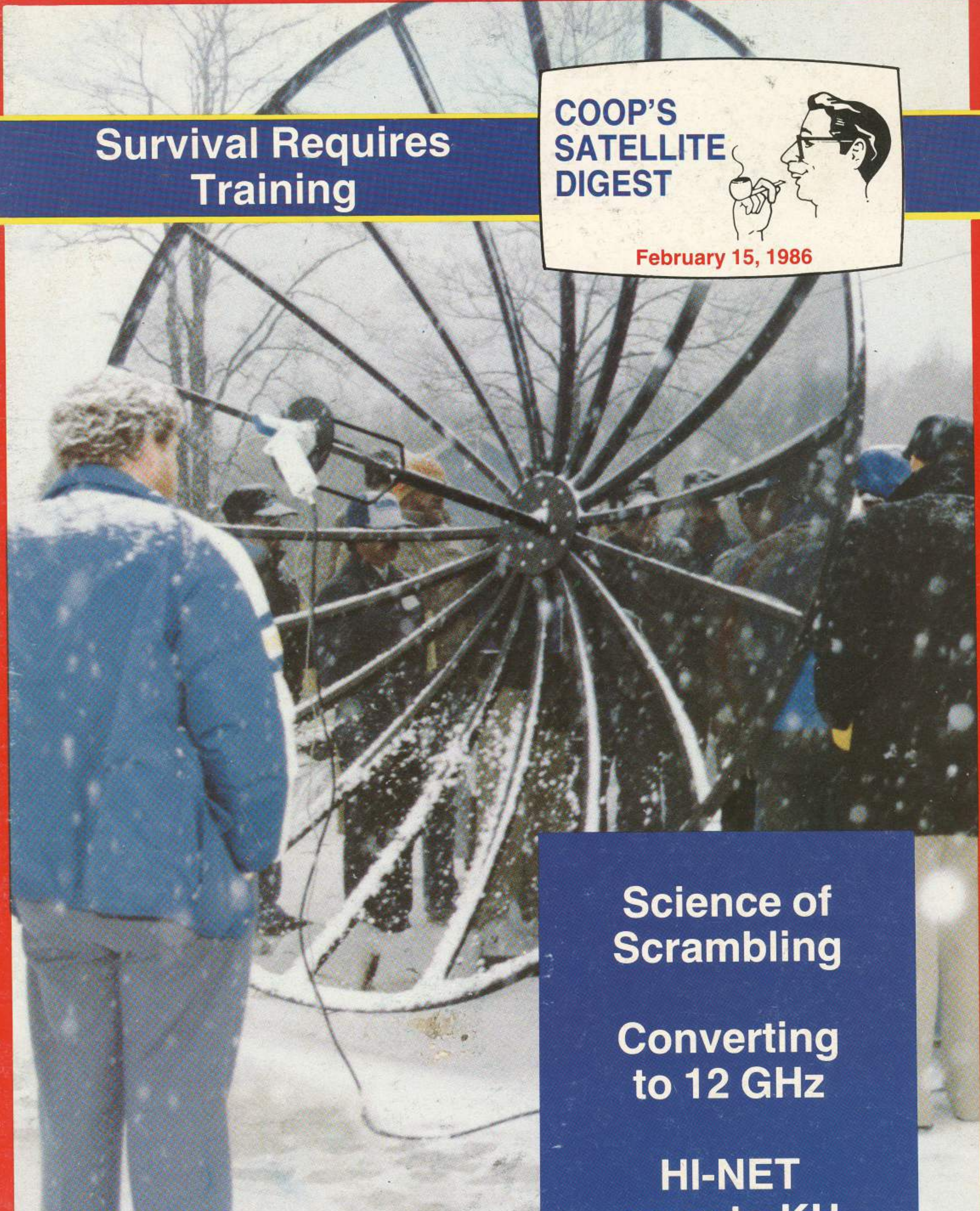
COOP'S SATELLITE DIGEST

February 15, 1986

Survival Requires Training



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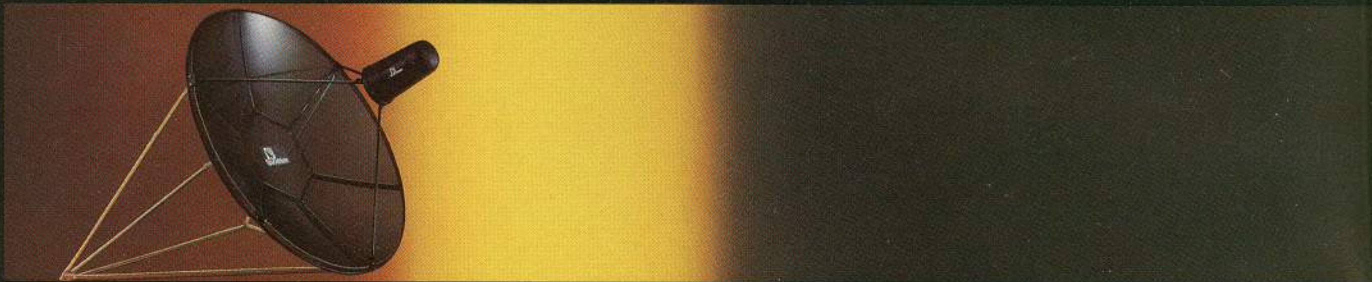

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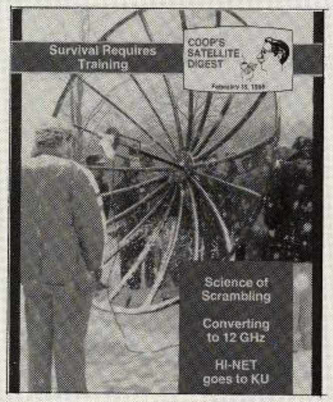
SpaceMate Plus

SpaceMate and SpaceMate Plus are also available with solid aluminum reflectors for optimum performance with Ku-band.

FEBRUARY 1986

COOP'S SATELLITE DIGEST

Our Cover/ Neither rain, nor sleet, nor a wet, clinging snow shall curtail the flow of information to this class of would-be satellite system dealers at Satellite Video Services (Inc.) in Catskill, New York. SVS routinely graduates more than 100 new dealers each month in their extensive, weekly training sessions.



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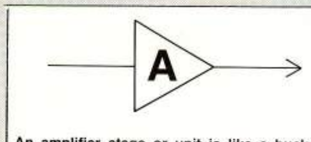
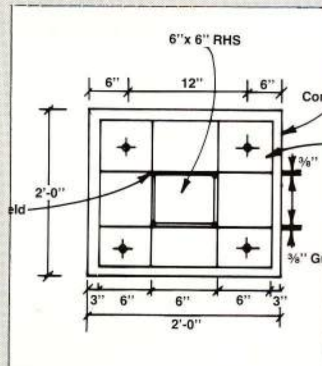
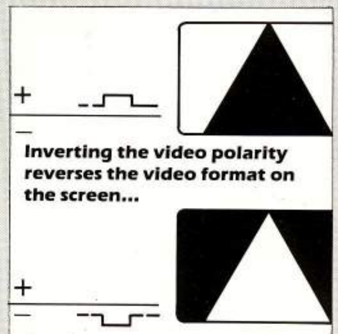


An amplifier stage or unit is like a bucket water...

when the capacity of the amplifier is exceede the excess simply 'runs over'.





Inverting the video polarity reverses the video format on the screen...

Causing dark colors to 'go light' and light colors to 'go dark'.

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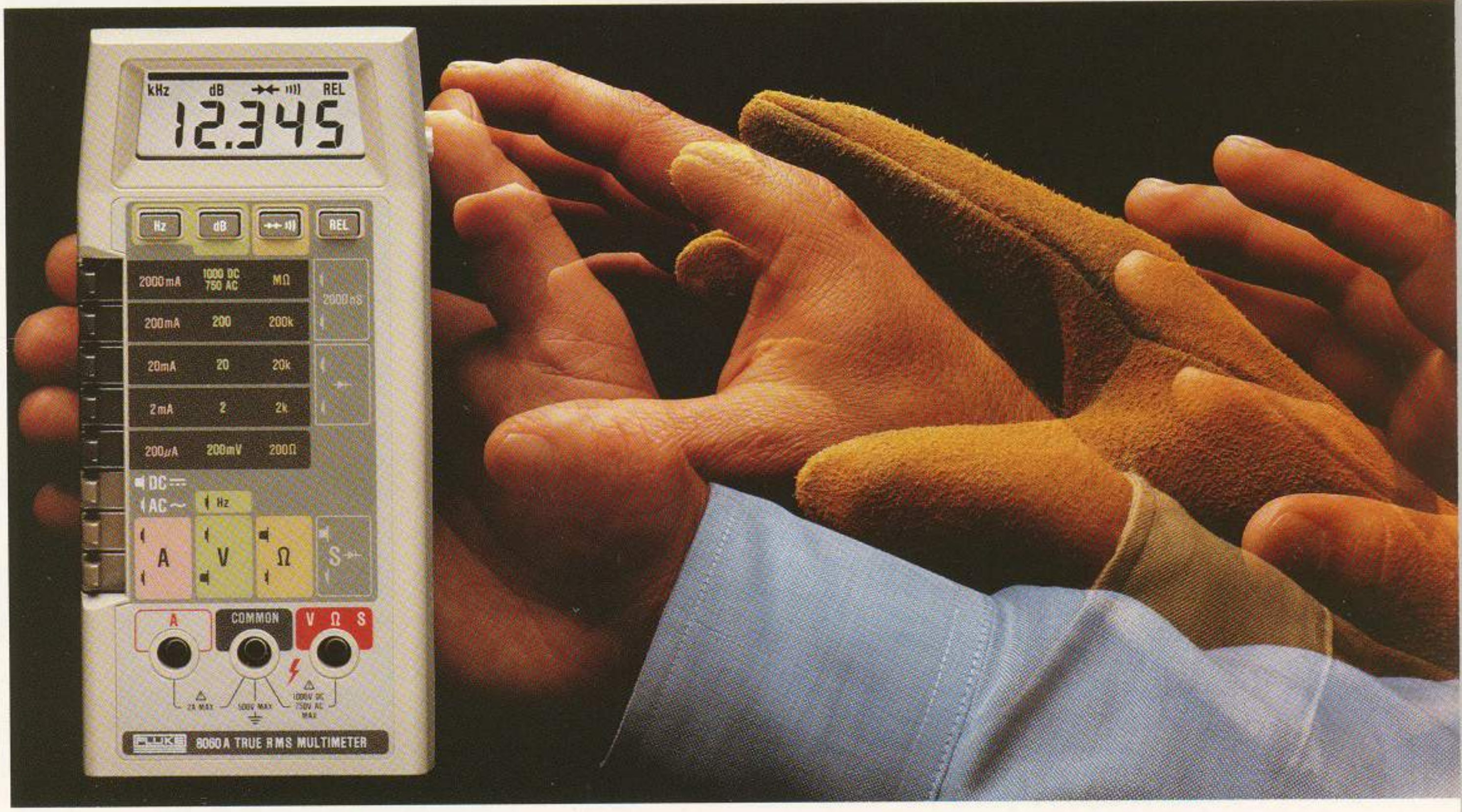
For Hz, people choose this DMM with amazing frequency.



Our 8060A has four unique buttons you won't find on any other 4½-digit handhelds.

Push the *Hz* button, and you're ready to measure frequencies from 12 Hz to 200 kHz.

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Relative reference	Continuity and Diode test	True rms ac
True rms ac	Autoranging megohms	Diode test
Continuity and Diode test	One-year calibration cycle and warranty	One-year calibration cycle and warranty
Autoranging megohms	UL 1244 listed	Factory Mutual approved/CSA Certified
One-year calibration cycle and warranty		
UL 1244 listed		

* Suggested U.S. list price.

Coop's Comments

Reassessing Practical Scrambling

A feature report in this issue addressed the science of scrambling in a way which I hope will help you better understand the real reasons why it is very unlikely someone will simply stumble onto a circuit for a make-believe Videocipher descrambler. Starting back in June, I began to hear stories about alleged bootleg descramblers. I found it interesting that the person I was hearing these stories from had heard the story from someone else; the storyteller had never seen the systems work. There are so many bucks involved in breaking the Videocipher scrambler system that I can envision all sorts of subterfuge in this game. I did have one fellow bring by a system he had worked up just days before the deadline for this magazine. He refused to show me the inside of this box but he did show me how it worked. It worked, and I was impressed.

