats in which dynamics are not a part of the art. However, use extreme caution in applying compression with classical music, in which dynamics are very important. It is something to behold the wrath of a classical musician whose work has had dynamics eliminated by over-zealous application of compression! Compression is generally specified by a ratio of N:1, meaning that N dB of input level change will result in 1 dB of output level change. A compression ratio of 2:1 would represent fairly small "meddling" with the dynamic range, while 10:1 would be a fair amount of compression.

Other criteria appropos to compression include attack and release times, and a related decision of whe-

TABLE 1

Meter Response to Various Tests

Test	Modulator A	Modulator B	Modulator C	Modulator D	VU Meter
1	-2.8	-7.5	0	0	-7
2	-1.9	-5.7	+0.7	0	-6
3	-1.9	-5.7	0	-0.2	-4
4	-0.7	-7.0	0	0	-5
5	-1.5	-5.0	+1.3	0	-4
6	+1.9	-18.0	-6.4	-1.1	

The material on each tape is briefly described as follows:

Test 1—Male voice PSA, easy listening style.
Test 2—Heavy, explosive sound effects (from movie advertisement)
Test 3—Strong male voice.
Test 4—Male newscaster.
Test 5—Piano solo in higher octaves - fast notes with sustain pedal.
Test 6—Not really a tape, but included for comparison. This is a test of meter frequency response at 15 kHz. The signal was reduced to take into account the pre-emphasis.

If the modulation limiter is overdriven, it acts as a compressor with high compression ratio.

ther the output peak amplitude shall be monitored, or whether output r.m.s. or average level (taken over some time span), is to be maintained. A variation available appears to involve equipment that separates the audio spectrum into two or more bands, compressing them individually.

Modulation limiting is the second technique for audio processing. Unlike a compressor, a modulation limiter does nothing to the audio level until a threshold (25 kHz peak in TV audio) is reached. Above this threshold, the limiter acts as a compressor with a very high (greater than 20:1) compression ratio. Thus, dynamic range is unaffected until a peak attempts to over-deviate the carrier. At this time, the gain is reduced until the modulation returns to a lower level. Modulation limiting is not to be confused with RF limiting, which clips the RF peaks, generating distortion. Modulation limiting is simply an automatic turning down of the gain if the level gets too high. This technique is often used as protection at a transmitter, to prevent overmodulation without introducing distortion. It is safe to use with all program material if applied properly.

If the modulation limiter is overdriven, it acts as a compressor with high compression ratio. This may be desirable in some instances, where a limiter is intentionally overdriven by a modest amount (8 dB seems to be a common figure) during normal programming. This permits minor drops in level, and increases in level, to be compensated, without masking the normal dynamic range of the material.

When using either a compressor or limiter, levels cannot be set arbitrarily: There always exists a maximum level that can be accommodated by circuits prior to the gain adjustment stage. The difference in level between normal operation and the maximum signal that can be handled without distortion, is called the headroom. Headroom is specified for a constant sinusoidal tone, not for complex program material. If the rise in input exceeds the headroom for the particular equipment, then distortion will occur even if the output level does remain constant.

For a copy of the figures that accompany this story, contact Linda Johnson, production editor, CED 600 Grant St., Suite 600, Denver, CO 80203.

[1] Terman, F.E., *Electronic and Radio Engineering*, McGraw-Hill, 4th edition, 1955, p. 589.
[2] Tremaine, Howard M., *Audio Cyclopedia*, 2nd edition, 1969, p. 450.
[3] Schmid, Hans, "Audio Program Level, the VU Meter, and the Peak-Program Meter," *IEEE Transactions on Broadcasting*, Vol. BC-23, No. 1, March 1977, p. 22ff. ■

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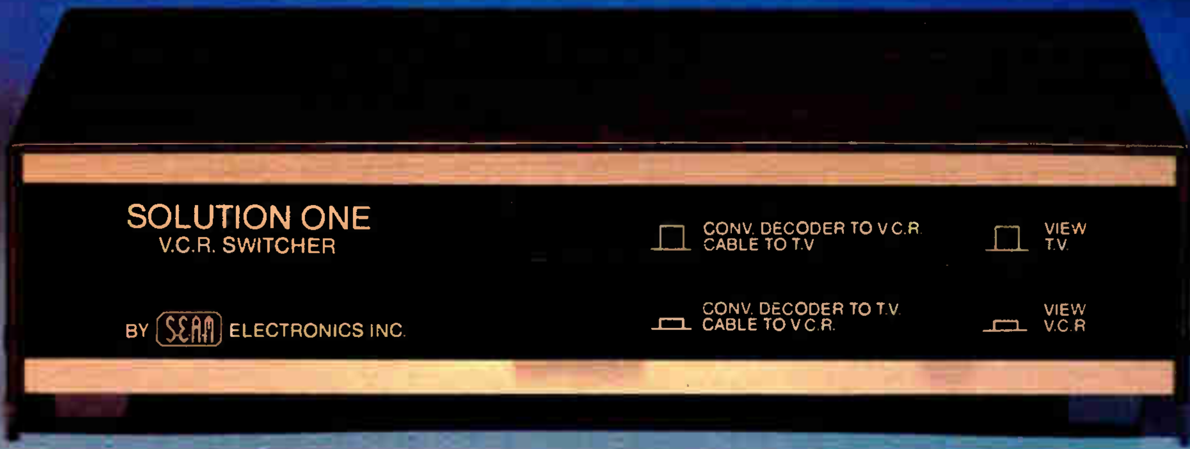

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Connecting Cable Systems to Subscribers' TVs and VCRs — Guidelines For The Cable Television Industry

by the NCTA Engineering Committee's Subcommittee on Consumer Interconnection

Chairman: David Large

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January 1987

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TABLE OF CONTENTS

A complete Table of Contents will appear in the last section of the booklet which will run in the June 1987 issue of *CED*.

Chapter One: Overview and Tutorial

Introduction

In past years, the connection of subscribers to a cable system was a simple matter of a matching transformer and, occasionally, a splitter to feed a second set. The FCC set up straightforward rules governing the technical specifications of the signal at the interface that would assure adequate quality reception. Recently, however, this interface has become very complex with the consumer electronics industry and the cable industry each trying to offer customers new features and solutions to problems caused by last year's new features. Increased tuning ranges, multiple premium service levels, remote controls and stereo sound, for instance, have all added to the interconnection problem.

The most dramatic development in home video equipment has undoubtedly been the video cassette recorder (VCR). To the consumer it offers much more than the capability of playing back pre-recorded tapes. It also offers the capacity for time shifting, recording material at will, simultaneous access to material on different channels, and numerous special effects that can be applied to recorded material, including "zapping" of commercials. Not only the cable industry, but the broadcasters and movie theaters have been drastically affected by its widespread market acceptance.

Of all the new consumer electronics developments, the VCR presents the greatest challenge to the cable television technical community. Most VCR's contain their own tuners, VHF modulators and a means for time-programming to allow unattended recording of a series of events on different channels. Connection to a cable system in such a way as to not lose any of these features is not simple!

This document will discuss problems of consumer equipment interconnection in detail, the technical requirements for a solution, and approaches to solutions using both discrete components and integrated switching systems. It is hoped that cable system operators will find the material useful in training of technical personnel and that manufacturers will find it useful as an aid to specifying designs for new consumer video products.

Scope of the Subcommittee's work

In January of 1985, the NCTA Engineering Committee proposed forming a subcommittee to examine short-term solutions to consumer interconnection issues. This effort was intended to complement the work of various other industry groups which are outlined in Appendix A, submitted by Walt Ciciora who chairs the EIA/NCTA Joint Engineering Committee and who has long been an industry leader in such matters, and by Judson Hofmann who served on the EIA Home Bus Committee. A few of these other groups are:

- The EIA/NCTA Joint Engineering working groups which are attempting to better define the electrical characteristics of the cable/consumer interface as a guide for future designs and operator practices.
- The EIA Decoder Interface Committee which is specifying a "universal" decoder interface jack for television sets and VCR's for use by post-detection descramblers.
- The EIA Home Bus Committee which is studying various communication needs within the home, including control of television equipment.

At its meeting in March, the subcommittee narrowed the scope of its investigation to the issues related to: VCR's, "Cable-Ready" television sets, Second sets in a single household, RF switching equipment, and Set-top descramblers.

Issues which were not considered, at least at this time, were two-way systems, off-premises equipment, stereo sound and baseband audio and video interconnections. Of these, the latter may be the most significant since many VCRs, an increasing number of TVs, and some converters contain such connections and they may be used in ways to both improve picture and sound quality and overcome some of the interconnection problems.

Aside from the switching features of various interconnection schemes, a major consideration is overall shielding effectiveness. Ingress from strong local television and communications radio stations may seriously degrade cable signals while egress from subscribers' terminal equipment will add to cable operators' leakage woes. Section I, chapter three, submitted by Joe Van Loan of Viacom, is a detailed treatment of those issues.

Acknowledgements

One paper in Section II, chapter three dealing with master-slave descramblers was authored by James Cherry and Tony Chen-tung Li and was presented earlier as an NCTA technical paper.

Obviously a great deal of work went into the illustrations of this document. We are indebted to Pan King of Jones Intercable for the diagrams in Chapter two and to Gloria Cook of Gill Cable for the bulk of the remaining artwork and for manuscript preparation and numerous editing sessions.

Although not individually noted, many members of the subcommittee and of the NCTA Engineering Committee made suggestions which have been incorporated with the intent of increasing the accuracy and readability of the final product.

Acronyms, Abbreviations

CSR	customer service representative
dB	decibel
dBmV	a signal level measurement expressed in decibels relative to 1 millivolt rms in a 75 ohm system

EIA	Electronic Industries Association
FCC	Federal Communications Commission
FM	frequency modulation
IR	infrared
MHz	megahertz
MSO	multiple system operator
nm	nanometer
OSI	open system interconnect
POS	position

Review of FCC Technical Standards

A major part of the FCC's technical rules for cable television (Part 76, Subpart K) are related to specifying the characteristics of the signal presented to the customer's television set. The principal ones that concern us here are:

- The signal level (75 ohm) shall be a minimum of 0dBmV but below "overload" level.
- The signal level of adjacent channels shall be within 3 dB and all channels shall be within 12 dB.
- The visual carrier-to-noise ratio shall be greater than 36 dB.
- The level of intermodulation products shall be at least 46 dB below visual carrier level.
- The leakage of cable signals shall be less than 15 microvolts/meter as measured at 100 feet and, in the range from 54 to 216 MHz, shall be less than 20 microvolts per meter as measured at 10 feet.

Note that, although these requirements (except for signal leakage) apply only to broadcast signals and are no longer enforceable at the federal level, they still have a sound technical basis.

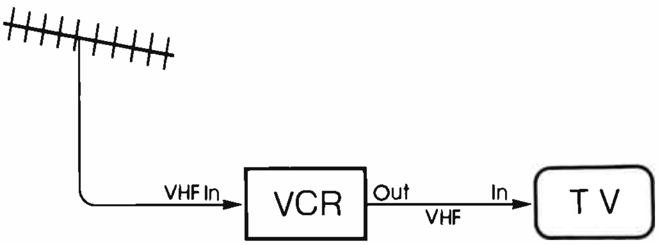
These rules were promulgated in a much simpler time when "subscriber terminal equipment" meant one, or perhaps two, television sets whose tuning ranges were limited to the standard broadcast channel allocations. In recognition of a changing situation, the EIA/NCTA Joint Engineering Committee has drafted a Proposed "CATV RF Specification for Television Receiving Devices" which is currently in the approval process by the parent organizations. This standard would augment the FCC rules to the following degree:

- In order to prevent front-end receiver overload, the maximum video carrier level should be limited to +20 dBmV.
- Channels using the same frequencies on different cables of dual cable systems should have the RF carriers phase locked together to reduce the visual effects of co-channel interference. Levels of equivalent channels should be matched within 5 dB.
- Any video equipment which is designed to "loop-through" the RF carrier (such as a VCR's "bypass" mode) should have a loss of less than 5 dB.
- Any RF selection switches contained in video equipment should have an isolation of at least 70 dB through 216 MHz and 60 dB above that.
- Any video equipment with an RF input port should meet the requirements of Part 76 with respect to the re-radiation of cable signals and should, further, have a non-visible level of picture degradation when operated in external fields of up to one volt per meter from local VHF television stations.
- In recognition of the splitting losses required for multiple terminal equipment, cable systems are advised that in future designs, levels of at least +5 dBmV should be provided at the first terminal equipment connection point.

Although these latter requirements do not have the force of law, even if accepted by the organizations involved, they are a fair representation of the performance levels that will be required in today's complex home video environment.

Technical Requirements for a Solution

A simple off-air connection of a VCR and television set is shown below. This connection allows for simultaneous multichannel access, timed recording of events on different channels, and tape playback, all without any switching of cables. More elaborate installations may allow for tape-to-tape copying, FM receiver interconnections, external sound



amplification or additional video sources.

The ideal solution for cable operators would allow the greater programming selection of cable without adding cost, picture degradation or operating complexity and without loss of features or an increase in signal leakage. None of the solutions presented here meet all of those requirements, though all present partial solutions which may be adequate in specific situations.