I was impressed until I figured out that he had taken a VC2000E descrambler, ripped its case off and placed it into his own homemade box. What I was watching was a Videocipher unit all along! Under some questioning, the guy planned to sell them for $600 under the theory that people will pay more for what they believe is a ripoff than they will pay for the real thing, given the built-in hostility towards M/A-Com we have at the present time.

So, how is the distribution of 2000E units going? I checked with a handful of authorized distributors who had placed orders prior to the M/A-Com fall deadline. They had to order 300 units to qualify as a distributor and they had to agree to pay $345 for the units. Yes, that comes to around $100,000 in product inventory. But not too worry, nobody was destined to get all 300 ordered at one time anyhow.

Other than a few hand drawn samples, nobody had the units prior to January 14-15. Then they arrived in quantities of 30 or 60 at a whack. Yes, that was pretty close to the self-imposed January 15th deadline of HBO to begin fulltime scrambling. Right up to the last minute there were rumors all over that the deadline would be extended and that HBO would not scramble full time on the 15th afterall. Not true, as you are now well aware.

There were also numerous stories that M/A-Com executives were being shuffled one more time (also partially true). Right up to the end, it was almost impossible to get proper instructions on where to go for a descrambler. The truth was quite simple; authorized distributors were reluctant to admit they had placed orders because they didn't have the merchandise on hand and therefore could not deliver anyhow. Moreover, many of the authorized distributors were afraid they might be branded as traitors if they popped out early with an announcement about the availability of the 2000E units.

When they finally did arrive, the early units disappeared like a forbidden fruit. SVS had 60 on January 15th and none by the end of the day on January 16th. That was to be expected; most of us will spring for at least one, just to see how it works. The bright dealer should have ordered one for his showroom because he needs to be able to show potential customers that there is a box available for descrambling.

On January 16th, Shaun Kenny got many people's attention on Boresight when he reported that it was illegal for a TVRO dealer to have a 2000E operating in his showroom. How could that be? How could a dealer demonstrate TVRO if he could not switch on the 2000E for a potential customer?

HBO has a restriction in their contracts; every customer will have a contract. HBO is not allowed to distribute their programming in commercial establishments where the public gathers. A bar is a public establishment. So is a TVRO store, they claim. That means HBO cannot be shown in a hotel bar, for example, even though it is shown in the hotel lodging rooms. That is the way it has been for many years now.

Would HBO prosecute TVRO dealers who showed HBO in their showrooms? Have they done so in the past? The answer is no. The whole problem stems from the HBO agreements with its movie suppliers, and the movie suppliers insist that HBO is licensed by them for private showings, not public showings. Alas, another problem to sort out.

Not all 70 MHz receivers worked with the VC2000E but the mention of any specific brands or models which did not seem to work properly, at this early date would be a possible disservice to the receiver manufacturer. We mention this, however, because a couple of brand name receivers don't appear to have the proper 70 MHz signal characteristics to work at all. You had better check with your VC2000E distributor or your receiver supplier for a hard promise before you make any wild promises on your own to a customer who feels he really must have the VC2000E for this system. In another 60 days, we'll all know far more about which receivers do and do not work with the production VC2000E units.

Pricing. There have been some interesting pricing developments in the descrambler program. For example:

1) At least one distributor (STS/Satellite Television Systems of South Carolina; 800/833-3610 outside of South Carolina) will discount the $365 price provided you buy a system from them. The discounted price is $345.

2) HBO makes turn on for your service quite easy. An 800 number with the VC2000E and a VISA or other major charge card gets you service, typically within 30 minutes of calling. Some reported their systems were turned on almost instantly as they hung up their telephone.

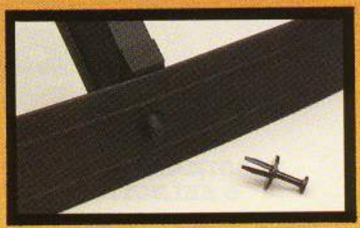
3) And the most interesting part: a few aggressive cable systems have decided to become national. Here is how that works:

As authorized HBO affiliates, they have been approved by HBO to sell their service into any region of the United States where there is no HBO (cable) affiliate. They have also decided to sell their HBO and/or

Coop/continued on page 62

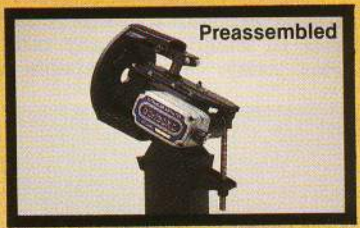
Today and Tomorrow THE deScrambler™ Sells Itself . . .

1



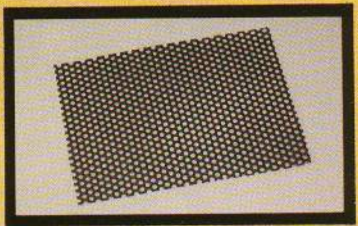
Snap together rim for easy installation

2



Permanently lubricated motorized mount

3



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4

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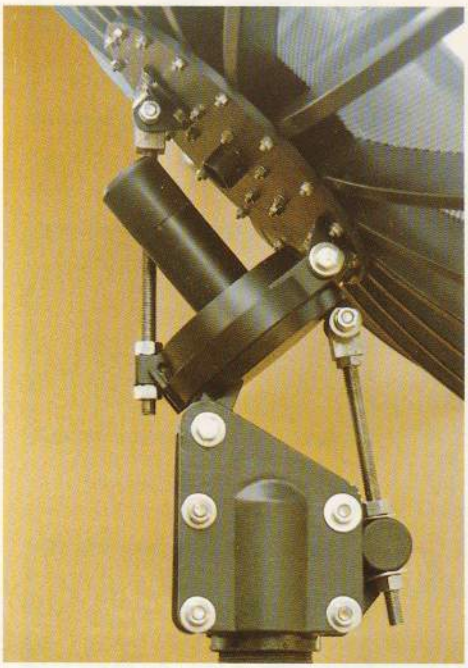

1000 ft/lbs Torque. Well, that's the design that's got the TVRO Industry so excited. The engineers at Raydx found that existing Geo-stationary satellite tracking systems just couldn't meet the company's exacting standards for superior performance, dependability and consumer appeal. So they suggested that Raydx, the Leader In Dish sales manufacture their own. And that's just what they did.

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PATENT PENDING

Starting Over

Starting Over

While the first block downconversion receivers were introduced in 1978, and the first block receivers appeared in 1981, it has only been during the last 10 to 12 months that the block downconversion concept has really caught on in the industry. There are many dealers who find the block concept difficult to understand and therefore difficult to properly employ. Much of the confusion concerning block downconversion originates from a lack of user understanding as to what block conversion is, and how it differs from the original 70 MHz (single conversion) concept pioneered first by Robert Coleman and then tidied-up by David Barker in 1980.

Let's start with the single conversion package since many of our references in explaining block conversion go back to the original single conversion system.

1) Satellite television is transmitted in a series of consecutively packed, but independently operated, downlink channels. These channels are each 40 MHz wide, and they are in the region of 3.7 to 4.2 GHz (also the same as 3,700 MHz to 4,200 MHz).

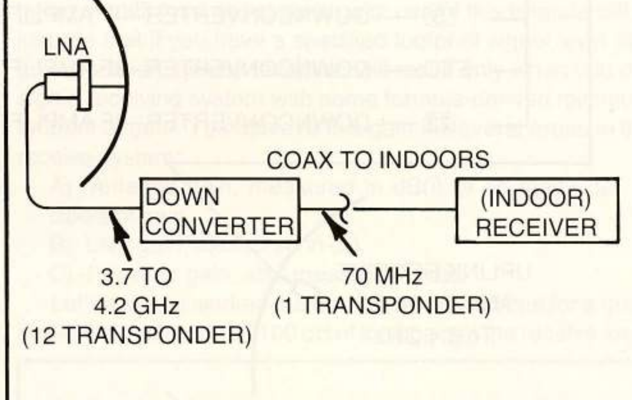
2) Each of these channels (or transponders) does its own thing, and each channel is tied to all of the other channels in the same satellite through a common sharing of such satellite parts as the antennas, the power supplies, and the control systems.

3) The transmitting power we see on earth from any single channel is a function of several factors, including:

A) The maximum power available for any specific transponder (typically 5, 7.5, 8, or 9 watts for US domestic satellites), and;

B) The strength of the uplink signal, from the originating program source, which sends the program material to the satellite.

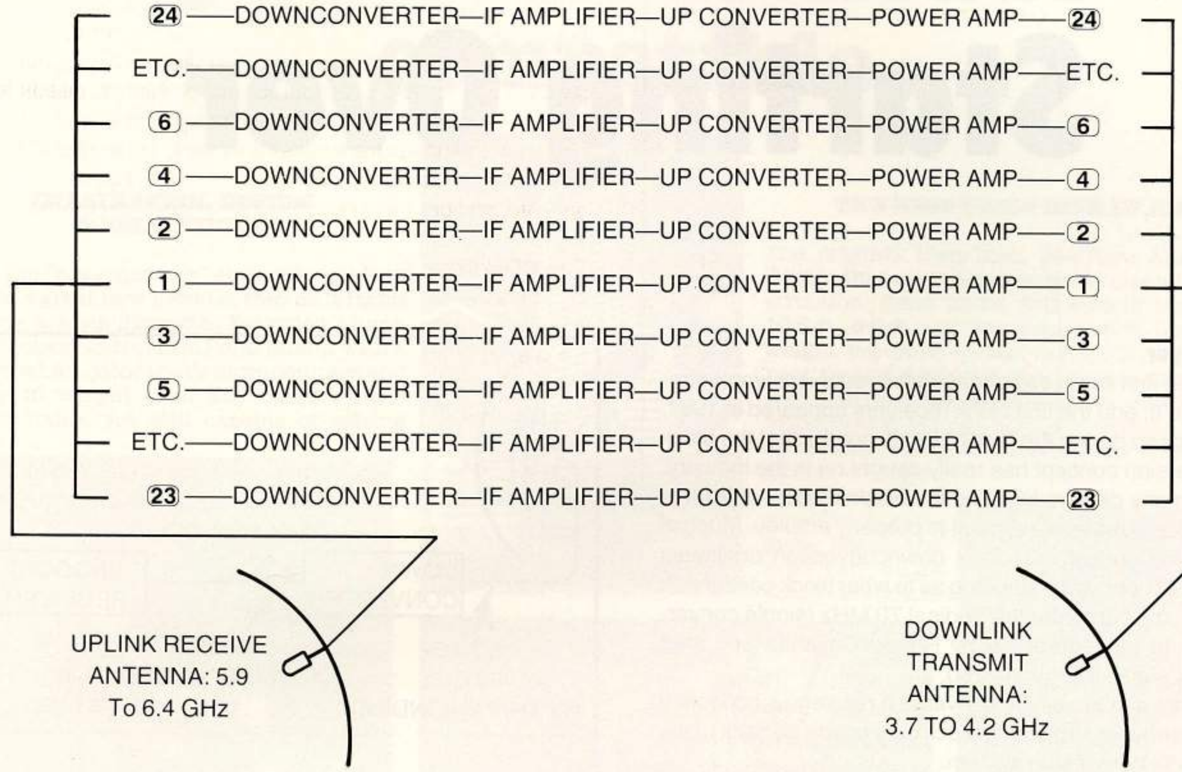
Certain transponders are designed for maximum transmitter power of 5 watts (transponders 1, 5, 9, 13, 17, 21 on F3R) while others may have powers as great as 11 watts (ANIK-D transponders). However, the owner of the satellite, RCA for instance, may issue special instructions to the user of a certain channel to throttle-back the uplink power to keep the transmitter power at some number lower than the full rating (such as CBS on TR8 of F3R). This throttle-back instruction may be caused by a fear that some part of the transponder is heading for premature failure, or a concern that some shared segment of the satellite, such as a powering system, is overtaxed and by cutting back on individual transmitter powers, the shared power source may last longer.