Before considering overall solutions, individual component requirements will be examined:

Switching Isolation:

In a typical non-cable installation, the output modulator of the VCR is set to a channel that is not used by a local broadcast station. Since that removes any possible co-channel interference situations, switch isolation does not have to be particularly high. A typical cable connection, on the other hand, will very likely have a cable channel, the converter output and the VCR output all on the same channel, usually channel 3 or 4. Furthermore, none of these sources are locked together. Under those situations, it is necessary to assure that the ratio of desired to undesired video carriers be at least 65 dB at the input port of any demodulating device. Since the levels of the various sources will typically be within a 10 dB window, a conservative specification for an RF selection switch's on-off insertion loss ratio would be 75 dB at frequencies at or below channel 4. Should one of the input sources be an external antenna, the variation in expected signal ranges would be higher and the suggested specification is 80 dB through 216 MHz, which is still below the specified performance of A-B switches used by the cable industry today. At other frequencies, generally the only co-channel situation occurs when selecting cables in a multi-cable system. If the opposing channels are phase-locked together an on-off ratio of 60-70 dB is adequate to assure non-degraded reception and to preserve the A-B isolation of the distribution system.

Losses and Amplification:

Although practices vary, many cable systems have been designed to deliver signal levels in the 0 to +3 dBmV range since that is adequate for simple television connection and higher levels add to the cost of plant construction and increase amplifier cascades.

Assuming a noise-free transmission network, the maximum attainable equivalent video carrier to noise ratio is:

$$C/N = 59 - NF + Level$$

where: C/N is the ratio of a noise-free incoming video carrier to the sum of thermal and internal noise sources measured in a 4.0 MHz bandwidth, NF is the terminal equipment noise figure in dB, and Level is the carrier level at the input terminals in dBmV.

Thus, if a converter has a noise figure of 11 dB and is driven with a 0 dBmV signal, the maximum attainable C/N is 48 dB. The noise of the signal processing equipment and transmission system will combine with this noise to determine the final video signal to noise ratio. If the terminal signal level is below 0 dBmV, the maximum attainable noise perf ormance will vary accordingly and the converter will play an increasingly large part in deteroomining overall noise level. Aside from FCC requirements, 0 dBmV was chosen as a compromise such that, in general, subscriber terminal equipment is not the dominant factor in total noise contribution.

In addition to the detrimental viewing effects of excess noise, low signal levels may interfere with proper operation of addressable devices and operation of teletext decoders and similar equipment. Typically, such equipment is specified for proper operation down to 0 dBmV only.

Thus, switching and splitting networks which result in more than minimal losses to the signal paths can result in noisy pictures at least and possibly improper operation of such devices as addressable descramblers. How much loss is too much will depend on drop levels in any given system.

To the extent that losses cannot be minimized by innovative circuit design, they may be overcome by amplifiers placed in some of the input or output ports of the switching network or, in some cases, by selectively changing customer tap levels or replacing RG-59 drop cable with RG-6. Section II, chapter one discusses more thoroughly the tradeoffs involved in adding amplification to such networks.

Shielding Requirements:

Any subscriber interconnection network should meet the requirements set forth in the proposed EIA/NCTA guidelines. Section I, chapter three deals with the mechanisms involved and methodology for minimizing both ingress and egress. Under current FCC regulations, cable operators have responsibility for total leakage of cable signal from their franchise areas even though some of the leaking equipment may be subscriber-owned. These requirements are detailed in FCC rule paragraph 76.611 as amended October 26, 1984 and are commonly known as Composite Leakage Index or CLI.

In discrete-component arrangements of splitters and A-B switches, the major contributor to leakage is liable to be the quality of F-connector installation and the tightness of the fittings. Such factors should be considered if the operator chooses to let the subscriber take the major responsibility for installation of networks.

Packaged networks generally have fewer external connections, but the added requirement of total shielding over the switching components. While Federal rules regarding the signal leakage requirements for various classifications of subscriber terminal equipment are currently under review, some currently available networks are rather poorly shielded.

In any case, operators should educate both customers and installers as to the importance of good connections. Aside from external leakage and ingress considerations, poor shielding and leaky cables will detract from the isolation of non-selected RF sources and cause co-channel interference.

Security Factors:

Much of the dissatisfaction with the connection options offered to customers by cable systems is related to converter/descramblers. They are used to convert a spectrum of input channels to a common output channel and to descramble selected premium services. The problem is that they only deliver a single channel at a time so that recording one channel while watching another is impossible, particularly if both channels are scrambled.

Some of the solutions that are being considered address this issue by using multiple descramblers to simultaneously deliver all subscribed services. While this may offer subscriber convenience the operator should evaluate potential revenue losses due to:

- Second descramblers offered at reduced rates being transported to other subscribers homes as primary units.
- "Backyard" interconnects with multiple descrambled services delivered to non-subscriber's homes or apartments by coaxial cable.
- Cost associated with more elaborate descrambling hardware.

Chapter Two — A/B Switch Solutions

Discussion

The lowest cost and easiest to implement method of overcoming some of the feature limitations of converter/VCR interconnections is through the use of A-B switches and splitters. The advantages are that typically both are available to the operator with excellent specifications and at relatively low cost. Also, they may be arranged in a variety of ways to solve specific situations.

On the negative side, even relatively complex networks do not give all the desired flexibility while the array of unlabeled, identical, A-B switches is both messy and confusing for the subscriber and can result in the loss of remote control capabilities. In addition component signal losses can degrade system performance.

Given the ready availability on the market of good, integrated switching networks for reasonable prices, we would expect that the use of discrete switching networks will decline rapidly. A packaged switching network which follows the suggested configuration of Section II is superior in nearly every respect to any of the discrete networks discussed below.

Below is a summary of possible configurations together with a summary of the capabilities of each to allow a logical choice to be made for a particular situation. The material presented was gathered from submissions by over 20 MSO's, independent operators, and manufacturers. Al Kernes of Jones and a working group of the Denver-based subcommittee members took on the task of redrafting the diagrams from the submitted suggestions.

How to use this guide

The 27 illustrations included in this chapter are arranged (for the most part) in ascending order of complexity. The first few installation set-ups depicted are the least expensive to install and the easiest for a subscriber to use. Unfortunately, the configurations that are least likely to confuse subscribers are the same ones that can limit the subscribers' ability to take advantage of features in their televisions or VCRs. Some subscribers may prefer to lose some remote control or VCR flexibility in favor of simplicity of operation, others may not. The selection guide summarizes installation trade-offs.

You will need to keep these factors and their relative importance in mind when choosing a configuration:

- simplicity of operation
- ability to use TV or VCR remote control (all illustrations allow for use of a converter remote control
- ability to use timed, multi-channel, multi-event VCR feature
- total signal attenuation (*i.e.* if your system levels are near 0 dBmV and the installation diagram calls for a four-way splitter, your subscriber will get snowy pictures)
- number of *high-quality* A/B switches (yielding 70 to 80 dBs of isolation at minimum) needed
- 0 dBmV is assumed to be the minimum input level for a converter
- mid-UHF converters may not translate all super-band channels to UHF
- VCRs in bypass require high drop levels

Notes on Illustrations — equipment, drop level, signal leakage considerations.

1. Some TV sets are shown with 300 ohm input terminals, others with direct coaxial inputs — either input terminal type is acceptable as far as the diagrams are concerned.
2. If direct connection to external antenna systems is part of the installation scheme, operators *have to* keep potential signal leakage in mind and avoid same with proper A/B switch quality and isolation. Read chapter three in this section — "Ingress/Egress Discussion" before attempting any cable TV installation.
3. If three-way splitters are used, note that the dot in the illustration's splitter denoted the higher level output leg, assuming one leg at -3.5 dB and two legs at -7.0 dB. If the splitter has equal splits or is hooked up differently, the minimum acceptable drop signal level will need to be increased.
4. Where only one input and output cable is shown for a VCR, it is intended to designate the VHF terminals.
5. Presence of cable compatible TVs and VCRs are assumed in "no-converter" hook-ups.
6. It is assumed that most converters do not have a timed channel selection scheme.
7. Only illustration #14 shows two TV sets; other connections can accommodate two TV sets by the addition of a 2-way splitter at the drop.

Background on Terms used in Illustrations' Text

ALLOWS — assumes that **simultaneous** TV and VCR use (to a greater or lesser degree of access to a full-range of paid-for cable programming) is the subscriber's aim

ANY CHANNEL — "any" = whatever channels a subscriber's home equipment (TV, VCR, converter) is capable of receiving and that a subscriber has paid for

SCRAMBLED — a signal that requires a descrambler

NON-SCRAMBLED — a signal that is never scrambled; sent in the clear

OFF-AIR — channels received via an external TV antenna, not delivered via "over-the-wire" cable TV service

CABLE CHANNELS — any channels delivered via "over-the-wire" cable TV service that a subscriber has paid to receive

RECORDING — videocassette recording

Step 1: The first thing to determine (and then locate in the selection guide) is the **number of converters** needed. For example: a cable system that uses traps will not need converters in the subscribers' homes, nor will a basic-tier subscriber owning a cable-compatible TV and VCR need a converter. The top, left-hand square of the selection guide says "no converter" indicating that the top row of the guide will list all applicable illustration numbers.

Step 2: The second thing to determine is the desirability of keeping the TV's or VCR's **remote control** feature and to scan the middle or right-hand columns of the selection guide according to that choice. (All illustrations allow for use of a converter remote control). For example: if one converter is used and the TV and VCR do not have a remote control you would look at the rows adjacent to the "one converter" box and find that illustration #s 7, 1, 3, 8 and 10 would all fit these requirements.

Step 3: You can also determine the importance of full-range-of-service, **simultaneous TV viewing and VCR recording** and find which TV remote control column subset lists the preferred options. For example: if I wanted to be able to watch any channel while my VCR recorded either the program I was viewing or a program on another channel, I would know that the set-ups in illustrations 18 through22, and 27 would allow that option.

Step 4: Finally, to determine which illustrations do not allow use of a VCR's timed and sequential **multi-channel recording** feature, note which illustration numbers are circled. For example: illustration #21.

Illustration Selection Guide

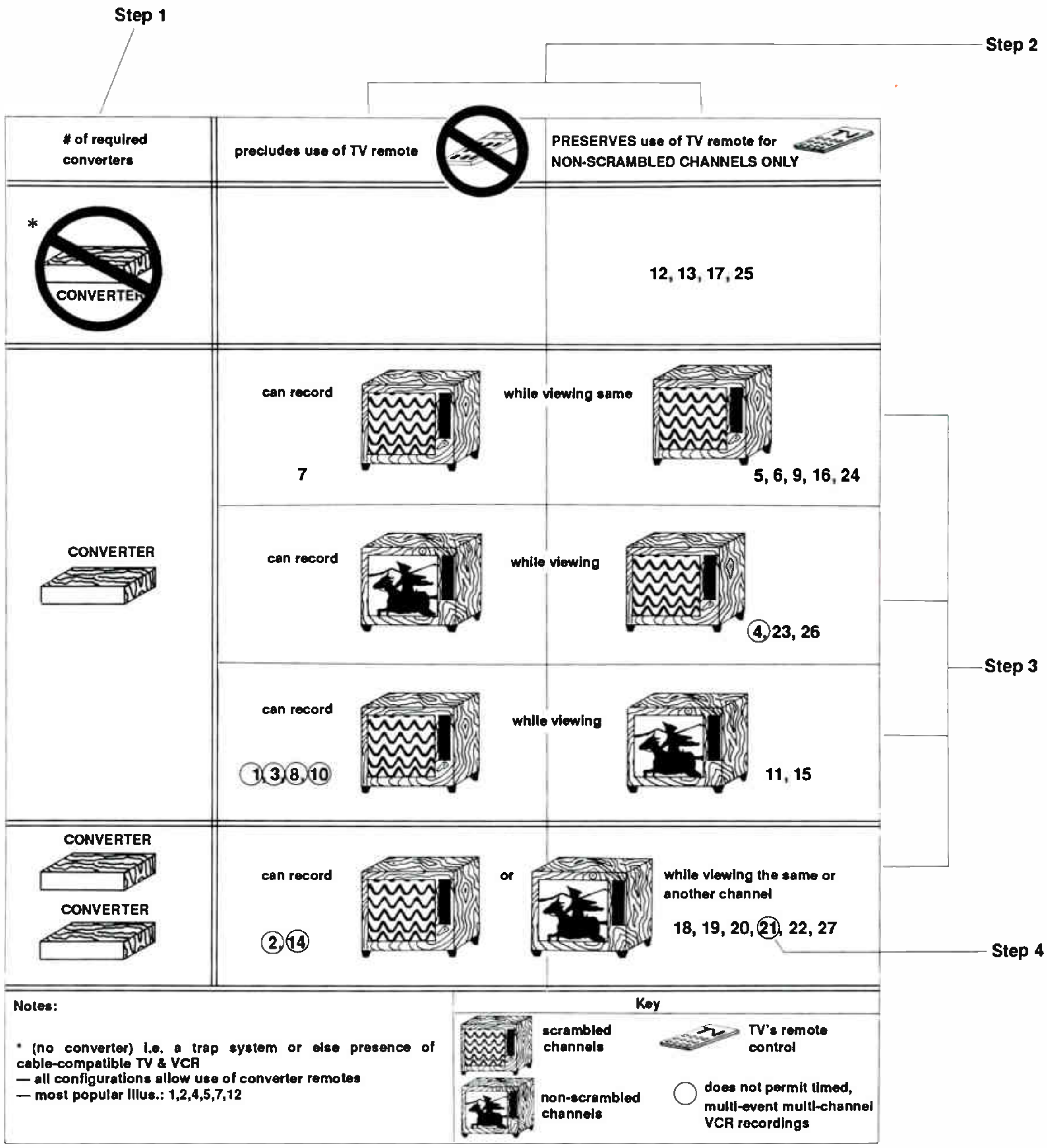
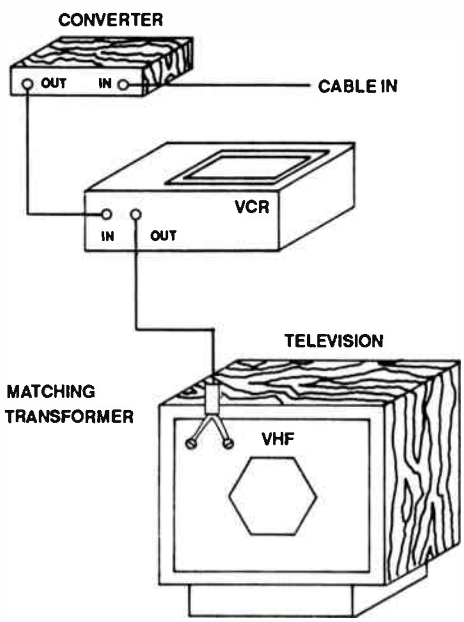


ILLUSTRATION # 1

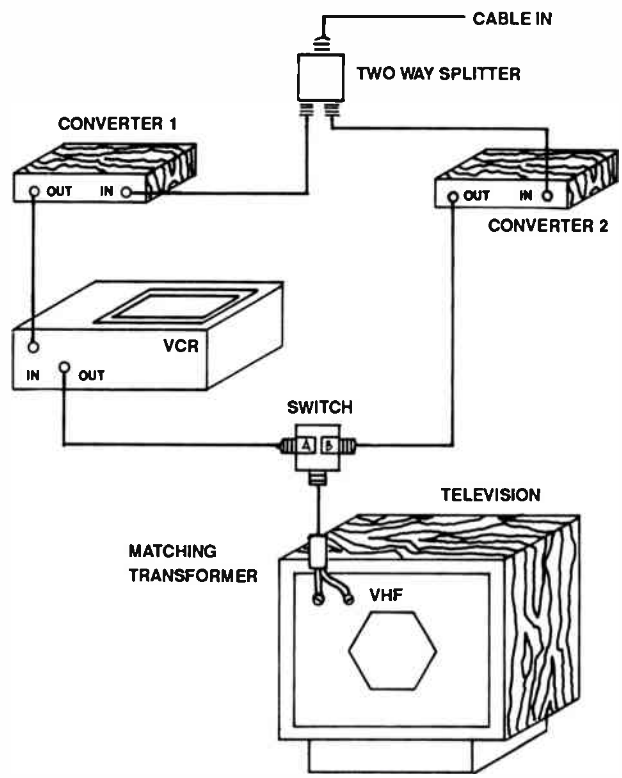


Allows:
• recording of ANY channel, while viewing the SAME channel

Precludes:
• 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.)
• channel selection by the TV remote control
• channel selection by the VCR remote control

NECESSARY DROP LEVEL: OdBmV

ILLUSTRATION # 2

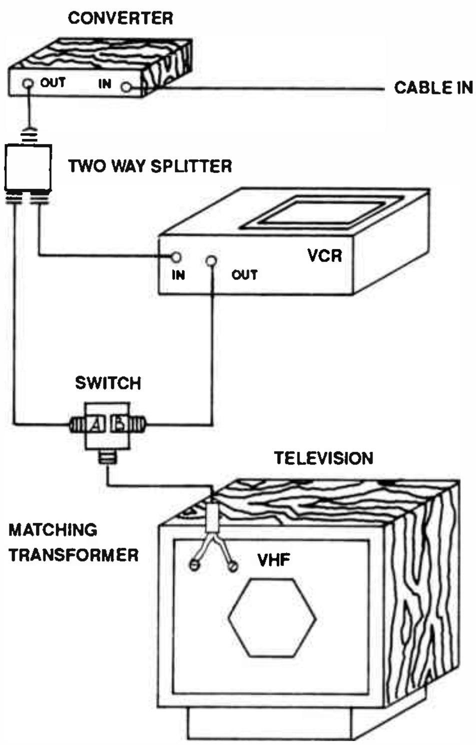


Allows:
• recording of ANY channel, while viewing ANY channel

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.)
• channel selection by the TV remote control
• channel selection by the VCR remote control

NECESSARY DROP LEVEL: +3.5dBmV

ILLUSTRATION # 3



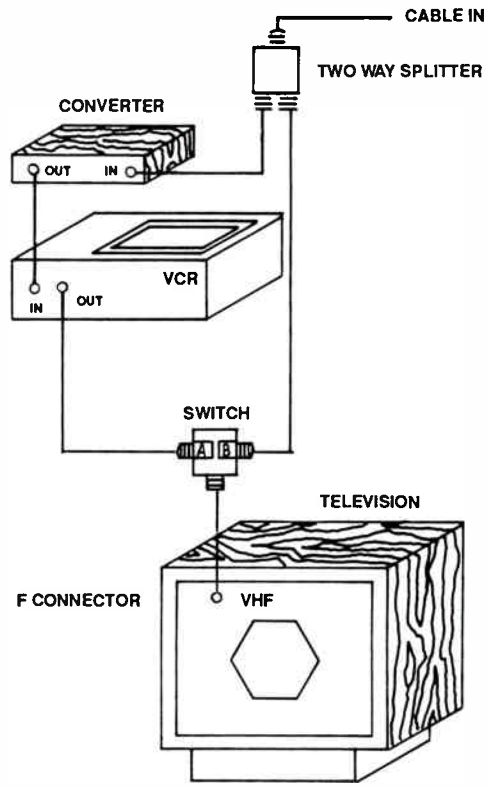
for VCRs without bypass circuitry

Allows:
- recording of ANY channel, while viewing SAME channel

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

NECESSARY DROP LEVEL: OdBmV

ILLUSTRATION # 4



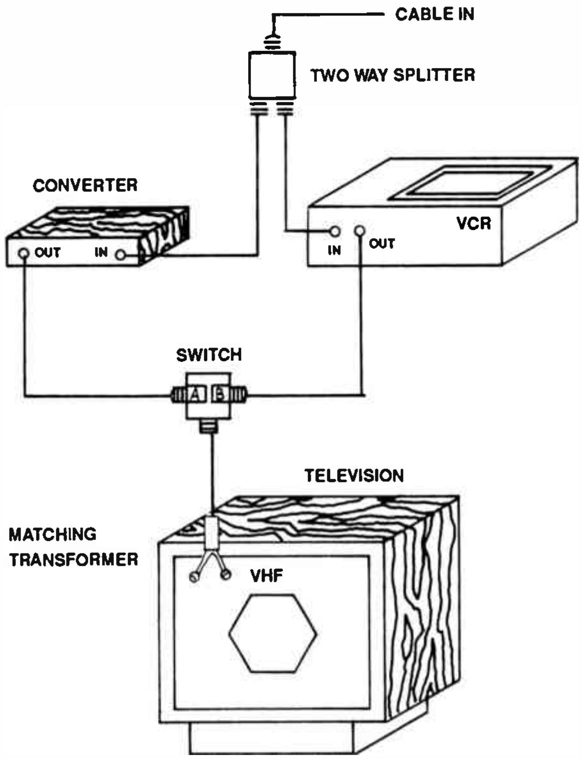
Allows:
- recording of ANY channel, while viewing ANY NON-SCRAMBLED channel
- *use of TV remote control for non-scrambled channels (only)

Precludes:
- 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.)
- channel selection by the TV remote control
- recording of non-scrambled channel while viewing a non-scrambled channel

Note: scrambled channels can only be viewed through converter and VCR

NECCESARY DROP LEVEL: +3.5dBmV

ILLUSTRATION # 5

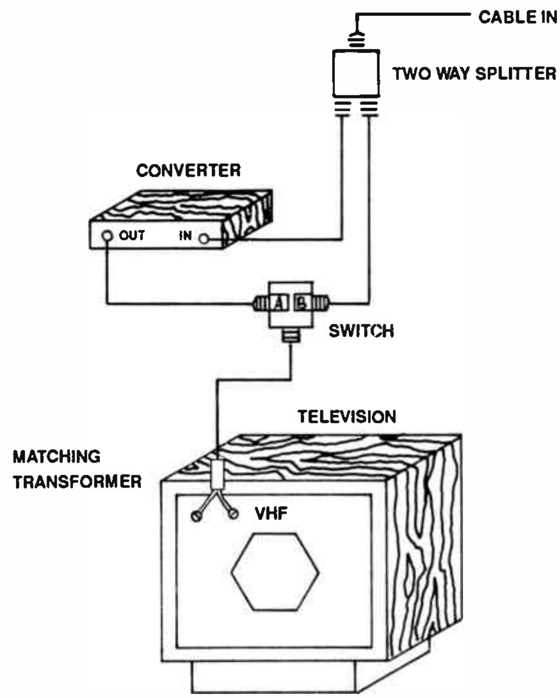


Allows:
• recording of (ONLY) NON-SCRAMBLED channel, while viewing ANY channel
• timed, multi-channel, multi-event recording (i.e. ability to program the VCR to record a movie on channel 5 at 6 p.m., and then a second program on channel 26 at 8 p.m.) of NON-SCRAMBLED CHANNELS ONLY
• full use of the TV remote control—WITH VCR IN BYPASS MODE (+8.5dBmV drop level required)
• full use of the VCR remote control

Precludes:
• recording of scrambled channels

NECESSARY DROP LEVEL: +3.5dBmV

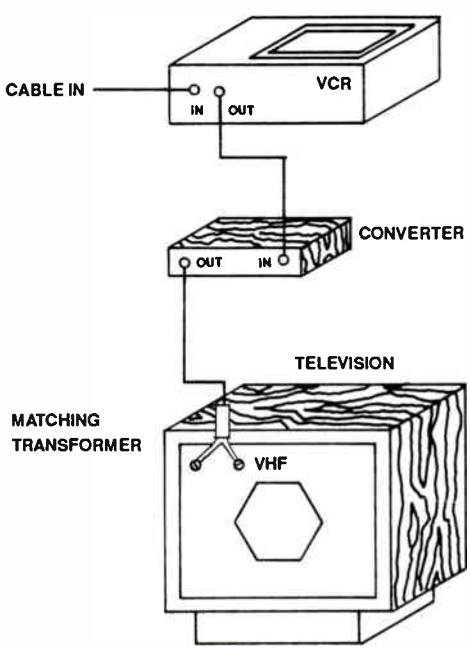
ILLUSTRATION # 6



Allows:
• viewing of ANY channel
• use of the TV remote control (for NON-SCRAMBLED CHANNELS ONLY)

NECESSARY DROP LEVEL: +3.5dBmV

ILLUSTRATION # 7

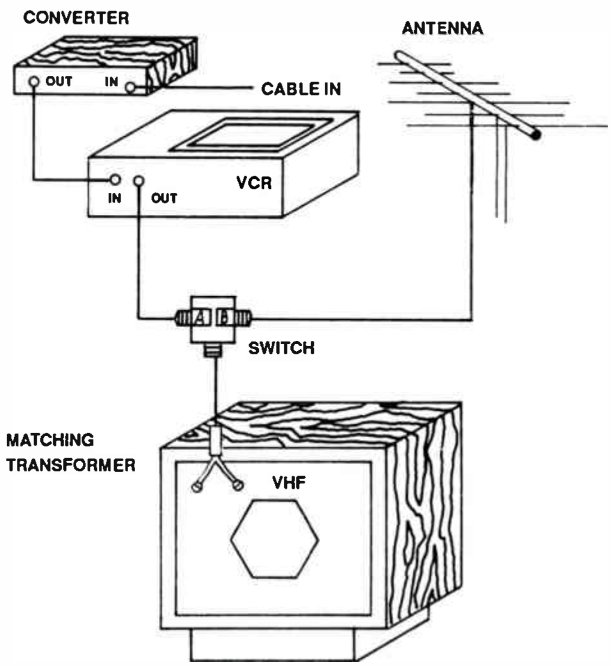


Allows:
• recording of ONLY NON-SCRAMBLED channels, while viewing ANY channel
• timed, multi-channel, multi-event recording (i.e. ability to program VCR to record a movie on channel 5 at 6 p.m., and then a second program on channel 26 at 8 p.m.) of OFF-AIR CHANNELS ONLY
• full use of the VCR remote control

Precludes:
• channel selection by the TV remote control
• may preclude use of converter's remote control