In single conversion receiver, transponder selection is made out-of-doors, in LNC or downconverter.

Therefore, as a satellite ages, we begin to measure some distinct differences in signal levels or strengths. As the satellite continues the aging process, closer and closer to the 7 to 10 year lifetime anticipated for a mature satellite, the differences in satellite signal strength between channels or transponders which are supposed to be equal, increases. This variation in signal levels is more pronounced with the older generation satellites than with the newer generation satellites. Still, other newer generation satellites, such as Telstar 3, use a hybrid technology for their transmitter amplifier powering systems and these hybrid birds will, in time, exhibit even greater variations in signal levels as the satellites age.

Satellites age in several ways. Every satellite is dependent upon its fuel supply and its powering system for long term use. The fueling system is a small supply of hydrazine gas which is allowed to escape from miniature thrusters built into three faces of the satellite. These jets of fuel are commanded by ground controllers at regular intervals to insure that the satellite stays where it is supposed to be. Several forces in space act constantly upon the satellite's position; gravity is the greatest of these and land mass areas on the ground exert a tiny, but constant pull on the satellites. Left alone, all of the satellites serving North America would gradually drift to a position near 104 degrees west where they would cluster from the gravity. Satellites east of 104 degrees must be kicked back to their assigned slot in space every 15 to 30 days by the careful firing of the hydrazine thrusters. Those west have the same re-



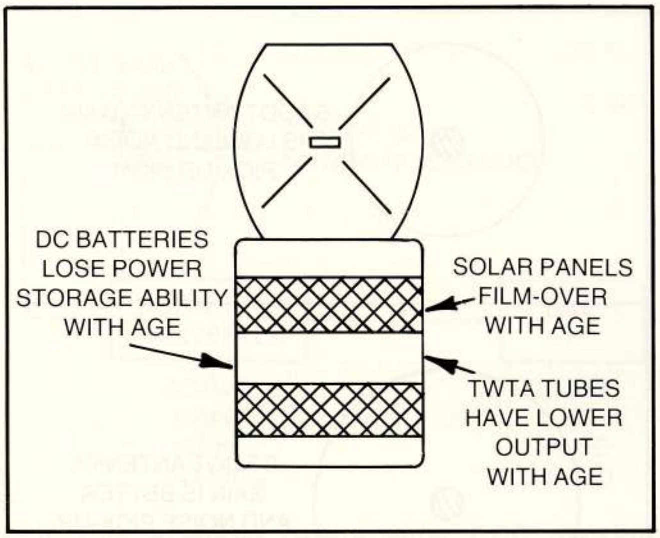
Simplified block diagram of traditional satellite signal processing system. Other than common use of antennas, each transponder has individual signal processing system on board the satellite.

peated rocket thruster firings except they are pushed back to the west.

Hydrazine fuel carried on board the satellite will eventually be used up (a small amount also escapes from the containers on board). The real lifetime of a satellite is usually determined not by the spent hydrazine fuel (once the fuel is gone, the satellite can no longer be controlled and the last bit of fuel is used to kick the satellites 'out of Clarke Orbit' and higher into space where a considerable junkyard of spent birds are already collecting), but by the electronics on board.

There were two critical time clocks in the orignal satellites. One was something called a traveling wave tube or TWT(A) for short. The TWT(A) is the power amplifier which creates the (5, 7, 7.5, 8, 9, 11, etc.) watt transmission source for each channel. There is one TWT(A) for each channel or transponder on board and in newer satellites a 24 channel bird may have six spare TWT(A) units in place ready to switch in by remote control from earth should one of the TWT(A) units fail prematurely. The second time clock on board is the solar panel powering cells and their associated rechargeable batteries. A satellite opens up sizeable flat panels of solar cells once it achieves its proper geostationary orbit location, and those solar panels are directed to follow the sun in outer space. The tracking system must be quite precise to insure that the sun's rays strike the solar cell panels at the angle which best transfers energy from the sun's rays to the panels. This requires a bit of high technology to keep the panels pointing directly at the sun at all times.

Solar panels wear with time; tiny dust particles in space wear away at the surfaces causing the cells to gradually receive less sunlight. The cells themselves, which convert sunlight into (DC) electricity, also lose efficiency in time. The weak link in the chain is the battery storage system which receives the DC voltage from the panels and stores that voltage for satellite use. The satellites cannot convert sunlight to DC and use that DC in real time because there are periods each year (two) when the sun is blocked from the satellite by the earth. During these eclipse periods, there can be several hours when the satellite gets no sunlight, and no power, at all. The satellite's battery storage system must be adequate to insure that during these eclipse periods the satellites still operate. In older satellites, such as Westar 1, 2, and 3, it was necessary to reduce the number of channels/transponders in use during the eclipse period to insure that the batteries did not run out of power before the sun came back in view. More recent satellites are equipped with larger battery and larger storage systems to allow full, uninterrupted, service during an eclipse period.



Batteries, even extremely high-tech batteries which operate for up to 10 years going through never-ending charging/discharging/recharging cycles eventually wear out. The condition for all batteries on a satellite is under constant surveillance by ground flight controllers. In fact, the satellite is flown by a flight controller 24 hours a day, 365 days a year. The flight controllers monitor, using a technique called telemetering, as many as 200 different important measurement points in a satellite constantly, and using uplink telemetering commands, make small adjustments in the satellite's altitude several times per day to correct for variations in satellite operation.

So, as a satellite ages, and the expected or unexpected decay takes place in the satellite's TWT(A), battery, solar panel, and other component sections, greater and greater precision is required by the flight controllers on the ground. Sometimes there are mistakes in the flight control commands and satellites momentarily shut down service (RCA's F2 satellite turned over briskly one day and pointed in the wrong direction, away from earth, for several hours).

TVRO users, with small dish antennas which are perhaps marginal in size to produce quality pictures when a satellite is brand new and everything is working perfectly, quickly notice this aging process of a satellite. When there is a change in the satellite's altitude, or its operating condition, even if only for a few minutes time, the small dish systems see these changes first because there is a lack of something called margin in the receiving system. Margin? Extra system gain, not needed for a new satellite or when a satellite is operating perfectly, but much needed when the satellite ages or momentarily points in a slightly off-boresight direction.

The TVRO dealer cannot be expected to fully understand all of the nuances of hour-by-hour and year-by-year satellite variations. What he should appreciate, however, is that the satellite system he depends upon for stable, solid service is subject to both human and mechanical/electrical error and problems and the smaller the dish the quicker these variations will be noticed. Additionally, the further the TVRO dish is located from the so-called boresight location, the quicker pointing or altitude errors or changes will be noticed.

All of this becomes increasingly important when you begin to juggle the antenna/LNA/receiver combinations which seem to produce satisfactory performance in your area in North America. When receiver systems adopted the block downconversion techniques, entirely new variable elements were introduced into the system equation. The dealer, to sort out his installation practices, procedures and problems, needs to appreciate the complexity of the entire system link which really begins at the uplink transmitter and really ends after the signal has traveled some 45,000 miles through space (up to the satellite, and back again) at the dish system you are installing.

The BDC Difference

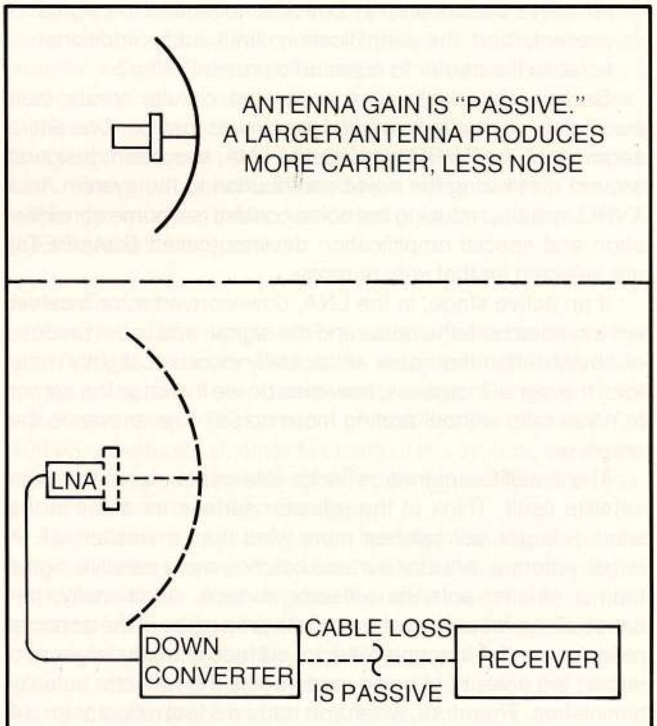
The satellite system you are installing is the only variable or adjustable function in the satellite link equation over which you have any control. There is a formula which allows the computation of path loss and system gain; use of this formula will illustrate that if you have a specified footprint signal level at a given location, quality reception will result only when you design a receiving system with some formula-derived minimum amount of gain. You achieve this gain in several areas in the receive system:

A) Antenna gain, measured in dB(i) or so many decibels of gain.

B) LNA gain, measured in dB.

C) Receiver gain, also measured in dB.

Let's say you worked the formula and found that for a quality picture you required 100 dB of total gain at the receive loca-



Only antenna gain increases can make significant improvements in the carrier to noise ratio. More gain at the LNA (LNB, LNC), downconverter or receiver will typically make the carrier to noise ratio worse, not better.

tion. Could you not trade off gain within the LNA and/or receiver for gain in the antenna, and get by with a smaller antenna? That is a logical, if not uninformed deduction.

There is another entry into the system equation and it involved an operating parameter known as carrier to noise ratio. The signal, coming from the satellite, is the carrier part. Noise, or an absence of signal but the presence of interfering signals originating in space itself, the earth and the electronic equipment, is the other half of the carrier to noise ratio. For a high quality picture, one with no noise present in the picture, there must be a minimum carrier to noise ratio. That number will vary between 7 (dB) and 10 (dB) depending upon the receiver's internal circuits.

The ratio, carrier to noise, is the result of taking a measurement of the signal with a meter device, and then taking a second measurement of the amount of noise in the receiver system. These two measurements are done in decibel power units and with the appropriate instruments you end up with 2 decibel (dB) numbers. There needs to be 7 (10) more dBs of signal than noise for our receive system to work properly.

The antenna gain, in dB, is passive; that is, the gain achieved in the antenna is done without electricity or active amplification. Gain created in the system after the antenna, in the LNA or downconverter or receiver proper is active gain; this gain is created with circuits operating from electricity. Here is the key:

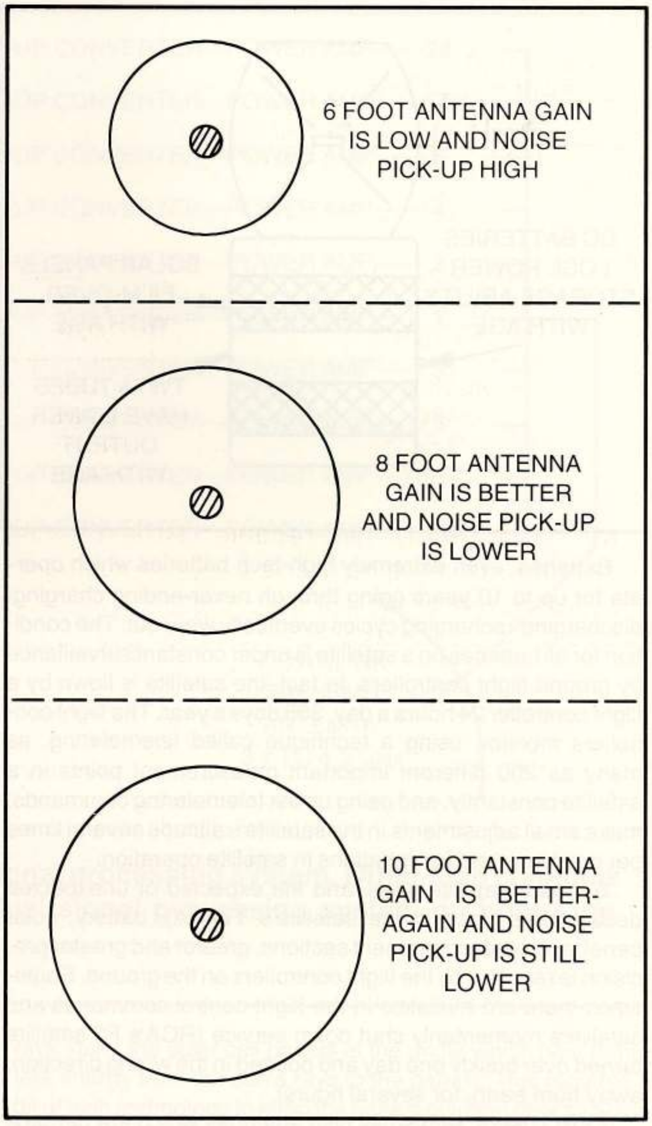
All active circuits amplify both the noise and the signal present, and the amplification itself adds additional noise to the carrier to noise ratio present. Why?