NECESSARY DROP LEVEL: 0dBmV

ILLUSTRATION # 8



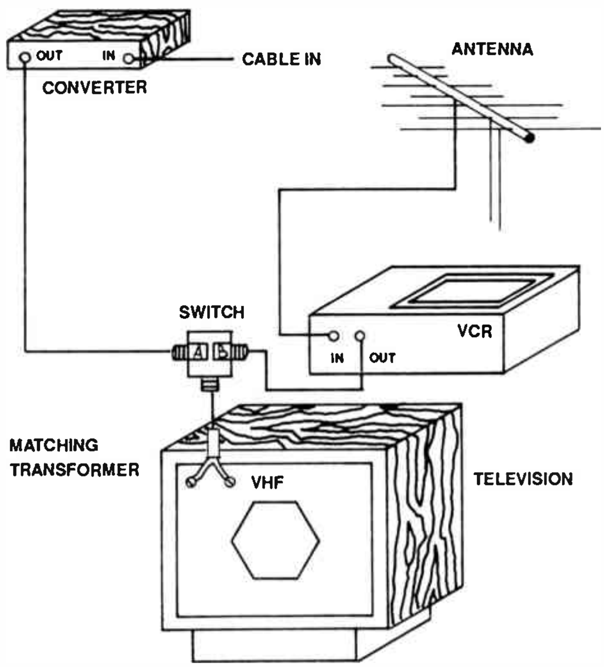
Allows:
• record of ANY channel, while viewing THE SAME CABLE channel *or* ANY OFF-AIR CHANNEL

Precludes:
• 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.
• channel selection by the TV remote control
• channel selection by the VCR remote control

Note: requires high-isolation A/B switch

NECESSARY DROP LEVEL: OdBmV

ILLUSTRATION # 9

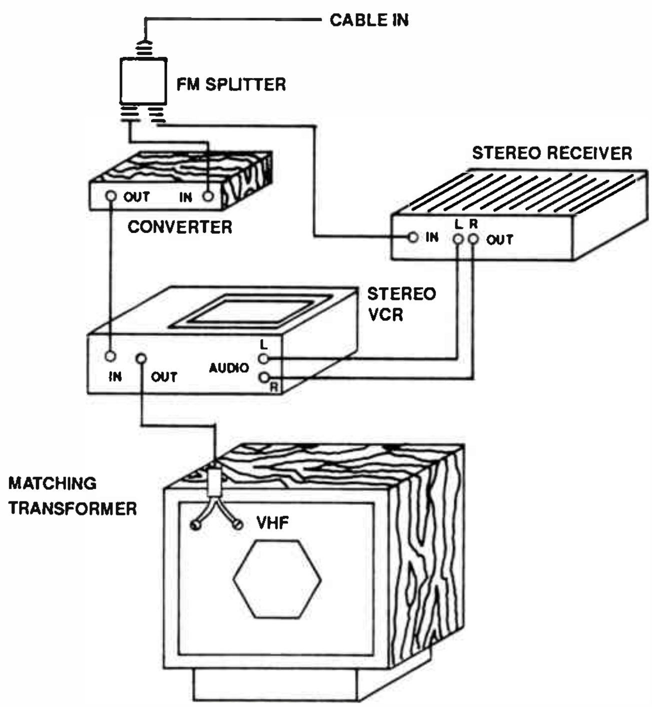


Allows:
- recording of OFF-AIR channel, while viewing ANY OFF-AIR *or* ANY CABLE channel
- timed, multi-channel, multi-event recording (i.e. ability to program VCR to record a movie on channel 5 at 6 p.m., and then a second program on channel 26 at 8 p.m.) of OFF-AIR CHANNELS ONLY
- full use of the VCR remote control

Precludes:
- channel selection by the TV remote control
- recording of any cable channel

NECESSARY DROP LEVEL: 0dBmV

ILLUSTRATION # 10

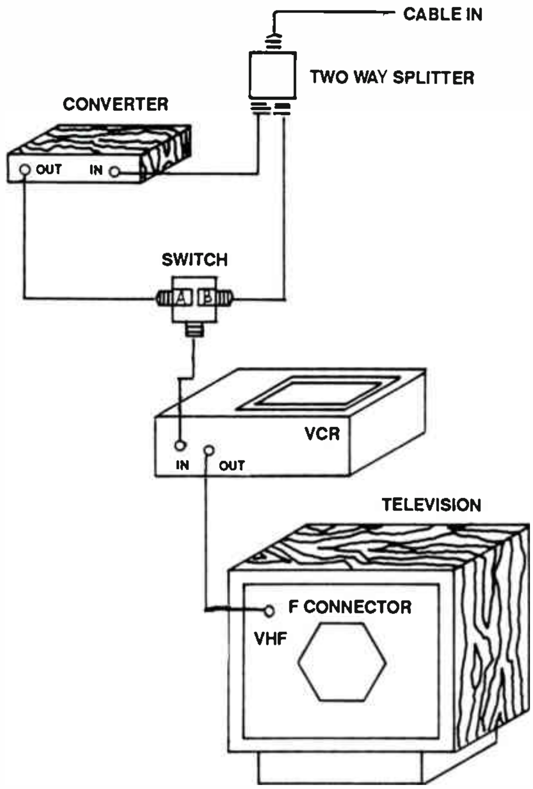


Allows:
- recording of ANY channel, while viewing THE SAME channel
- recording of simulcast audio

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.)
- channel selection by the TV remote control
- channel selection by the VCR remote control

NECESSARY DROP LEVEL: +1dBmV

ILLUSTRATION # 11

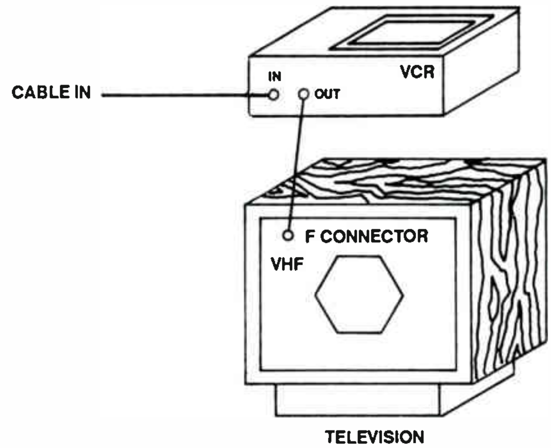


Allows:
• recording of ONLY NON-SCRAMBLED channels, while viewing ANY NON-SCRAMBLED channel
• recording of scrambled channel while viewing same channel

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.) of OFF-AIR CHANNELS ONLY
• channel selection by the TV remote control
• channel selection by the VCR remote control
Note: only real benefit of this connection appears to be use of VCR remote and independent timed, multi-channel, multi-event recording

NECESSARY DROP LEVEL: +3.5dBmV

ILLUSTRATION # 12

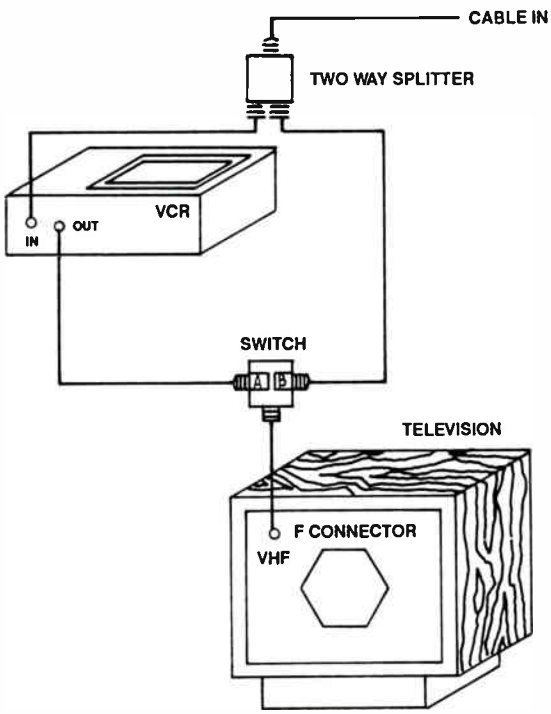


Allows:
• recording of ANY channel, while viewing ANY channel
• timed, multi-channel, multi-event recording (i.e. can program VCR to record a movie on channel 5 at 6 p.m., and then a second program on channel 26 at 8 p.m.)
• full use of the TV remote control
• full use of the VCR remote control

Precludes:
• non-cable compatible VCRs
Note: assumes all channels are non-scrambled

NECESSARY DROP LEVEL: +5dBmV

ILLUSTRATION # 13

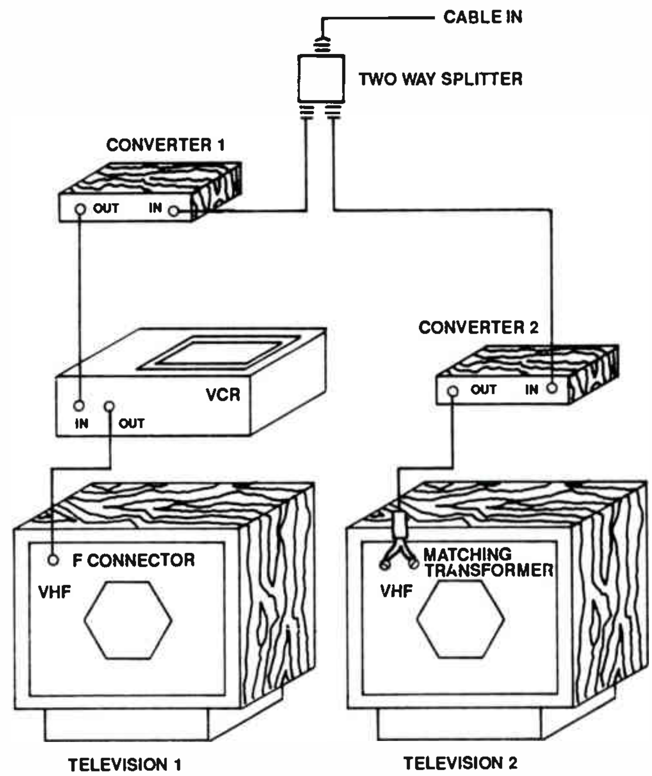


Allows:
- recording of ANY channel, while viewing ANY channel
- timed, multi-channel, multi-event recording (i.e. ability to program VCR to record a movie on channel 5 at 6 p.m., and then a second program on channel 26 at 8 p.m.)
- full use of the TV remote control
- full use of the VCR remote control

Assumes:
- VCR does not have a bypass or the bypass has high insertion loss
- all channels are non-scrambled

NECESSARY DROP LEVEL: +3.5 dBmV

ILLUSTRATION # 14



Allows:
- recording of ANY channel, while viewing SAME channel on first set
- viewing of any channel on the second set

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.)
- channel selection by the TV remote control
- channel selection by the VCR remote control

Note: this is the only illustration for two TV sets; other connections can accommodate two sets by the addition of a two-way splitter at the drop.

NECESSARY DROP LEVEL: +3.5dBmV

'It's kind of a snoozer until you see it'

And even once you see it, TCI's new security system may be misunderstood.

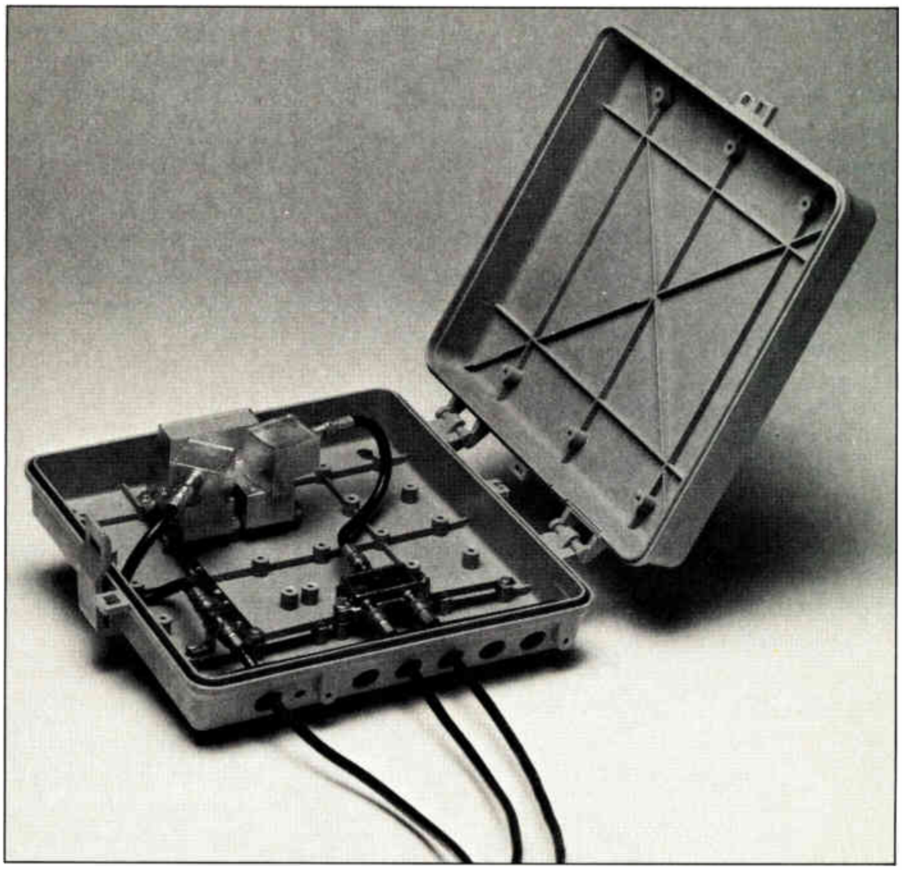
Picture if you will Tom Elliot, cast as a fiery young Martin Luther, challenging Church orthodoxy by nailing 95 Theses on the wooden door of an ancient church in Wurttemberg, Germany. Cast Elliot's brainchild, the new TCI on-premises control system, as the Theses. Have addressability and impulse pay-per-view play the part of Church orthodoxy. Cast any one of a number of leading technical figures in CATV as the Pope; the remainder as the Vatican Council. Open the first scene as they ponder the implications of the Theses, which the Council fears will launch the Protestant Reformation all over Europe. That script would pretty much sum up the anxiety created by the trap-based on-premises control system TCI is aggressively pursuing.