Because all electronically-operated circuits create their own noise, no matter how good the circuits may be. One entire segment of the TVRO system, the LNA, has been designed around minimizing the noise contribution to the system. In a TVRO system, reducing the noise content is a prime consideration and special amplification devices (called GaAs-FETs) are selected for that very purpose.

If an active stage, in the LNA, downconverter, or receiver will increase both the noise and the signal, and in the process of amplification the noise will actually increase slightly more than the signal increases, how then do we increase the carrier to noise ratio without adding more noise? The answer is the antenna.

The satellite antenna reflector intercepts signal from the satellite itself. Think of the reflector surface as a sail in the wind; a larger sail catches more wind than a smaller sail. A larger antenna reflector surface catches more satellite signal than a smaller antenna reflector surface. Additionally, because of the focusing or beamwidth properties of the antenna reflector, as the antenna reflector surface is made larger and larger, the amount of noise captured by the reflector actually diminishes. Therefore, when you trade a 6 foot reflector for a 4 foot reflector, you are increasing the signal at the same time you are decreasing the noise. This follows through for any increase in antenna size; a larger reflector captures more signal and less noise than a smaller reflector.

There is no way to increase the carrier to noise ratio other than increasing the passive gain of the antenna. Adding more system gain, electronic gain created by active electricity driven circuits, after the antenna increases the noise and the signal at the same time and by act of active amplification also decreases the carrier to noise ratio because each amplifier stage or section adds additional noise to the composite signal plus noise package.

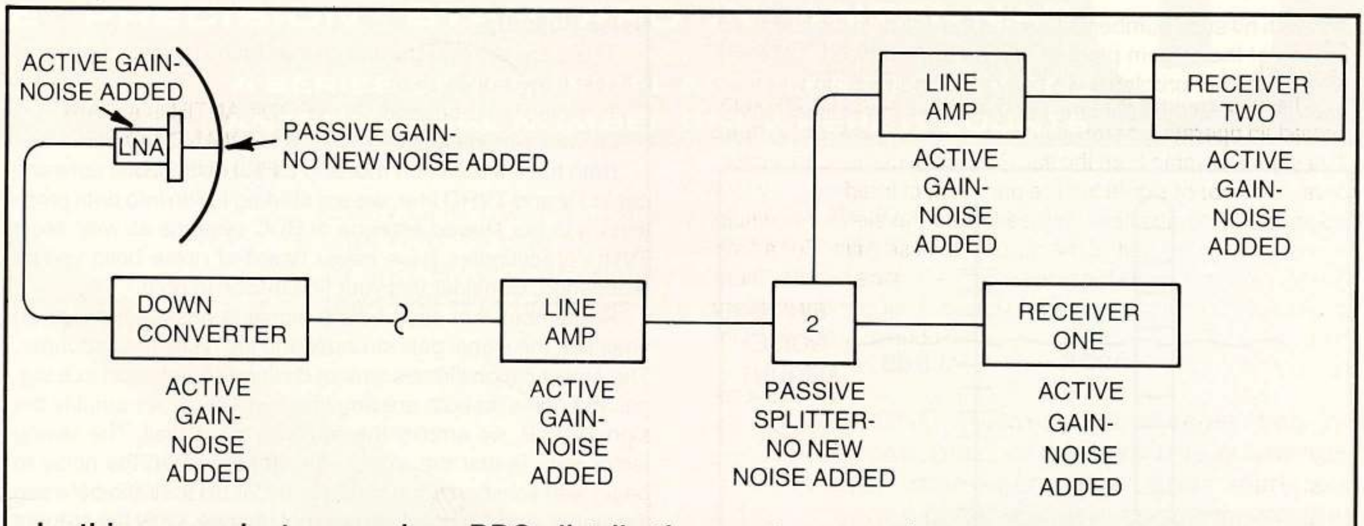


This is basic to any TVRO receive system regardless of the type of receiver design employed. However, the carrier to noise relationship, which is the key to producing high quality pictures from space, becomes more complex in a BDC (block downconversion) system. Let's see why.

Run and Split

The carrier to noise ratio (CNR) is maintained in a system right up to a section of the receiver called the demodulator. This is after the antenna, the LNA, the downconverter/block converter, the receiver amplifier, the receiver filters, and a host of other receiver circuits including the AGC (automatic gain control). It is important to remember that the original FM format of the uplink transmitted signal remains intact, just as it leaves the uplink antenna, all the way to the input to the demodulator section of the receiver proper in your system.

This means that any processing you do of the signal, prior to the demodulator, can and will have impact upon the carrier



In this example two-receiver BDC distribution system, receiver two has additional line amplifier and will have five separate noise contribution points while receiver one will have four points noise contribution points.

to noise ratio. Also, recall that each time you amplify a signal using an active electricity-driven circuit you are contributing (new) additional noise to the composite signal + noise package. Ideally, a system would be designed so that you extract picture and sound from the composite signal before you did any amplification at all since all amplification adds (and distorts) to the noise originally present.

The primary gain in any system is the antenna gain. As we saw, gain added after the antenna trades off more noise for more gain. In a BDC system, the lure of BDC is that an entire block or group of transponders are treated simultaneously by the conversion and amplication process. And this allows the installer/user to independently access individual transponders with individual receivers each connected to a common antenna.

Alas, there is a price to be paid here.

The concept behind BDC systems is that by downconverting the full 500 MHz satellite frequency (downlink) band from its original 3,700/4,200 MHz range to a lower IF range, the new IF band can be amplified and signal-voltage-split again and again to drive a coaxial cable distribution network serving multiple receiver locations. We diagram that for you here.

Noise 'vs' Noise

There are two separate types or categories of noise in a system such as this. You might characterize source A as:

Noise caused by a lack of signal, and you might characterize source B as: noise caused by an abundance of signal.

What is that all about?

When the carrier to noise ratio at the antenna is too small, there is a shortage of carrier (and therefore an abundance of noise) in the system. We see that type of noise as sparklies or we see tearing edges on sharply defined images on the screen accompanied by picture 'jitter'. The solution to this sort of picture is a larger antenna.

When the carrier to noise at the antenna is adequate, but within the system between the LNA input and the demodulator (stage) input there is excessive amplification, the systems pictures suffer because the carrier to noise ratio suffers from the amplification-added noise. This type of noise can be seen as a fine-grain which is most apparent at close viewing distances.

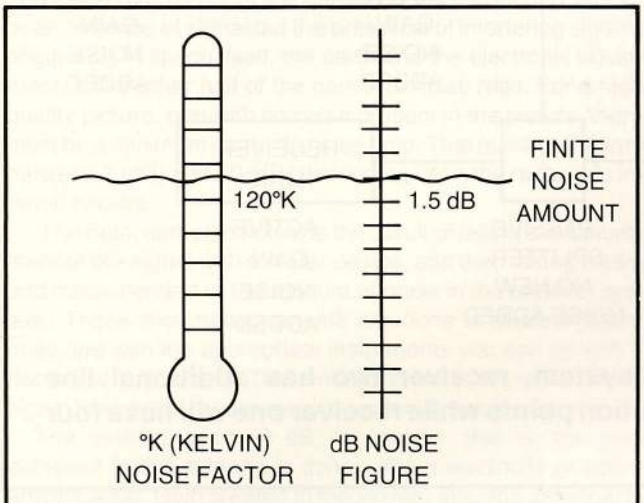
Sparklies are caused by an initial lack of signal and the cure is a larger antenna, or in marginal situations, a lower noise LNA. Fine-grain noise is caused by a noise build-up created within the receiver/cable distribution system and the cure is the subject of this report.

Noise Factor

Every amplifier stage within a system has some measureable noise factor. In the LNA world, we measure the noise factor by using the Kelvin temperature scale. So much noise equals some equivalent amount of noise temperature (such as 100°K). In virtually all other sections of the system, we measure noise on another scale called noise figure. Here, the measurement is done in dB once again.

Both systems have a common heritage and actually it is the scale of measurement that differs and not the approach to the measurement. In either degrees K or dB a lower noise number means a better circuit. Ideally, there would be 0 degrees K or 0 dB noise in an amplifier. No such ideal amplifier has ever been created and in fact none will ever be created since the motion of (electrical) molecules in a circuit sets atoms into motion and that motion creates noise all by itself.

With appropriate measurement equipment, it is possible to determine the amount of noise in a circuit or amplifier stage. LNAs routinely are subjected to this type of measurement; that's where the noise factor (85 degrees K, 100 degrees K, etc) specification or rating comes from. The same type of measurement is just as important in our balance-of-receive-system equipment as well. But, unfortunately, such measurements are not always performed on the balance of a system and with no such numbers stated on the unit or in the literature, the job of the system planner can be quite difficult. Let's see why, and what problems we can get ourselves into when we don't know enough about the equipment we are working with.



Degrees kelvin (°K) and (dB) noise figure are two complimentary scales which relate to the same thing; how quiet (or noisy) a circuit is.

Noise Build-Up

There are two system-design foes faced by every builder of a cable television system:

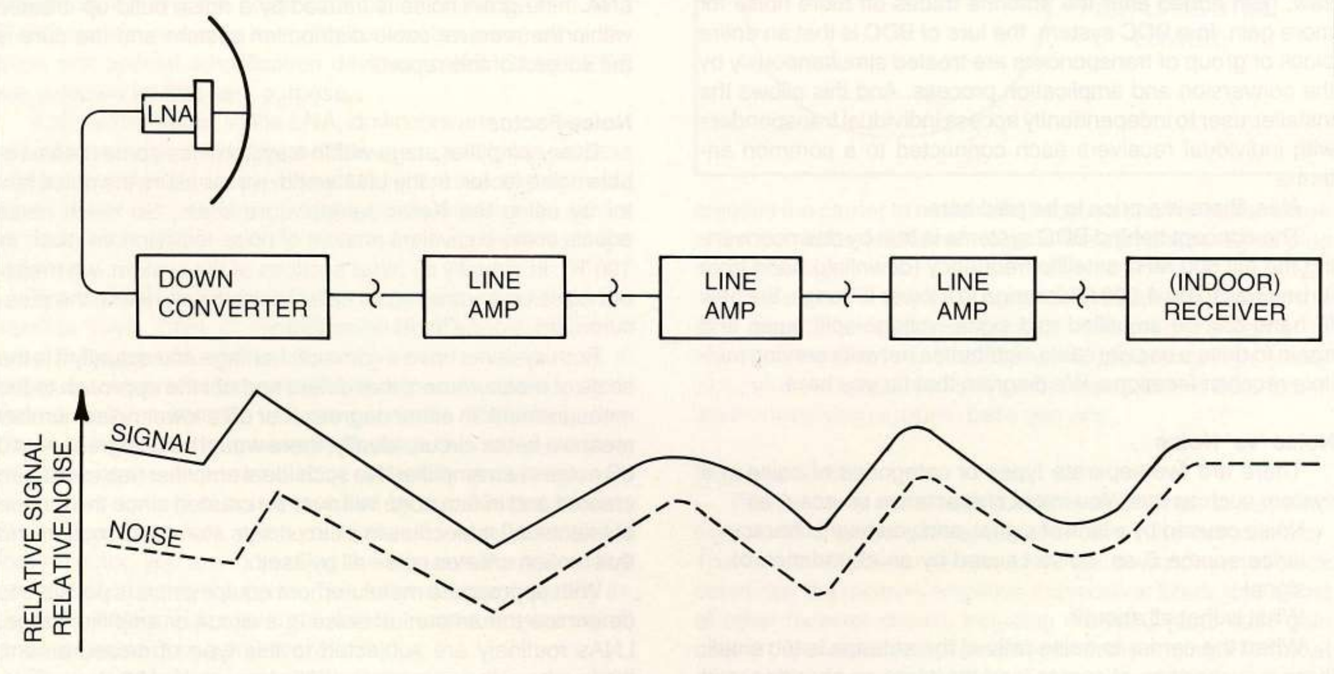
1) Noise build-up, and,
2) Cross-modulation

Both have a common root and as the distinctions between cable TV and TVRO blur, we are starting to run into both problems with our shared antenna or BDC systems as well. Most TVRO practitioners have never heard of noise build-up nor cross-mod. Consider this your first lesson in both.