Elliot, TCI's energetic and thoughtful director of research and development, probably would say he's been mis-cast. Without question, he's as committed to this project as was Luther. But his Theses aren't really a direct challenge to addressable orthodoxy, he insists, although that is commonly thought. In fact, he's agnostic. He's neither for, nor against, addressability as such. TCI's position is the same, he says. No, the problem he's trying to nail is security, specifically security that is consumer friendly. As if to calm the fears of possible critics, he readily admits that there are situations where addressable, in-home descrambling converters are the only way to go. And just as readily, he admits that impulse pay-per-view and home shopping may change business realities—and the economics of addressability—as much as BTSC and VCRs already have changed industry priorities. In fact, he also says TCI is committed to moving ahead with an addressable module for the new "line of demarcation" box. In short, he's saying that TCI has to deal with security first, distinctly from the separate but related issues of addressability and in-home terminal equipment. The confusion surrounding TCI's position on addressability, he suggests, is partly caused by the industry's own confusion of addressability and scrambling issues.

None of which is to say there still aren't industry differences of opinion over the use of traps as security devices, positive traps vs. negative traps or the relative economic virtues of addressability. And the emphasis on trapping certainly has some effect on how fast addressability grows, whether that's an intended side effect or not. Yes, Elliot is well aware of all the arguments. But it's important to understand what he's trying to do, as he sees it. To repeat: "The problem we're trying to tackle is consumer friendly security. And the real question is whether that security is done remotely or manually." The issue that has bedeviled TCI internally since 1984—when the company had time to gauge the impact of its big addressable push in the spring of 1983—is scrambling. In fact, he says "consumers like addressability. It's scrambling they don't like."

Enigma

That TCI's position sometimes seems a paradox wrapped in an enigma is understandable. On one hand, the company has already proclaimed its intention to get out of the converter business and is energetically pushing its new control strategy. On the other hand, the company has recently made large purchases of addressable converters. And, as Elliot himself muses, some of TCI's own statements probably have confused the separate issues of addressing and security. But the modular, self-contained design of the new enclosure and components illustrates clearly TCI's separation of the two issues. More important, perhaps, is the



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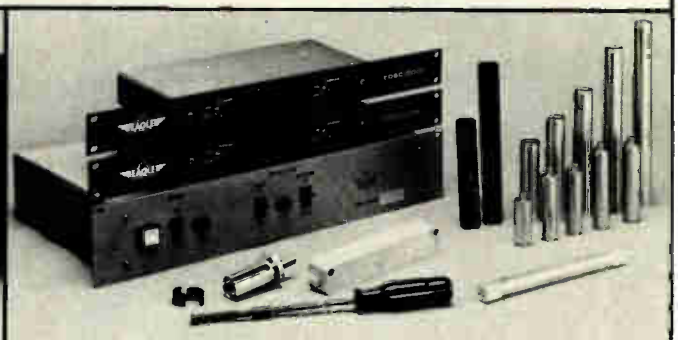

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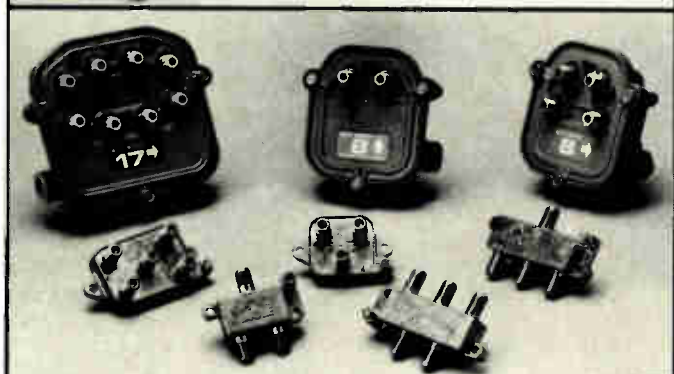

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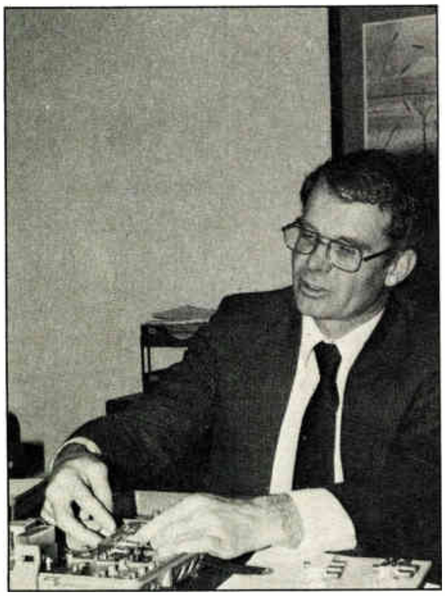
Reader Service Number 22

Unquestionably, the project has pushed the frontiers of knowledge in at least one respect.

built-in agnosticism about what components might be needed in the future.

Inside the casing is a grid system composed of inch-and-a-half squares that can incorporate a variety of devices: positive and negative traps, a surge arrester and test point, ground block, and splitters. An addressable module and interdiction devices will come later. Overall, the idea was to allow for flexibility. "We don't predict the future in our design," Elliot says. Just as important, the design doesn't limit the future, either. "Ultimately, we'd like each component designed so it lasts forever. But the design also allows us to make changes if we really do make a mistake." The modularity carries over to individual components as well.



Tom Elliot

"We've carefully separated the various functions of the devices in the box," Elliot, a former physicist, says. "Functionally, we understand the purpose of each component. We've also reduced the number of interfaces to the minimum required to achieve our objectives." Taken as a whole, this openness to the future of technology is a deliberate attempt to avoid the sort of blindsiding that another development like VCRs or BTSC might cause. TCI's box is a way of saying "never again."

High shielding also is built in, because "you just can't have emissions," the low-keyed yet lively R&D chief says. Everything is gasketed with O-rings or sleeves. A self-sealing foam gasket ensures a tight seal when drop cable is pushed in or pulled out of the enclosure. And Elliot himself is responsible for the emphasis on internal seals. "I may be one of the few who believes this, but since fittings are the major cause of our trouble calls I want everything sealed up tight."

Plastic was chosen for the initial single-family-home unit because it tracks ambient temperature better than metal, offering better resistance to internal condensation. Plastic also means no rust stains running down the side of a subscriber's house. And the grey, high-impact plastic casing is tough. Elliot says it's had a 20 lb. ball dropped on it at -20 degrees Fahrenheit. The ball bounced off, Elliot says with a satisfied grin. Eventually a family of enclosures is seen, perhaps of different shapes. But metal versions also are envisioned for MDU applications.

New frontiers

Unquestionably, the project has pushed the frontiers of knowledge in at least one respect. The design of the new, narrow-notch positive trap, carried out by a talented Scientific-Atlanta team lead by Jim Farmer and Lamar West, has taken a bit longer than the enthusiastic Elliot would have liked. The process also has made Elliot a SAW expert. "The shape factor of the notch is stringent and has really pulled SAW and RF expertise together in new ways," Elliot says. "We're really attacking new problems." Ultimately, some new proprietary technology may develop for application in other areas as a result.

Despite the slight delay, Beta site

Educational materials aimed at consumers and explaining how CATV works are a must.

testing is expected to begin in March, putting the project behind schedule about a month. But most of the other components are ready. Belden has produced a new solid sheath jumper. The box is in production and ground blocks are ready. New splitter molds have been tested. The prototype jamming carrier generator, already compatible with Jerrold and S-A modulators, is running. Most likely, S-A will add the line of negative traps. Amplifiers and addressable module development awaits. Since there's demand for interdiction devices, off-premises system vendors should have a head start, should they decide to jump in.

Very likely, there'll someday be a second subscriber-accessible box that bolts to the TCI enclosure. The purpose: make it easier for subscribers to do what they want with the signal once it's inside their homes. "Conceivably, the consumer could get in and install his or her own modules," Elliot says. "This also gives the customer a test point, similar to the phone company's. If a subscriber has a problem someplace in the house, all you'd have to do is plug a device in at the test point. If it works there, but not after that, you know you have a problem on the subscriber side, not our side." And he knows CLI compliance isn't really addressed yet. "We'll simply have to learn to deal with it. We've already lost the battle to keep 'Radio Shack' accessories off our networks," Elliot firmly believes.

That doesn't mean nothing can be done. Educational materials aimed at consumers and explaining how CATV works are a must. And there also are many different ways to help consumers: teach them how to do crimps, cut jumpers for them, loan coring or stripping tools and develop relationships with local electrical contractors, Elliot argues. Telephone companies do some of this today at the local storefronts. Maybe we can do something similar, he suggests. No, he hasn't thought through all the issues yet. But Elliot's obviously brimming with conviction that they can be solved.

In hindsight, everybody—consumers, TV set manufacturers and CATV interests—would have been better off if cable operators hadn't gotten into the tuning business at all, Elliot muses. True, the industry initially needed converters for tuning purposes. But the tuner could have been developed as a module fitting in the TV set, much as the proponents of the IS-15 interface now are suggesting. Of course, "once we had the box on the set, we went to the box for security, and that was a major mistake. Later, we decided it would be nice to remotely control the box. The upshot is that we're now stuck

TOCOM UNLOCKS THE FULL POTENTIAL OF VCRs

VCRs. Subscribers love 'em until they discover what they *can't* do: record multiple cable events while away or simultaneously record and watch different cable programs. Or easily connect a VCR to their converter. What should be a convenience becomes a chore that leaves subscribers frustrated, confused — and dissatisfied.

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For expanded recording capability, TOCOM offers the VCR-Mate, an optional video adapter that fits easily and neatly on the back of the converter. The VCR-Mate allows limited simultaneous recording and viewing of different channels. Of course, the 5503-VIP is stereo and IPPV-ready, too. And to help you market these new services, TOCOM offers complete subscriber marketing support and promotional programs.

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Reader Service Number 25

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General Instrument Corporation
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214/438-7691

GENERAL INSTRUMENT

A slow drift into a technological corner is precisely what Elliot is determined to avoid.

with providing a subscriber tuning function for quite a while."

A slow drift into a technological corner is precisely what Elliot is determined to avoid by going to the new control scheme. "If the IS-15 standard had been here four to five years ago we might not have needed this type of box, although we'd still have wanted a clear demarcation point between our network and the subscriber's in-home equipment." And while he's not sure what might develop in the future, high-definition television is probably as good an example as any of a possible future challenge that would drop a three to five year window of opportunity right into CATV's lap. And if that happens, Elliot wants to be ready with a control scheme that is flexible and cheap enough to go with quickly. The new modular box does that, he's convinced.

Inherent advantages

Of course, there are other inherent advantages. The box really ought to cut trouble calls and truck rolls because there's less need to meddle with the drop cable and connectors just to test components or change out service. And since there are no poles to climb, it might be possible to have salespeople do installations or provide service demonstrations. Also, since the traps are permanently in place, and the security doesn't move with the converter, the cost to authorize the next subscriber in a home really does start to drop down, approaching the current phone company mode of switching directly from the central office.

As an interesting aside, Elliot has recently been reworking TCI's cost of truck rolls, making sure the numbers are loaded for the system level, and excluding marketing and other costs that corporate accountants apportion. In breaking out new installs, reconnects and disconnects, Elliot is getting indications that, in some cases, the actual cost to roll a properly scheduled truck isn't nearly as high as common industry figures would indicate: dramatically less, in fact. New connects are pretty easy to figure, and also are pretty high. But disconnects, move reconnects, upgrades and downgrades are a different story. That's important, of course, in assessing the economic advantages of addressability.

But truck rolls weren't the fundamental driver behind the new control scheme. It really was developed because TCI didn't have a really good way to deliver pay services at low cost where penetration was low. Basically, there really are only two ways to secure signals, he says. "You can pay money to get a subscriber or pay money to

MOST FOLLOW STANDARDS...

...A VERY FEW SET THEM.

In every industry there are leaders who are innovative and dedicated to producing the highest quality product. The vision of these leaders fuels progress; they forge ahead and bring new solutions to the marketplace. Most of all, these leaders listen to their customers and translate their needs into products and services of the highest standard.

In CATV, Alpha has set the standard in Standby Power technology. This leadership is based on a long list of 'firsts' in powering concepts and product capabilities. Implementation of Alpha's single ferro-resonant power supply design revolutionized the industry and gave new meaning to cable system reliability and customer satisfaction.

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established the highest quality and safety standards. To date Alpha remains the only Standby Power manufacturer offering UL, CSA and SEV listed products to the CATV industry.

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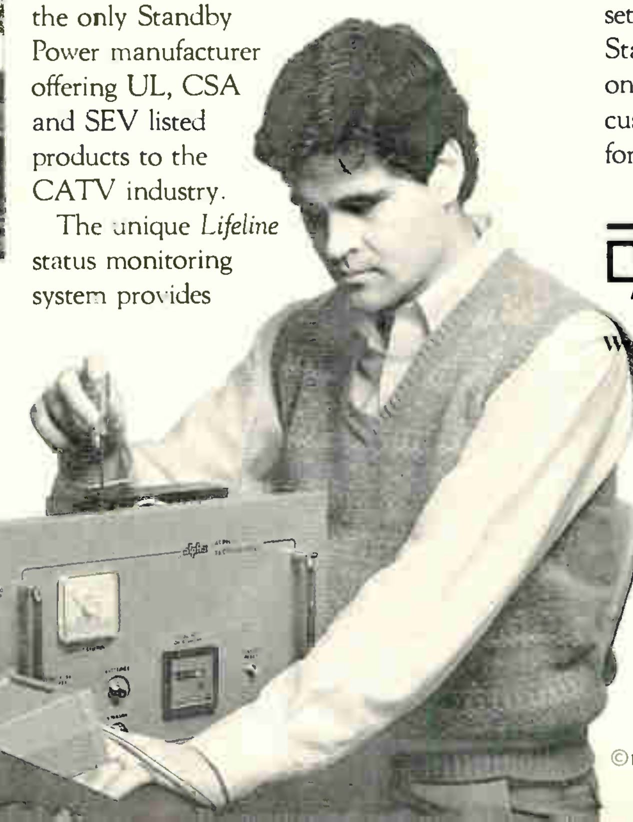

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Reader Service Number 27

TCI's positions on a variety of issues, then, are less dramatic than sometimes is supposed.

deny a subscriber, essentially, positive and negative traps. Scrambling is really a form of negative trapping and it's okay for low penetration. It's when you've got high penetration that you run into the problem. Looking back on it, scrambling was almost seductively attractive. You only had to give the decoder to customers who bought, and it didn't really matter whether the service turned out to be a high or low penetration proposition."

And while he certainly isn't agnostic about scrambling, Elliot still thinks, long-term, that TCI might find some economic way to deal with it. Narrowcast services—medical training for doctors, for example—might be one place where it might work because picture quality isn't that big an issue in this area.

TCI's positions on a variety of issues, then, are less dramatic than sometimes is supposed. It is agnostic, not opposed, to addressability. "Where we've got lots of pays we might want to go with addressable descramblers anyway. I'm sure that, as an industry, we'll continue to use addressability. I guess my question is whether I can pinpoint a type of subscriber who changes services often enough that addressability really is cost effective. Today, I'd have to say it's a dicey call; too close for me to be certain." Still, he plans to support development of addressable modules for the new box.

Elliot is aware that CLI implications flow from its current position, but he's prepared to deal with that. As for the charge that trap technology will degrade picture quality, he's overseen the development of dramatically better technology than is currently available—technology that should deliver pictures no worse than current descramblers. If impulse pay-per-view or home shopping order entry needs should develop strongly, something would have to be done. But, theoretically, something should be possible, since there's expansion capability built into the scheme. Yes, auditing programs will be mandatory. But, he argues, auditing ought to be a mandatory part of any system's program. And under most circumstances, not every portion of a system needs close inspection. College campus areas certainly are a place to be vigilant. But not every part of the subscriber base has the same amount of theft.

Tom Elliot

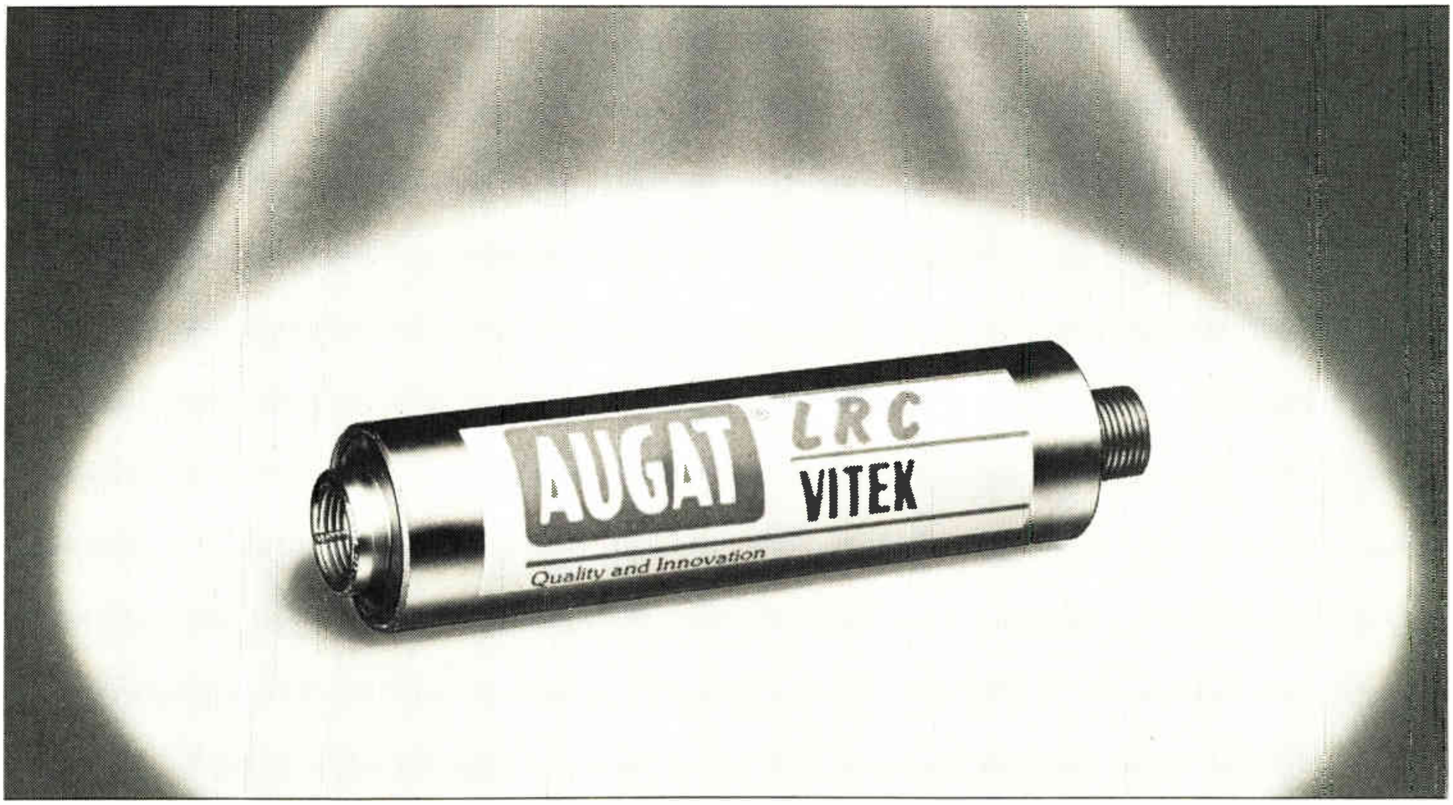
It's been feared that TCI might actively oppose propagation of the IS-15 technology. That fear seems misplaced. True, TCI's actions may have some effect on IS-15 diffusion. But the MSO's pursuit of its own strategy doesn't logically conflict with IS-15.

One aspect of the program nobody can quarrel with. It is born of a burning conviction that cable has to get consumer friendly. Not someday. Today. Not because it should be done, but because it must be done.

There's room for disagreement over the methods chosen to implement that change and over the possible ramifications. But without question, the program is dramatic, thoughtfully considered and breathtakingly quickly executed.

—*Gary Kim*

THE SHOW STOPPER.



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Reader Service Number 29

SCTE forum

SCTE TECHNICAL TUITION ASSISTANCE

Name: Mr. Mrs. Ms. ______________________________
(Last) (First) (Middle)

Telephone Numbers:

Mailing Address: ______________________________

Home: ( )________

Work: ( )________

Date of Birth: ____/____/____
Mo. day yr.

Social Security No. ______-______-______

SCTE STATUS:

Chapter or Meeting Group Member? ____ Yes ____ No

Nat'l Member? ____ Yes ____ No

Chapter or Meeting Group Name: ______________________

Member Number: ______________________

CURRENT EMPLOYMENT INFORMATION:

Total No. of Years in the Cable Industry: ____

Company Name: ______________________

Telephone Number: ( )________

Address: ______________________

Present Supervisor: ______________________

Title/Position: ______________________

Duties: ______________________

Employment period: from:________ to________

EMPLOYMENT HISTORY:

Employer: ______________________

Address: ______________________

Phone Number: ( )________

Title/Position: ______________________

Duties: ______________________

Immediate Supervisor: ______________________

Employed from: ________ to ________

Employer: ______________________

Address: ______________________

Phone Number: ( )________

Title/Position: ______________________

Duties: ______________________

Immediate Supervisor: ______________________

Employed from: ________ to ________

Professional Activities & Memberships:

Activity or membership: ______________________

Your most significant contribution: ______________________

Activity or Membership: ______________________

Your most significant contribution: ______________________

Activity or membership: ______________________

Your most significant contribution: ______________________

Current SCTE/BCTE Certifications: ______________________

EDUCATION HISTORY: (Attach all appropriate transcripts)

High School Level Completed: ☐ 9 ☐ 10 ☐ 11 ☐ 12

Names & Locations of Schools: (Attach additional page if necessary.)

______________________ ______________________

Diploma Granted: ____Yes ____No Date________

Diploma Granted: ____Yes ____No Date________

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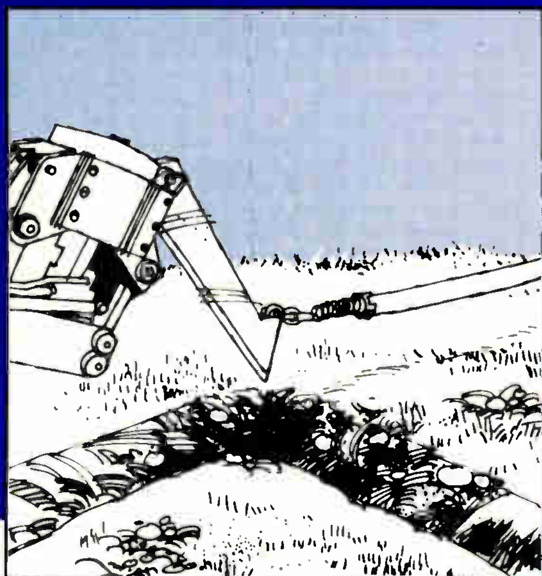
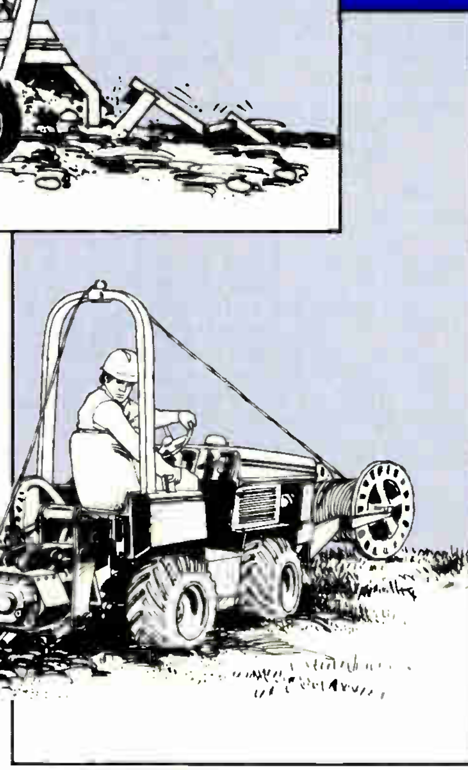


PULL IT,

TRENCH IT,



PLOW IT!

Whatever your underground trunk and feeder cable installation requirements, Cablecon Cable-in-Conduit provides you far greater flexibility.

If you're using PVC, you'll find that Cablecon is much easier to handle and install — greatly reducing labor time and your overall costs. And if you prefer to plow or pull direct buried cable, Cablecon offers protection and durability for just a few cents more. *Why* direct-bury coax when you have Cablecon's added benefit of long-term protection, *plus* a lifetime "hole-in-the-ground" for future upgrading?