Remember that each time a signal is passed through an amplifier, the signal gets stronger and the noise gets stronger. The amplification circuits cannot distinguish between true signal and noise so both are amplified equally. If we amplify the signal 20 dB, we amplify the noise 20 dB as well. The saving factor here is that the signal was stronger than the noise to begin with so when each increase by 20 dB the ratio between the signal, and the noise, should not change. Only the amount of signal, and the amount of noise, changes. But the ratio, on paper or in theory, stays essentially the same.

Each amplifier stage has its own noise factor. It imparts some of that noise factor to the noise already present in the amplification process. The change is slight, but in a series of amplifiers there is a build up of additional noise as the signal is amplified, amplified again, and re-amplified.

Let's assume we have a 10 dB carrier to noise ratio in the first amplifier stage input, after the LNA. That would normally be in the input to the downconverter. Let's assume something that is valid only for this discussion and the downconverter



As more and more stages of amplification are added together, system noise 'figure/factor' increases, reducing carrier to noise ratio (CNR) or the total system.

adds no noise of its own, but merely shifts the frequency of the signal from the GHz band to a new IF band of say 950 (to 1450) MHz. Now we have a BDC distribution system consisting of some number of amplifiers, splitters, and taps. Our BDC downconverter shifts the input frequency downward, on its way to the 950-1450 MHz region. We diagram that for you here.

The cable losses are quite high at 950 (–1450) MHz so we need some amplifiers to carry the signal through the high loss cable and to reach our more distant TVRO receivers connected to the system. Without much thought, we select a handful of 20 dB gain BDC IF amps and proceed to wire up the system. At the end of the line, our pictures look grainy; they have a fine-dot type of noise which looks like a film laying over the top of the video. The closer you get to the screen, the more the noise stands out.

If we could measure our carrier to noise ratio, we would quickly see what has happened here. In the process of selecting our 950-1450 MHz 20 dB gain line amplifiers, we have chosen amplifiers with too high an internal noise factor. We have totally ignored a basic law of cable system plant design.

When We Double The Amplifiers

A strange, but predictable, thing occurs when you start sticking amplifiers in a line or row on a cable distribution plant. Each time you double the number of amplifiers in the series or line, the noise factor increases by a significant amount. In a standard cable TV plant, engineers know that if they have a certain signal to noise (their equivalent of our carrier to noise) ratio of 48 dB when they start out, after two amplifiers the signal to noise will be 3 dB worse, or 45 dB. After four amplifiers, the signal to noise will be another 3 dB worse of 42 dB. Each time the number of amplifiers is doubled, the signal to noise ratio typically goes down by 3 dB. In other words, the noise from the amplifiers doubles in a predictable way as the number of amplifiers itself doubles.

A careful study of our existing BDC systems, a simple DBS system, will reveal the following:

1) Most BDC downconverters have an amplifier stage built into the downconverter. The downconverter consists of a mixer driven by a fixed frequency oscillator, and then after the frequency conversion, a stage (or more) of signal amplification for the new IF signal(s); whether they are 400-900, 950-1450 or some other chosen IF range.

2) Inside the receiver, typically indoors of course, we have an input stage which consists of another IF amplifier stage. Like the unit outdoors in the downconverter/LNB, this IF stage adds gain and some noise to the system equation.

Even before we start off with adding new, external BDC-IF amplifiers along the cable to get the signal inside and to the various TVRO receivers connected to the system, we have two stages of IF amplification in the system. That means we have degraded or reduced the carrier to noise ratio in the system with our IF amplification unavoidably.

Now, fortunately for us, the contribution of noise in a frequency modulated system (i.e. a system which is processing and passing signals which are FM rather than AM) is significantly more manageable than the cable TV people find things. This means we can be more tolerant of noise sources. It does not mean we can ignore the degradation of noise coming from IF line amplifiers. In fact, you can use this rule of thumb:

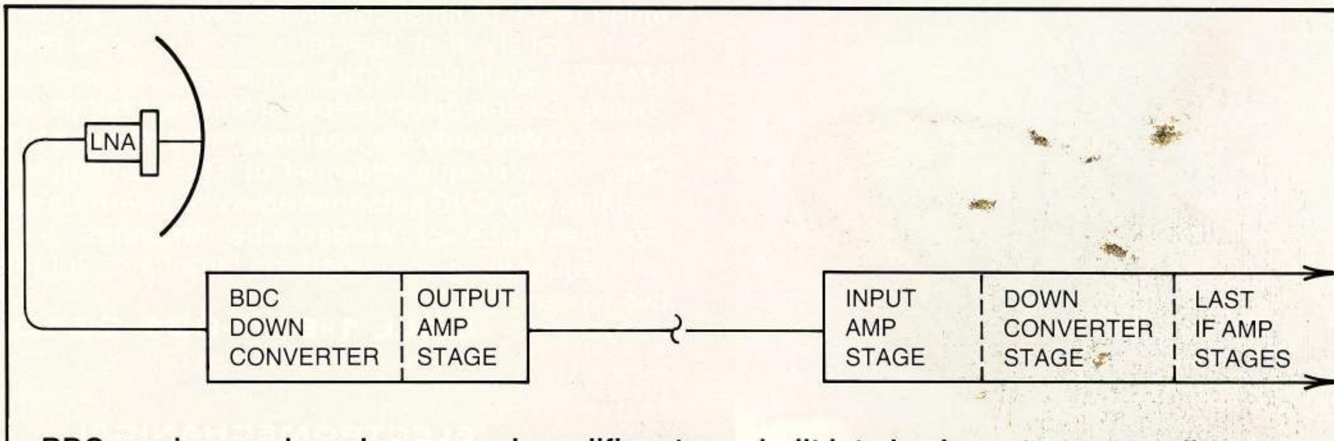
"If you can see a fine grain type of noise on the pictures, you know that you have a system (downconverter, line-amplifier, or receiver) amplifier noise figure problem. There is an accumulation of noise factor in the system and no amount of improvement in the LNA noise temperature nor in antenna gain will resolve this problem."

And then there is cross-modulation. Every amplifier stage is designed to have a certain amount of gain. Let's call it 10 dB since many of the small cable amplifiers created for TVRO distribution have this amount of gain. Gain alone is not the only criteria we must be concerned with, however.

1) Every amplifier unit is rated in its gain ability.
2) Every amplifier unit is rated in noise figure or factor.
3) Every amplifier is rated for its maximum output.

Maximum output is the potential culprit. Here's why.

An amplifier uses transistors which have a certain amount of gain, when placed in a specified circuit, over a given (specified) frequency range or band. The transistor(s) in the



BDC receiver package has several amplifier stages built into basic system so any line amps added to cable line are adding to basic noise levels already present.

amplifier has a specified operating voltage (such as 12 volts DC) and a specified operating current. The sum of the operating voltage and the operating current equals power. For example, 12 volts operating voltage and 20 mils operating current equals 12 x 20 or 240. In this case, it happens to be .240 of a watt. This numerical sum is the total amount of power which the transistor will dissippate or turn into heat in the amplification process.

Why should you care about the heat? No, not because heat causes equipment to quit.

The transistor in the amplifier has maximum ratings. Let's say the operating current in the transistor stage changed. Rather than being 20 mils, it suddenly became 30 mils. Now the transistor is dissipating .360 watts of heat. That's a 50 percent increase. What happens given this change in operating condition? The transistor may break, and like a fuse will snap or melt. It is important, then, that the specified operating conditions be maintained and not exceeded if we want the amplifier to function as it was designed to function.

Now suppose that we do something else with that amplifier which we should not do—like overdrive the amplifier. What does that mean?

Just as the amplifier has a specified power dissipation rating, it also has a maximum output power rating. Perhaps the output rating is +30 dBmV. and the amplifier has 10 dB of gain. That simply means that IF +30 is the maximum output allowed, and we will amplify the signal fed into the amplifier by 10 dB, the maximum input the amplifier will stand is +20 dBmV. How's that?

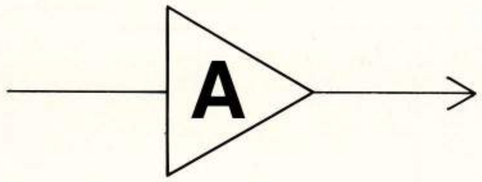
So how do you avoid this problem? You overdrive an amplifier, go into the amplifier with too much signal, by placing an amplifier too close to a preceding amplifier. You would not connect two amplifiers together, back to back for example, because in doing so the output of the first amplifier would be too strong to pass through the second amplfier, be amplified by 10 dB, and not come out at a stronger signal level than the second amplifier was capable of handling.

In an AM or standard TV distribution system, when you make this mistake you see the video from one TV signal being super-imposed on top of the video from another TV signal. Typically, the video (modulation) from the strongest TV signal passing through the amplifier marries itself to the video signal of the weaker signals going through the same amplifier.

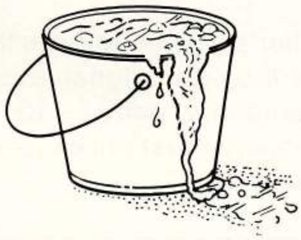
In an FM system, the kind we have in TVRO, having too much amplification and therefore exceeding the rated output of an amplifier stage (whether it is in a line amplifier or in a receiver proper) creates a slightly different type of visual problem—pseudo-sparklies.

When an amplifier is overdriven in the FM service, we see pictures that should be clear and sharp take on a noisy appearance not unlike what we have if we are trying to squeeze by with too small an antenna. The noise part of the received composite signal 'shotguns' on top of the stereo and the picture degrades quickly.

This overdriving condition can occur at the receiver or it may happen back at an amplifier in the line between the receiver and the antenna. If you are using receivers with an adjustable IF gain control, or with an input RF attenuator, you should first check for overdriving at the receiver by simply turning down the gain or attenuator control at the receiver. However, if this does not work, it is not proof that you are not overdriving. If the overdriving (cross-modulation) is occuring in a line amplifier ahead of the receiver itself, turning down the gain or increasing the attenuation at the receiver will not cure the problem. The problem must be corrected (by reducing the amplifier output level) at the stage or unit where it is occuring.



An amplifier stage or unit is like a bucket of water...



when the capacity of the amplifier is exceeded, the excess simply 'runs over'.

Here is a sequence of steps to try when troubleshooting a suspected overdrive situation:

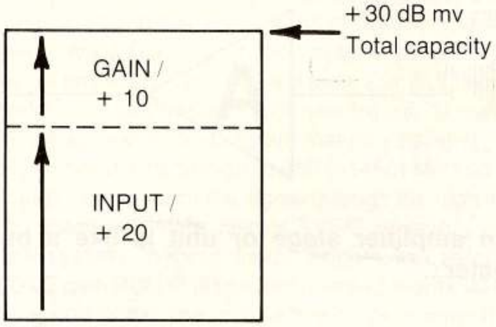
1) Reduce the receiver gain with its input IF gain control and/or its input (IF) attenuator.

2) Remove a line amplifier, especially one that may be too closely spaced to the amplifier ahead of it in the system.

3) Check your operating voltage on the cable line; if it is higher than the line amplifier requires, you may be exceeding the power dissipation rating on an amplifier and therefore changing the amplifier operating condition(s).

4) Take a fixed attenuator, equal to 25 to 50% of the gain rating of a line amplifier (ie. 10 dB pad for a 20 dB amplifier) and try placing it at the input of each line amplifier between the receiver and the origination point for the block IF signal (ie. output of downconverter of LNB). Note that the pad must be power passing and be capable of functioning at the operating frequency of the block IF.