Whether you're trenching, plowing, pulling, or re-pulling, it's time to use Cablecon..."the great protector!" For complete information on CIC, drop-in-conduit, empty duct with pull-string pre-installed, or prelubricated conduit, contact Integral Corporation or Channell. Direct sales representatives and distribution facilities are located throughout North America:

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Reader Service Number 30

Course of Study: ________________________

GPA______ Dates of Attendance:________________

Course of Study: ________________________

GPA______ Dates of Attendance:________________

College Level Completed: ☐1 ☐2 ☐3 ☐4 ☐5 ☐6

Names & Locations of Schools: (Attach additional page if necessary.)

____

____

Degree Granted:__________ Date:__________

Major:________________ GPA:__________

Dates of Attendance:__________ to__________

Degree Granted:__________ Date:__________

Major:________________ GPA:__________

Dates of Attendance:__________ to__________

Vocational/Military School:

Name & Location of School:

____

Graduated: ____Yes ____No Date__________

Course of Study:________________________

Dates of Attendance:__________ to__________

Grade Point Average (4.0 scale):__________

Correspondence Courses:

Name and Location of Institution:

____

Diploma Granted: ____Yes ____No Date__________

Course of Study:________________________

Dates of Attendance: __________ to__________

Grade Point Average (4.0 scale):__________

PERSONAL REFERENCES: (Industry-Related)

Name:________________________

Title/Position:________________________

Company:________________________

Address:________________________

____

Telephone Number: (   )________________

Name:________________________

Title/Position:________________________

Company:________________________

Address:________________________

____

Telephone Number: (   )________________

CONFIDENTIAL FINANCIAL DATA:

Gross Annual Income:* $__________

Net Taxable Income:* $__________

Number of Dependents: __________

*As reported to the IRS in last tax year; for married couples filing separately, include both incomes.

Explain why you should receive an SCTE Technical Tuition Assistance Grant and how it will benefit you:

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Signature:________________________

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Bustin' out all over

Are you cut out to manage your system's engineering department?

Are you cut out to manage your system's engineering department? Can you effectively lead a team of installers and technicians? Assessing and developing leadership and management abilities was the focus of a two-day seminar organized by the SCTE National and its Chattahoochee chapter in Atlanta recently.

Managing subordinates is an art, says Merrill Hanlon, training director for Scripps Howard, and an important part of it is identifying the "informal" leaders—the person others go to when you're not around. "Get to know those people and cultivate them," Hanlon advised, "because if they're with you, they'll bring the others with them." Look to those leaders to fill supervisory positions. Too often the best installer or best technician is given a supervisor's role when he's better in the field.

If you're having difficulty getting others to follow directions, perhaps it's time to assess your leadership skills, Hanlon said. Are you truly communicating—expressing yourself clearly? Do you identify problems and work to solve them? Provide direction? And above all else, do you delegate tasks to others, even when you know you can do it better, faster? "People who don't delegate are insecure managers," said Hanlon. They also don't get promoted because no one else can do their job.

But delegating is tough because it's perceived as a risk to teach others your job, added Chandler Brown, a training consultant at Broadwell Training Institute. And the person's competence and motivation levels must be examined before he is given the task. A highly competent employee with little motivation needs deadlines, while a highly motivated person with less competence may need a partner to share the work.

Allowing employees to participate in decision-making improves communication, a said Brown. "Participation and involvement equal commitment," he said, which motivates workers toward the outlined goal. Involving others takes time and results won't be apparent overnight, but it's a better system, Brown added. "If you change your thinking, you'll change your world."

On the technical front, signal leakage should be the big worry of every engineer for 1987, said Cliff Paul of RT/Katek. Paul told the audience that James McKinney, chief of the FCC Mass Media Bureau, is fed up with cable signal leaks that disturb aeronautical navigation and communication frequencies.

"As an industry, we must realize there are problems out there," said Paul. And, he cautions, systems that have been recently cited will probably be the first ones reinspected. "Don't try to snow the inspectors, you'll only lose," Paul advised.

The Cumulative Leakage Index was conceived as an indicator designed to show a probability of leakage, explained Paul. He said leaks should be logged on a monthly basis to determine if a system's problems are improving or getting worse. "If you comply (with the CLI rules), you'll reduce maintenance costs, have better pictures and happier subscribers," he noted.

With systems increasingly bottom-line oriented, it's important to reduce costs. One way to improve that bottom line is by minimizing the number of on-the-job accidents. Marty Mason and Kathy Dupree of Metrovision offered tips on loss control and insurance.

Dupree suggested that cameras be made available so employees can record exactly what happened during an incident. " 'See ya later, alligator' has become, 'Sue ya later, alligator,' " Dupree warned. Mason focused on ways to prevent accidents, which include filing a detailed report that describes the incident, determines the cause and suggests ways to avoid similar incidents from recurring.

Looking for a raise? Lee Tenebruso, vice president of national accounts at Showtime/The Movie Channel, suggested ways to successfully negotiate with your employer. The process consists of stating your need, listening for a specific type of reaction, acknowledging the other person's position, overcoming that reaction and securing a commitment.

"It's not hard, you've done it (negotiation) all your life," noted Tenebruso. "It's a state of mind."

Event organizers were Guy Lee of Telescripps and Mike Aloisi of Showtime/The Movie Channel.

The following day, a standing-room-only crowd at the Heart of America meeting group in Kansas City (paid membership stands at 125) heard CWY's Greg Lemon give a tutorial on system sweeping. "There are four types of sweep response testing: the low-level synchronous or 'tracking' sweep; the low-level asynchronous; the high-level synchronous or the processed sweep," Lemon said. The low-level synchronous sweep produces almost no subscriber interference but requires an expensive tracking analyzer and also suffers from decreased resolution as the number of carriers increases and cascades lengthen. The high-level synchronous sweep offers higher resolution but worse subscriber interference.

News from chapters includes new officers. The North Jersey Chapter has elected new 1987 officers. Virgil Conanan is president and Art Mutschler is first vice president. Richard Wagenblast is the new secretary/treasurer.

The Rocky Moutain Chapter also has new officers. Steve Johnson is president, Eric Himes is vice president, Sally Kinsman is secretary and Alan Babcock is treasurer. Chapter directors are Eric Himes, Joe Thomas, Doug Adams, Bruce Catter and Richard Covell. The group also set topics for upcoming meetings. April 22 will feature video and audio; June 3 features distribution systems; July 1 focuses on test equipment; Sept. 9 targets relations with broadcasters; Nov. 4 looks at data and Dec. 17 will see election of a new board.

Also, the SCTE has awarded the first of its planned educational scholarships. David Wilhelm, technician, Cable America Corp. and Ruben Gonzalez, design/field engineer for Group W Cable, are the first recipients.

The SCTE also has a new national headquarters: 669 Exton Commons, Exton, PA 19341. Grand opening ceremonies were held Jan. 14.

—Roger Brown and Gary Kim

If it's not IMPULSE, it's Obsolete

All addressable converters are not the same. Some . . . most . . . will never be able to handle impulse-pay-per-view ordering. Those converters are obsolete before you ever remove them from their packing crates.

It is now generally accepted that pay-per-view is a viable business—but only when you use impulse ordering. Impulse is the difference between buy rates languishing in the teens and zooming into the hundreds.

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GENERAL INSTRUMENT

Reader Service Number 32

S-1879

product profiles

Signal level meters

ComSonics Inc.

The Window from ComSonics is a portable battery-powered field strength meter using frequency synthesis and microprocessor technology to perform voltage amplitude measurements on specified channel segments within the range of 5 MHz to 550 MHz in a multichannel configured coaxial cable environment.

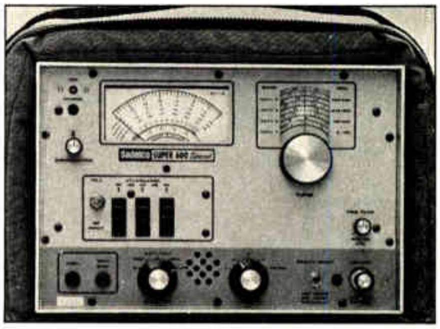
Opening the Window reveals a display of all video signals from which the operator selects the desired frequency and, using the cursor, "zooms" deeper into any selected frequency. The entire screen then updates to a detailed profile of the F channel's video and audio condition, including: channel ID, frequency in MHz, video and audio level in dBmV and a list of additional channel parameters.

The Window also features a memory mode whereby the user can store, use, recall, review or overwrite complete channel information from up to three system locations. In addition, readings on signal-to-noise ratio and hum are accessible. At any time during use, the operator can access the special "User Help" programming built in the Window. Housed in a rugged ABS plastic carrying case, the Window offers frequency accuracy of ± 10 kHz.

For additional information on the Window, contact ComSonics, (800) 336-9681 or in Va., (703) 434-5965 collect.

Sadelco Inc.

Sadelco manufactures a variety of signal level meters for a number of different applications and budgets. The Model 733C Super SLM is designed for CATV installers and features a multi-color meter scale that indicates the peak levels of both picture and sound carriers. The digital delay timing circuit in the 733C automatically shuts the meter off at a preset interval of time. The 733C has continuous cover-



Sadelco's Super 600 SLM

age from 54 MHz to 450 MHz in two bands, each of which has its own individual tuner. This design configuration permits multiple testing. Frequency coverage from 4.5 MHz to 45 MHz may be added by using the

Reader Service Number 33

The Spectrum 600 from Texscan provides 5 MHz to 600 MHz coverage in six bands.

optional Model MK III low frequency adaptor.

The Model 7450 from Sadelco is also designed for CATV installers and features all of the above-mentioned features. In addition, the 7450 offers the option of using nicad batteries and features and charge-indicating LED and a retractable cable suspension hook on the cover of the standard case.

The Super 600, Super 900 and "Special" series from Sadelco offer total coverage from 4.5 MHz to 600 MHz or 900 MHz with no missing frequencies. Each band is individually illuminated and the microameter provides scales for signal level, ohms, AD/DC volts, hum and battery condition. In addition, an LED window automatically displays center scale dB level. The frequency dial is fully protected behind the front panel window with four or five bands (depending on the model) with channel and frequency indications always displayed upright behind a fixed cursor. The tuning knob on the units allows for 360 degree non-stop rotation dialing, and variable gain boost control increases sensitivity up to 10 dB. The units also feature an automatic shut-off feature, factory preset to 15 minutes. The user may, however, change shut-off parameters to 2, 8 and 30 minutes or continuous operation. The LCD window alerts the operator when the battery needs recharging.

Other features of the 600, 900 and Special series of signal level meters from Sadelco include: headphone jack, three position light switch, spring-loaded S/N switch, five position function switch for selecting the measurements of ohms, volts, battery test, signal levels and hum; and a dBmV/dBuV switch which gives the user the option of reading the signal in conventional dB millivolts or the new international standard dB microvolts.

For additional information on Sadelco's complete line of CATV signal level meters, contact Jerry Goldman, (201) 569-3323.

Texscan

The Texscan line of signal level meters includes the SPECTRUM II, a handheld unit capable of monitoring two channels (3 or 4 and 36 or 37). The unit has a range of -5 dBmV to +15 dBmV of level indication using the 10 segment LED bar display. The nickel-cadmium battery provides two hours of continuous use allowing prolonged battery life. The SPECTRUM II is housed in a high impact-resistant housing with a padded carrying case.

The Spectrum 600 from Texscan provides 5 MHz to 600 MHz coverage in six bands with level measurement

Continued on page 74

classifieds

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Must have own truck and tools for long term build in Washington D.C./Metro area. High earning potential. Excalibur Cable Communications, Limited, (703) 451-7584 EOE.

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8,000 Channel 4 decoders EAGLE DF-4. 4 Channel 4 encoders TEST EC-4. For more information, call Bob Huber (402) 474-7621.

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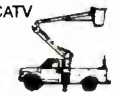

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in the news

'You can't stand between the consumer and Radio Shack'

Late this month, Denver's Mile Hi Cablevision will begin telling its subscribers about the new changes that will make CATV service more transparent to VCRs. At about the same time, TCI's new on-premises control system, developed by Scientific-Atlanta, should get its first Beta testing. Like TCI, Mile Hi will be focusing on scrambling as a primary culprit preventing consumer friendliness. One of Mile Hi Vice President, Engineering John Dawson's customers told him, "Don't stand between me and Radio Shack." TCI's Tom Elliot couldn't agree more (see story on page 48).

John Walsh, ATC vice president, engineering, Orlando, Fla. division, recently was named Engineer of the Year. Walsh is an 11-year veteran and also won the award in 1982. Ariel Parodoa, field maintenance manager at the Orlando system, a 15-year veteran, won the Award for Outstanding Engineering Achievement. ATC also has appointed Jay Vaughan and Ronald Wolfe project engineers. Both will do technical inspections, coordinate FCC filings and issue technical bulletins.

At Anixter, John Johnson is new executive vice president of the manufacturing division. At Sachs Communications, Peter Hineson is technical manager, west; Sam Wells is technical manager, east. Both will provide training for Sachs clients. At NCS Industries, Samuel Landis is new sales engineer.

John Walsh, vice president engineering, Orlando Division of ATC, left, Bill Brown, president, Orlando division and Ariel Parodoa, field maintenance manager, Orlando, recently received ATC's Engineer of the Year awards.

At United Artists Cablesystems, Frank Baxter is new vice president, engineering. Previously, Baxter had been UACC VP for the Midwest.