In each case, your concern is that you are not overdriving an amplifier stage, giving it too much signal to amplify and therefore exceeding its output rating. Remember that the receiver has an IF amplifier stage at its input and this amplifier



The amplifier's output rating is the numerical product of the input signal level (+20 here) and the amplifier gain (+10 here) which when combined must not exceed a specified number in dBmv.

stage can exhibit the same type of overdrive condition as a line amplifier located along the coaxial cable itself.

Too much signal, then, can be just as troublesome as too little signal when you are dealing with any active (electricity-operated) gain or amplifier stage. The symptoms (ie. picture that results) can also be very similar leading the installer to make an incorrect assumption about the cure to the problem (additional gain will definently not solve this one!) In fact, a number of packaged systems now available to dealers are especially susceptible to overdrive and require special care when installing. The Uniden 7000 unit, for example, can be overdriven if you use a 50 dB gain range LNA and also close-space or short-space the LNB or downconverter to the receiver proper.

In this situation, the engineers designing the Uniden system planned for a minimum amount of cable loss or attenuation between the output of the downconverter and the input to the receiver proper. Their gain stages between the LNA/LNB and the demodulator section of the receiver were created based upon that minimum amount of loss. When an installation adds additional gain and/or has less than the planned for cable loss from outdoors to indoors, the receiver is overloaded by the signal voltage present. The carrier to noise ratio, the ultimate measurement of picture quality, is degraded by the overdrive condition and noisy pictures result.

Line amplifiers, then, should be used sparingly, when required but not as a cure-all to BDC system cable losses. There is such a thing as too much system gain and the installer who tacks on unneeded line amplifiers is causing himself and his customers needless problems. There is one more problem related to line amplifiers to note:

All line amplifiers will have a minimum (and maximum) specified line operating powering voltage. A 12 volt minimum is common while others state they must have 18 volts (DC) to operate properly.

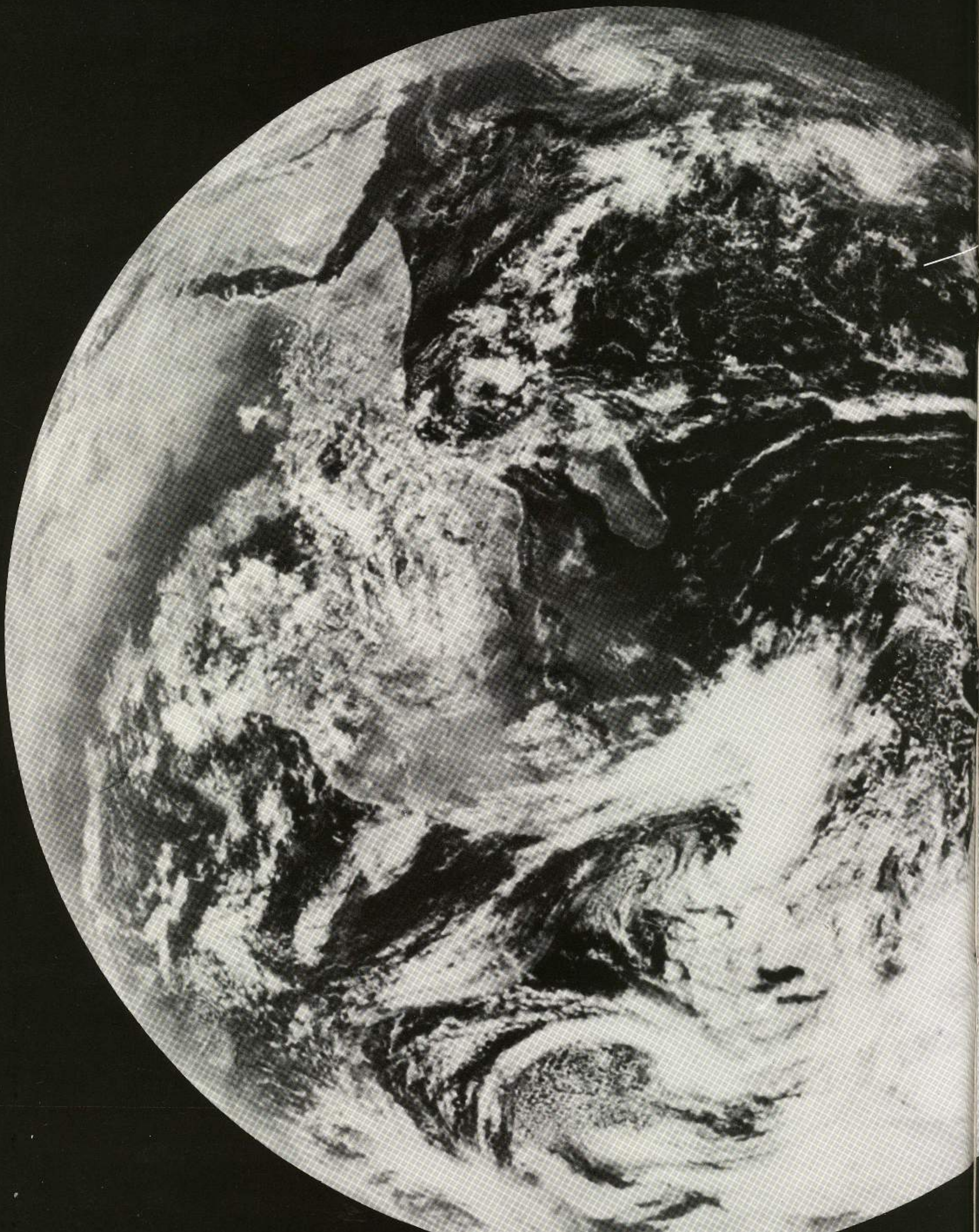
Line amplifiers do not suddenly quit working, as a rule, when the line powering voltage drops to a below-specified-minimum level. Rather, the amplifier characteristics change. For example:

1) Low line voltage can reduce the output capability of a line amp (ie. where the specified output is +30 dBmV, the actual permissible output now becomes +26 dBmV). If you are pushed into a corner and must operate a line amp on below-specified line voltage, also reduce (pad) the input signal to cut back on the total output available, thereby reducing the heat generated by the amplifier stage.

2) Low line voltage can raise the noise figure of the line amp, in some cases very quickly. You will see this increase in amplifier noise as an increase in fine-grain, busy (noise) in the background of the picture. Two possible solutions here; raise the DC operating (line) voltage to a safe level, or substitute another brand/model of line amp that is capable of operating at reduced (DC) line voltage.

Don't be afraid to measure the DC line voltage with a VOM when you have stretched the cable out and are using an unusually high amount of cable. Depending upon the configuration of the BDC distribution system, you may also be suffering from too-low voltage at the LNA/LNB/downconverter as well, compounding your problems.

A less common problem is too high a line (DC) voltage for the line amplifiers. Remember that you are line powering your BDC equipment from the IF input on the receiver proper. The voltage (and maximum current) available here is established by the receiver's internal power supply. Not all line amplifiers operate within the same voltage range as the receiver provides so before you start an installation, check the available voltage from the receiver to insure that it is within the voltage window specified for the line amplifier.



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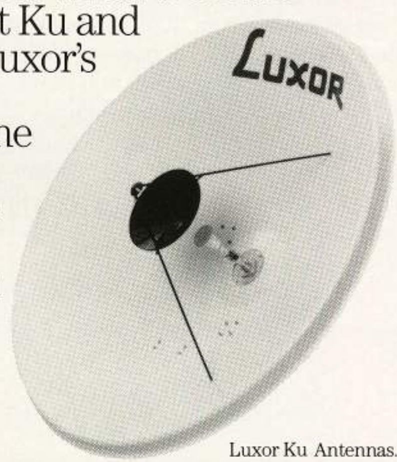

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The Site

The requirements for the site are very minimal, simply a clear view of the southern sky. If horizon to horizon tracking is required and a 10° lowest elevation angle is assumed, then we require a clear view from about 265° in azimuth which is approximately due west to 96.5° azimuth which is about east. No buildings, trees, etc., should block this arc. Once this simple requirement is met, any site will be satisfactory.

The setting up of the antenna structure on the site, however, is an important matter. In order that the mount tracks the satellite belt correctly, a number of important directions and dimensions are required.

1) Determination of true north. Magnetic north is not good enough. True north must be established by the method of the surveyors. The one used at York Castle Avenue was the tracking of the star Polaris during its nocturnal movements. After several hours of this, true north was established and pegs set up as markers.

2) The column or support must be vertical. Since all the calculations and adjustments of angles depend upon the assumption that north is true north and vertical is true vertical, these two (2) parameters must be established accurately.

3) The angle a + A is the tilt of the axis and needs to be set up correctly. This angle can be set up accurately by measuring lengths and adjusting heights, using the standard methods used by surveyors.

4) The offset angle. This offset angle actually causes the dish to look at the satellite and does not miss any satellite in its tracking across the satellite belt. This is angle F in Appendix 3:2. Here again this angle can be accurately set by linear measurements, using the standard tools of the surveyor.

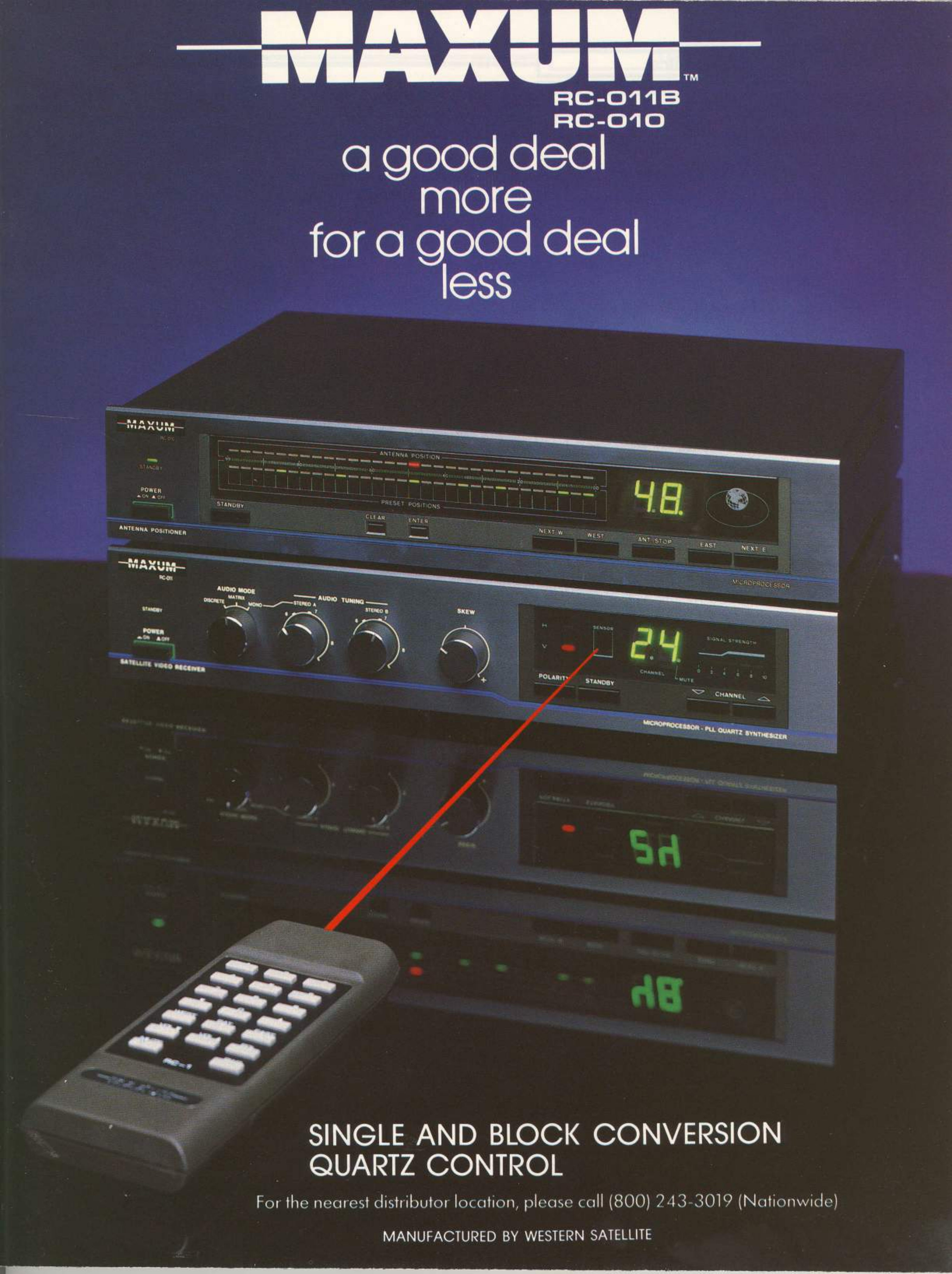
Appendix 4:1 shows the structural design for the mount and foundation. It is shown that the foundation is mass concrete to resist overturning and this worked out to be a 7 foot 6 inch square by 4 foot deep mass concrete base. No great amount of steel is required, since the requirements are for weight, to resist overturning.

It is important that a good electrical ground be established and there is no better way than the insertion of a ground wire or plate in the excavation before concrete is poured and a lead taken out to make connections to the structure and eventually to the electronic equipment. It is important that another electrical ground be not established at the equipment end and that one ground only be used. Ground loops will be caused if two grounds which are likely to have different potentials are used.

Appendix 4:1
STRUCTURAL DESIGN - MOUNT & FOUNDATION

(a) Mount		
Diameter of dish	= 23 ft	
Projected area	= 414 ft^2	
Wind speed (unexpected gusts)	60 mph	
Pressure by wind	= 0.0026×60^2	= 9.36 lb/in^2
Mesh surface say 70% voids		
∴ Wind force on dish	= 414 x 9.36 x 0.3 = 1163 lb	
Force on bolts and pivots	= 1163/4	= 291 lb
Bolt area required in tension	= 291/1800	= 0.016 in^2
One 3/8" dia bolt	= 0.1104 in^2	O K
One 3/8" dia bolt in single shear	= 0.55 x 2240	= 1232 lb O K
One 3/8" dia bolt bearing in 3/16" plate	= 0.7 x 2240	= 1568 lb O K

Weight of dish 200 kg	= 441 lb	
Framework at rear of dish	= 60 lb	Total 501 lb
R H S stanchion	= 116 lb	Total 617 lb
C G of parabolic = 0.6 of depth	= 0.6 x 4.35 ft	= 2.61 ft
Distance from surface to fulcrum	= 2.08 ft. (from drawing)	
∴ Total arm	= 4.69 ft.	
Moment at base due to eccentricity	= 501 x 4.69	= 2350 ft lb
Assume 3 ft deep base		
Total height	= 3 + 12.5	= 15.5 ft
Moment at base due to wind	= 1163 x 15.5	= 18027 ft lb
Total moment at base	= 2350 + 18027	= 20377 ft lb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Appendix 4:1

Try 6" x 6" x ¼" Hollow section (welded)

WT per ft run = 19.4 lb, Area = 5.72 in^2,

$Z = 10.5,\ r_{xx} = r_{yy} = 2.35$

$\therefore 1/r = (12.5 \times 12 \times 2) / 2.35 = 128 \qquad P_c = 3.45\ T/in^2$

$f_c = 617/2240 \times 5.72 = 0.048$

$f_{bc} = 20377/10.5 \times 2240 = 0.0866 \qquad P_{bc} = 10.5$

$$\frac{f_c}{Pc} + \frac{f_{bc}}{Pbc} \not> \frac{0.048}{3.45} + \frac{0.866}{10.5} = 0.0139 + 0.082$$

$$= 0.096 \not> 1$$

$\therefore$ 6" x 6" x ¼" OK

Total overturning moment	=	20377 ft lb (9.0 T)
Base say 6'.0 x 6'.0 x 3'.0	=	6.9 Tons
Stanchion		0.4
Total direct load		7.3 Tons

Moment $= W_c$

$= \frac{M}{W} = 9.0/7.3 = 1.23$ ft

FOS $= 7.3 \times 3/9.0 = 2.43$ OK

$$P = \frac{W}{A} \pm \frac{M}{2} = \frac{7.3}{36} \pm \frac{9.0 \times 6}{6 \times 6^2}$$

$$= -0.202 \pm 0.25$$

OK 6' x 6' x 3' deep

1:3:6 Concrete

Total overturning moment = 2350 + 18027 = 20377 ft lb

= 9.0 Ton/ft

Total direct load

Dish		= 500 lb	
Stanchion	12.35 x 31	= 383 lb	
		883 lb	
	Say	900 lb	= (0.40 Ton)

Try 6' .0 x 6' – 0 x 3' – 0 Base = 15552 lb. = 6.9 T

Total load = 6.9 + 0.4 = 7.3 Tons

eccentricity = 9.0/7.3 = 1.23 ft.

Factor of Safety against overturning

$$= \frac{7.3 \times 3}{9} = 2.43 \text{ OK}$$

P_{max} without uplift

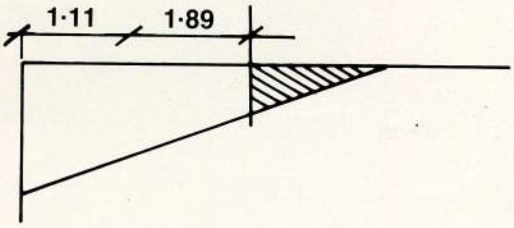
$= 3 \times 1.11 \times .5 \times P = 7.3$

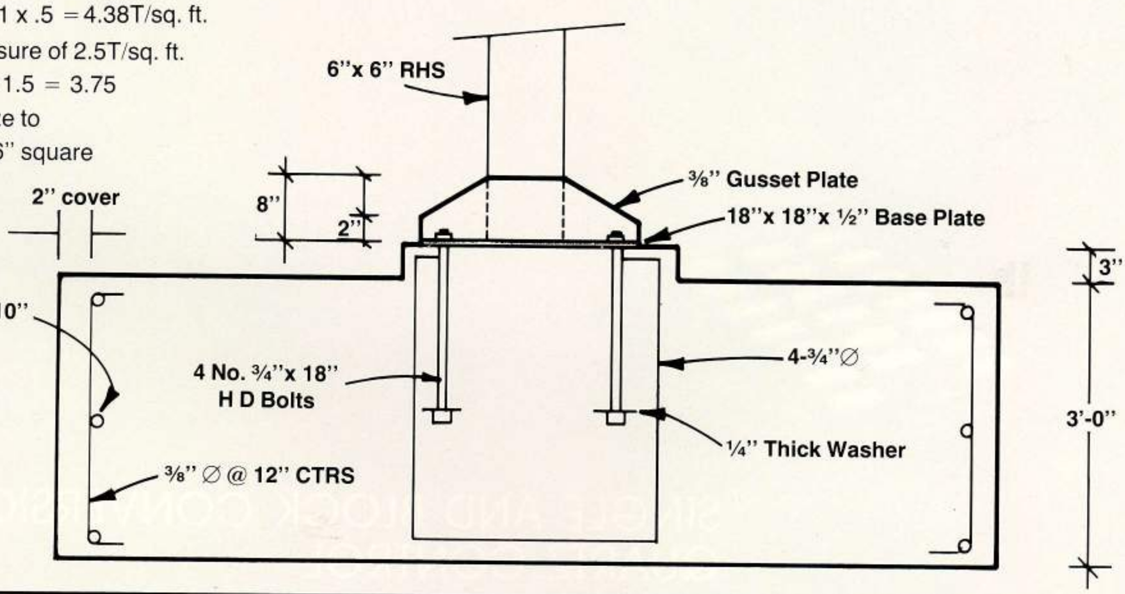
$P_{max} = 7.3 \times /3 \times 1.11 \times .5 = 4.38$T/sq. ft.

Assuming a soil pressure of 2.5T/sq. ft.

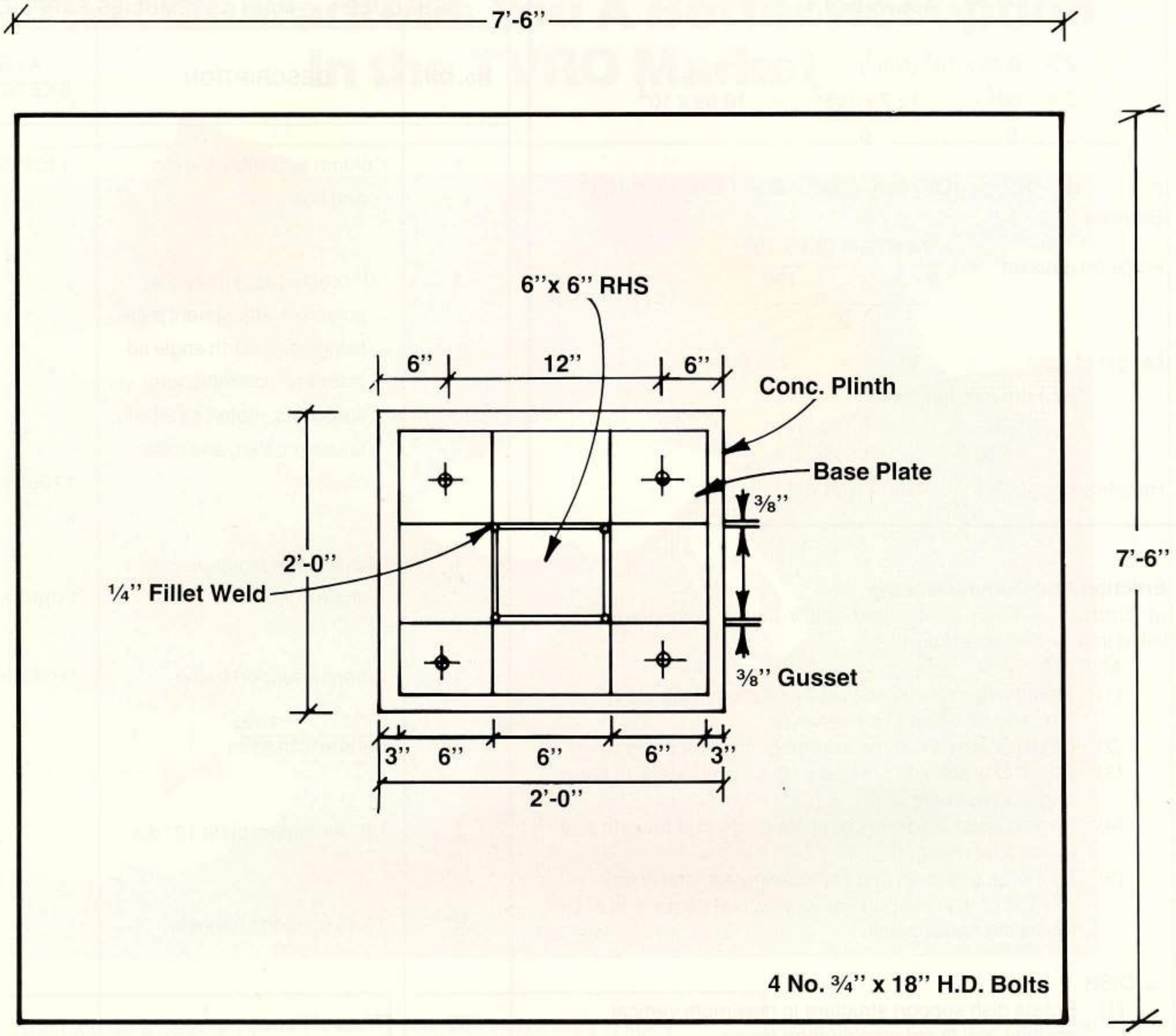
Permissable = 2.5 x 1.5 = 3.75

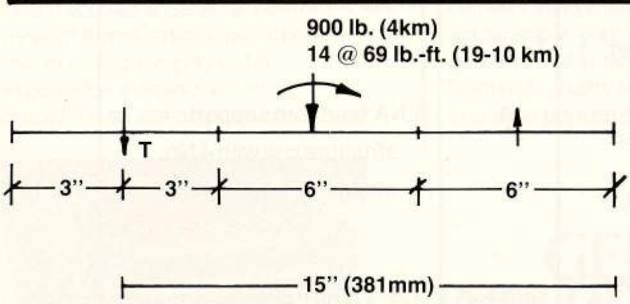
Increase the base size to approximately 7'.6" square





Appendix 4:1





$f_s = 130 \text{ N/m}^2$

$f_c = 32 \text{ N/m}^2$

$$NA = \frac{m f_c d}{m f_c + f_s} = \frac{15 \times 3.2 \times 381}{15 \times 3.2 + 130} = 102.74 \text{ Nm}$$

center of compression of triangular distribution

$$= \frac{102.74}{3} = 34.25 \text{ Nm}$$

taking moment about T

$$c = \frac{19.1 \times 10^3 + 4.0 \times 228.6}{346.75} = 57.72 \text{ kN}$$

$$T = 57.72 - 4 = 53.72 \text{ kN}$$

Handbook page 702. Use 2 x 3/4" diameter black bolts.