Science Dynamics, the IPPV ordering firm, has named Paula Sullivan manager, market development, cable products. CableData, meanwhile, has named Gerald Knapp president. Knapp has been with the company 14 years. At Pico Macom, John McClosky is new vice president, operations. Glenn O'Connell is vice president, marketing. At Jerrold, G. Bickley Remmey is manager, sales support/administration.

Victor Colontonio, formerly of Tele-Engineering, has joined Murray Telecom, a Stratford, Conn.-based LAN firm. Ken Cooper is now a regional director for Fairchild Data Corp and J. Thomas MacAllister is sales manager, satellite communications division, at Microdyne Corp.

In the converter area, Panasonic plans to include stereo synthesizers in its line of TZ PC-150 converters. GI's Cable Products Group, formerly M/A-COM Cable Home Group, now has a new catalog describing its product line. Call (800) 982-1708.

Alpha Technologies reports it has won its lawsuit against Data Transmission Devices, alleging that DTD was publishing false/misleading advertisements for its standby power supplies. In particular, Alpha objected to claims that DTD products can double or triple battery life, and DTD has agreed not to make unsubstantiated claims to this effect. As *CED* readers might recall, we published a lengthy editorial (*CED* January 1986) explaining our own similar concerns about such claims. We also detailed the reasons why *CED* had refused to accept the DTD advertisements in question. Our policy of accepting no advertising we believe to be false or misleading remains in force.

LRC Electronics has a new Accu-Tap, a dynamic broadband directional coupler offering 1 dB adjustments (14 dB to 45 dB in a four-way coupler; 17.5 dB to 48.5 dB in an eight-way coupler). The Accu-Tap also has an RF and AC bypass switch for 24-hour maintenance without affecting total system operation. Call (607) 739-3844. Broadband Networks has a new split-band tap featuring upstream and downstream control of tap loss values in 1 dB steps. The tap comes in a mid-split version with 5 MHz to 120 MHz return and 450 MHz forward passband, as well as a high-split version at 5 MHz to 186 MHz return and 220 MHz to 450 MHz forward passband. Eight tap values are available, ranging from 11 dB to 33 dB, allowing tap loss configurations from 11 dB to 40 dB. The taps cost $46. Pads cost $1.25. Call (814) 237-4073.

FM Systems has a new version of its MTS encoder, the model FMT633. Costing $985, the encoder produces a BTSC-compatible signal, although it is not

C-Cor Electronics has released its 1987 schedule of regional technical seminars.

BTSC format. Call (800) 235-6960 outside of California or (714) 979-3355 in California.

Channel Master has new microwave products, the model 6651/6656 repeater and the model 6650/6655 multiplier, all part of the Micro-Beam family. The repeater comes in one- and five-watt versions. The new multiplier also comes in one- and five-watt versions. Both cover the entire 500-MHz CARS band. Call (919) 934-9711.

Pico Macom has two video switchers available, the model HVC-1 and HVC-1A (amplified). Isolation ranges from 55-60 dB for the HVC-1 and 50-55 dB for the HVC-1A. Call (800) 421-6511.

C-Cor Electronics has released its 1987 schedule of regional technical seminars. They'll be held Feb. 24-26 in Pittsburgh; March 24-26 in Portland, Ore.; April 21-23 in Atlanta; June 23-25 in St. Louis; Sept. 22-24 in Des Moines, Iowa; Oct. 27-29 in Albany, N.Y.; and Nov. 17-19 in Houston. Call (814) 238-2461.

A week-long seminar on AML begins March 16 at Hughes Aircraft Co.'s Torrance, Calif., plant. Call (213) 517-6244.

Anixter has a new cable assemblies guide aimed at the voice/data networking market. Call (312) 677-2600.

Video Data Systems, the character generator manufacturer, has added Mega Hertz Sales as a representative for the Texas, Rocky Mountain and Central Plains states. MPCS Video Indutries is the New York metropolitan area representative and Omnivue Inc. is the Northeast contact. Call (516) 231-4400.

PVS Publishing, meanwhile, has a model Pro Video CGI character generator package based on the Amiga 1000 computer. Call (612) 854-7793.

Klein Tools has new winder reels for its line of fish tapes. Call (312) 677-9500. Ben Hughes Communication Products Co. has modified its hex crimp tool, simplifying the holding device for the adjusting wheel and cogged wheel. Call (203) 526-4337.

Rhoades National Corp. has released the model CPX-1 Channel-Plexer, which changes channel 3 or 4 source inputs to unused UHF frequencies for in-home distribution. Call (615) 381-9001. Also new from Geneva Group is a video switcher and kit. The switcher has a suggested retail price of $99.99 and the switching kit, containing jumpers and splitters, has a suggested retail price of $24.99. Both will be available in the first quarter of 1987. Call (612) 829-1724.

Polywater Corp. has software called Pull-Planner for the IBM PC and Apple micros that predicts cable tension when pulling cable through conduit. Call (800) 328-9384.

Andrew Corp. has a new ASR300 frequency-agile dual band (C and Ku) receiver designed for commercial applications. Call (312) 349-3300.

Zephyrus Electronics has commercial block conversion receivers as well, the ZXR-900 for C-band and the CKU-900 for C- or Ku-band. Call (918) 834-1229.

Signal Processing has the Chanelmax, a single-unit modulator and receiver offering dual band reception. Call (800) 527-4361 or (800) 442-3574 in Texas.

Tektronix has a 16-page application note on video measurements. Call (503) 627-2892.

General Instrument's VideoCipher Division is now shipping an integrated receiver/descrambler consumer unit, the model 2500R. Also new is the model 2100E descrambler unit, featuring a sleeker casing. Call (619) 457-2882.

The E.F. Johnson Co. has a line of universal self-crimping connectors attaching to more than 50 cable types and reusable up to 25 times. Most cable sizes smaller than RG-8/U can be accommodated. Prices in quantities of 1,000 or more start at $1.80. Call (800) 247-8343 or (507) 835-6307 in Minnesota.

Connectors and assemblies from Shogyo International Corp. are described in a new catalog. Call (516) 466-0911.

The 1987 Private Cable Show will be held Nov. 4-6 at the Sheraton Denver Tech Center Hotel. Call (303) 798-1274.

Alpha Technolgies, meanwhile, has introduced its line of high-power uninterruptible power supplies, available in 3KVA, 2KVA and 1.5KVA versions.

The SCTE recently opened new national headquarters in Exton, Pa. Present for the grand opening ceremonies were: from left to right, back row, Ron Simon, AVT; Pat Keleher, International Thomson Communications Inc.; Bill Henesey, AVT; Gary Kim, CED *magazine; Sally Kinsman, Kinsman Design Associates; Tom Polis, RT/Katek; John Kurpinski, Wade Communications; Andy Devereaux, American Cablesystems Corp.; Gary Selwitz, Warner Cable Communications; and Ron Mountain, Warner Cable Communications. Front row: Pat Zelenka, SCTE; Jay Capperella, SCTE; Anna Riker, SCTE; Beverly Zane-Kurpinski, GI/Jerrold; Diana Riley, Jerry Conn Associates; Bill Riker, SCTE; Bob Luff, Jones Intercable; Randy Evans, Harron Communications; Lee Burkholder, Warner Cable Communications; and Paul Levine,* Communications Technology *magazine.*

Ken Leffingwell has joined Wegener Communications as sales engineer, responsible for CATV and broadcast products.

Call (206) 647-2360.

Adams-Russell Video Information Systems now has available the faster Motorola 68000 processor and upgraded software for the ARVIS system. The 32-bit chip makes possible daily logs produced in five to 10 minutes that previously took 15 to 45 minutes. Availability reports, formerly four- to five-hour jobs, now take half an hour. The company also has introduced its new random access insertion system for smaller ad sales operations. The COMPACT system comes pre-assembled in a single rack, is upgradeable to full ARVIS capacity, and can accommodate from one to four or more channels. The system handles automatic traffic reporting, insertion and billing. Call (617) 890-5850.

Ken Leffingwell has joined Wegener Communications as sales engineer, responsible for both CATV and broadcast products. Leffingwell formerly was an applications engineer for Scientific-Atlanta. In addition, Michael Heimberger is the new company manager of customer services; Neil Kohrn is the new executive account manager and Lisa Andrews is now sales engineer.

The Society of Cable Television Engineers will be accepting applications for its 1987 National Achievement Awards until March 16. The awards recognize outstanding individuals on the technical side of CATV and all current SCTE national members are eligible to submit an application or be nominated. Nominations can be made by chapter or meeting group members. Call (215) 363-6888.

Also, astronaut and shuttle commander Paul Weitz is the featured luncheon speaker at the upcoming SCTE Engineering Conference April 2 in Orlando, Fla. The conference preceeds the Cable-Tec Expo, to be held April 3-5, also in Orlando. Until March 2, registration fees for the Expo and Engineering Conference, for SCTE members, is $195. Non-members pay $350. After March 2, SCTE members will pay $215 for the full package; non-members $370. Call (215) 363-6888.

And remember that this year's NCTA convention will be held May 17-20 in Las Vegas. Advance registration forms must be received by NCTA by April 17 for full processing of both registration and hotel reservations. Between April 18 and May 1, only show registration can be handled. Hotel reservations must be made directly with the hotel. After May 1 no processing is possible. NCTA members pay $330 to attend; non-members $600. NCTA member spouses pay $225; government officials or educators $330; overseas delegates $330. Call (202) 775-3606 for details.

Pico Products has introduced a new Little MAC home satellite system including the HR-100 C/Ku receiver and MAC-100K actuator/controller. Also new: a concentric C/Ku feed. Call (315) 451-7904.

A new 544-page reference on fiber optics is available from Howard Sams Co. Edited by E.E. Bert Basch, the volume discusses nonlinear phenomena in single mode fibers; optical system theory; coherent optical systems; analog and digital transmission systems. The book costs $69.95. Call (800) 428-7267.

LanTel Corp. has introduced the model 810 Broadband Voice Intercom for single-line telephones operating over broadband cable networks. The first product in LanTel's planned line of switched-voice products, the 810 operates over mid- or high-split networks using a 192.25 MHz translation offset. Up to 300 full-duplex station pairs are supported on the 30 MHz bandwidth and over 50 full-duplex circuits can be activated simultaneously. The 810 modem is priced at $1,080, and is initially seen as a product for the factory network market. Also new: a Broadband Portable Telephone Modem, available for 156.25 MHz or 192.25 MHz offsets. The BPT provides a mobile ringdown circuit that can be plugged in at any tap point on the network, and is suited for maintenance or troubleshooting applications. Call (404) 446-6000.

Allen-Bradley, the factory automation giant, now has a training course running on IBM PCs explaining the Manufacturing Automation Protocol. The eight-module series explains the Open Systems Interconnection model, local area networks, MAP and its sister, the Technical & Office Protocols, factory communications, and testing issues. Call (414) 382-2277.

—Gary Kim

Wavetek produces a wide variety of signal analysis meters for a range of applications.

Continued from page 65

accuracy of ±0.75 dB to 450 MHz and ±1 dB to 600 MHz. Linearized tuning with automatic frequency control facilitates selection of system carriers. The padded, soft-shell carrying case provides weatherproof housing for the Spectrum 600 and allows ease of transport. The narrow profile of the Spectrum 600 permits placement of the meter in front of the user while making adjustments and measurements.

Texscan's SPECTRUM 700 signal level meter offers 5 MHz to 600 MHz coverage, ±0.75 dB accuracy and a 0 to +130 degree F operating temperature range. The unit's aluminum case, contained in a weatherproof padded nylon carrying case, enables maximum portability.

The SPECTRUM 700 also features a large easy-to-read meter which allows precise measurement resolution of less than 0.5 dB. A battery saver feature notifies the user by audible tone of power on at five minute intervals. For more information, contact Mike Adamson, (317) 545-4196.

Wavetek

Wavetek produces a wide variety of signal analysis meters for a range of applications. The SAM Jr. is a 10 MHz to 450 MHz meter with built-in audio speaker, RF tuning circuitry, built-in RF attenuator switches, front panel calibration and battery charge interface, and an environmentally protective ABS plastic case.

The SAM I meter features internal calibration signal level, hum modulation, voltage measurement, spectrum analyzer capability, front panel battery charging interface, and 300 MHz or 450 MHz capability.

SAM III from Wavetek is a microprocessor controlled SLM with keyboard or manual tuning. This unit includes an LCD display of tuned frequency, a built-in calibrator, voltmeter, and carrier-to-noise and hum measurement functions. A spectrum analyzer interface for an X-Y display scope is also provided with the SAM III, which operates at 4 MHz to 450 MHz with optional UHF coverage. An RS-232 interface option is also available to enable remote operation.

The SAM IIIE 600 is a microprocessor-controlled signal level meter with the same standard features as the SAM III, with its frequency range extended to 600 MHz.

The SAM IV DX is a microprocessor-controlled headend rack-mount meter with built-in spectrum analyzer display. Features of the SAM IV DX include an RS-232 interface, a built in phone modem, 47 MHz crystal calibrator, and horizontal or vertical sync suppression scrambled channel peak detection capability.

For more information, contact Steve Windle, (317) 788-9351.

—Leslie Camino

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