Maximum allowable concrete pressure = 3200 kN/m^2

and if width of base is υ

$$\upsilon = \frac{57.72 \times 10^3 \times 2}{102.74 \times 3.2 \times 10^3} = 351 \text{ mm} = 14 \text{ in.}$$

say 18"

$$M_{max} = 53.72 \times .2286 = 12.28 \text{ kN/m}$$

$$\frac{N}{2} < 130 \text{ N/m}^2$$

$$\frac{12.28 \times 10^6}{Z} > 130$$

Appendix 4:1

$$Z > 9.45 \times 10^4 \ (Nm^4)$$

$$Z = \frac{bd^2}{6} = \frac{12.7 \times 305^2}{6} = 19.69 \times 10^4$$

$b = ½"$, $d = 12"$ (OK) or $b = ⅜"$, $Z = 14.76 \times 10^4 \ Nm^4$

Gausset

$$\text{Force on gausset} = \frac{\frac{9 \times 60\%}{2} + \frac{9.1 \times 10^5}{150}}{2} = 32 \text{ kN}$$

Length of weld = 9" = 228.6mm

force per mm run

$$= \frac{32}{228.6} = 0.140 \text{ kN/m}$$

Handbook page 741 Use ¼ fillet weld

Erection And Commissioning

a) Erection — Erect as directed below all the components listed in attached schedule 1.

1. MOUNT
   (1) Mount column on prepared foundations, align to NS direction as directed by surveyor.
   (2) Fit U bracket on column assembly, check NS alignment.
   (3) Adjust U bracket to precisely 18·42° and lock with earth angle adjustment.
   (4) Fit dish support frame c/w chain guide to U bracket and check alignment.
   (5) Fit motor, gearbox, and chain, energise and check rotation of dish support frame, and that center line of DSF tracks the satellite belt.

2. DISH
   (1) Rotate dish support structure to maximum vertical position and fit antenna support frame.
   (2) Adjust antenna adjustment bolt assembly to obtain offset angle of precisely 2·74°.
   (3) Fit trusses to lower half of ring of antenna support frame.
   (4) Fit center plate, periphery support channels, and truss stiffeners and bolt up.
   (5) Repeat (3) and (4) for other half of antenna by rotating dish support structure to other extremity.
   (6) Fit LNA/feedhorn struts and support assembly.
   (7) Fit narrow part of mesh to trusses, using special screws and screw gun, each piece to butt over 1" width of truss.
   (8) Fit wide part of mesh to trusses as in (7).
   Note: Trusses and mesh must not be walked upon under any circumstances.
   (9) Adjust LNA/downconverter/feedhorn assembly to 7-6 feet from center of dish surface.

7m TVRO TERMINAL

SCHEDULE 1 — MAIN ASSEMBLIES SUPPLIED

No. Off	DESCRIPTION	ACS SKETCH #
1	Column assembly c/w pin and bolt	1109/Sht.1
1	"U" bracket assembly c/w polar axis adjustment plate, fixing bolts, earth angle adjustment assembly, idler sprockets, motor, gearbox, drive sprocket, and roller chain.	1109/Sht.5
1	Dish support structure c/w chain guide	1109/Sht. 14
1	Antenna support frame	1109/Sht. 18
30	Parabolic trusses	
4	1/8" Aluminum plate 12" dia.	
30	Truss support channels	
30	Truss stiffeners	
1	LNA/feedhorn support structure c/w with 4 No. struts.	
60 pcs.	1/2" x 0.081 Aluminum mesh cut to sector sizes (1 wide part and 1 narrow part per sector)	

3. ELECTRICAL
   (1) Lay cables supplied in prepared trench per cable schedule, labelling each end with reference number.
   (2) All joints to be soldered, taped, and "gooked" with compound.
   (3) Tape and "gook" all outdoor connections.
   (4) Ground LNA cables at both ends of trench.
   (5) Earth mount metalwork.
   (6) Before installation, check and note for reference current drawn by LNA.
   (7) Before installation, check LNA for operation by lamp test.
   (8) Align rotator control 180° from stop.
   (9) Erect 115 volts WP outlet on column.
   (10) Put all cables on base in WP trunking.
   (11) Erect light reflecting paper sensors on chain guide.

b) COMMISSIONING
   (1) Arrange scaffolding so that adjustments can be made to LNA assembly while watching signal meter and TV set.
   (2) Position dish to Satcom F5 and rotate polarotor for strongest signal on meter.
   (3) Move LNA/feedhorn assembly in/out for change in signal level.
   (4) When maximum in/out position found, measure from feedhorn opening to exact center of dish. Measure diameter across 2 diameters.
   (5) Move LNA assembly left/right. If max signal is not from center, measure positions from dish surface to calculated focus position. If corresponding positions are not equal, it means that some members are not parabolic. They will have to be taken down and fixed.
   (6) Move assembly up/down. If max signal is not from center, do as in (6).
   (7) If okay, proceed to tracking with other satellites viz: F3, F4, etc.
   (8) Fit photocell.
   (9) Earth equipment pit mount.

NOTES:
   (1) Dish support fixing consist of four bolts, two short ones for pivots and two long ones for adjustments. Ensure that:
      (a) The pivot's bolts are sufficiently packed with flat washers, so that the shanks are secure between the plates of 8" x 3" frame and the dish fixing plate.
      (b) The adjusting bolts are adjusted to give the same offset as presently obtained with the surveyors JIG.

7M TVRO TERMINAL
SCHEDULE 2 — CABLES TO BE INSTALLED UNDERGROUND

REF.	FUNCTION	TYPE	METHOD	FROM	TO	REMARKS
A1	Signal, 4 GHz	Heliax	Direct burial	LNA	Sat. Receiver	Joint in middle
A2a	Signal, 70 MHz	RG59	Conduit, 2"	LNA/DC	Sat. Receiver	One cable
A2b	LNA Powering	3C, screened	Conduit, 2"	LNA/DC	Sat. Receiver	Same conduit
B	Supply to drive motor	110/0076 2x3C, Circular PVC	Direct burial	Control box, shack	Drive motor,	
C	Polarotor control	40/0076 4C, Circular PVC	Direct burial	Control panel, shack	Polarotor, Antenna	
D1,D2	Limit switches	40/0076 2x3C, Circular PVC	Direct burial	Control panel, shack	Chain guide, Antenna	
E	Photocell amplifier	40/0076 2x3C, Circular PVC	Direct burial	Control panel, shack	Main Column, Antenna	
F	Spare	25 pr. Tel. Cable	Direct burial	Shack	Antenna	
G	Supply to 115v outlet	110/0076 3C Circular PVC	Direct burial	Panel in shack	Outlet on column	
H	70 MHz IF for test	RG59	Conduit, 2'	Sat. Receiver	Ant location	Testing

Science of Scrambling

"If you grovel in the dirt long enough, sooner or later you may find a nugget." Such is the life of the TVRO dealer who is faced with coping in a scrambled environment.

For many months, the TVRO industry has been awash with rumors and suggestions concerning illegal descrambling equipment. "Give me $200 and I will hand you back a descrambler which will descramble anything!" said the tall, thin man carrying a battered briefcase at the January CES show. He was serious and well intentioned, even if he didn't have the slightest inkling about the problems facing TVRO. The woods, and show floors, are filled with people who mean well but who cannot deliver. There is a belief, a conviction, that anything one man can scramble, another man can unscramble. Let's see just what the odds are of somebody breaking the present scrambling codes. As a dealer, you need to understand where these wild claims of bootleg descramblers are coming from and decide for yourself just how much credence you should give to such claims.

Basics First

There are two distinct problems associated with the descrambling of the TVRO feeds: problems legal and problems technical. The legal problems are quite straightforward. Anyone who attempts to sell units designed to decode a satellite transmission without the authorization of the programmer doing the encoding faces some very stiff civil and criminal fines and penalties. There is jail time associated with such activities. There is at least the suggestion that anyone aiding or abetting such an illegal act can also face civil and criminal charges. For example, if we were to describe a complete descrambler to you and tell you how to build such a unit, it is conceivable that we would end up in the pokey.

"Build the units offshore" is one quick response. That's fine, but you still have to sell or deliver them on shore, and the consumers have to use them on shore. The civil and criminal sanctions cover on shore use or on shore delivery regardless of where the units are manufactured.

"Only sell the plans from offshore," is another suggestion. You still have the problem of delivering the plans on shore.

"Sell an 'almost-decoder' that will not work as delivered and then in the instruction manual tell people Do Not Cut This Wire OR Illegal Reception From HBO Will Result...,is another suggestion. Cute. The courts would waste no time finding that the intent of the seller was to provide an illegal descrambling device contrary to Section 705 of the Communications Act, as revised...." So, that is not cute enough.

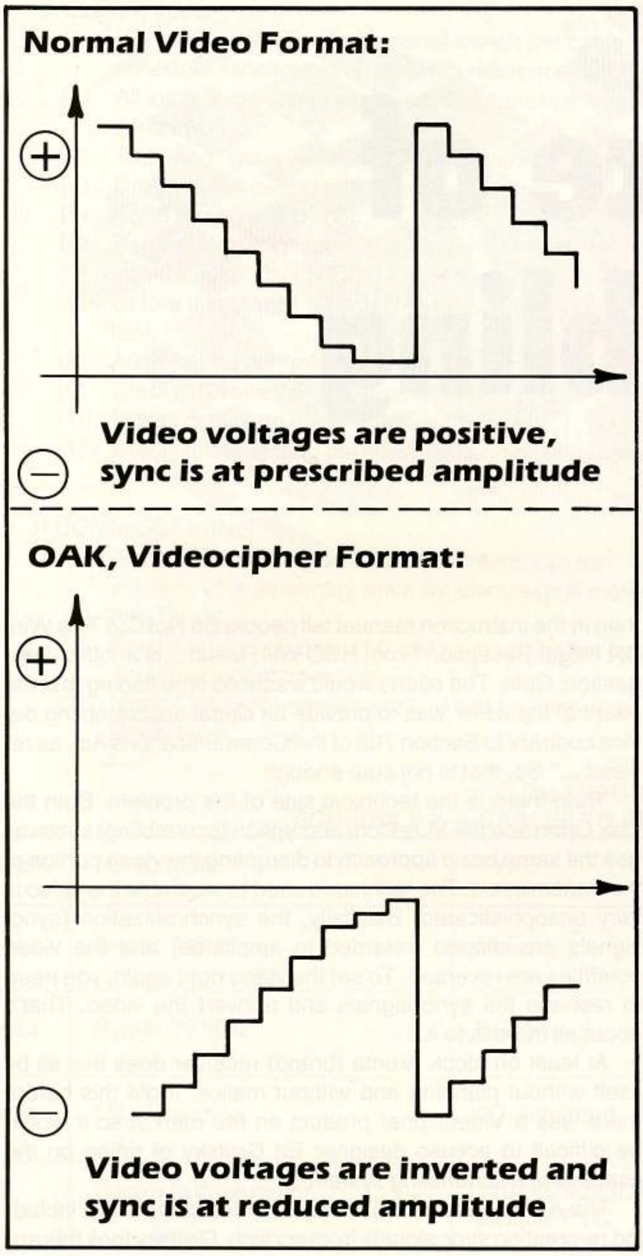
Then there is the technical side of the problem. Both the Oak Orion and the M/A-Com encryption (scrambling) systems use the same basic approach to disrupting the video portion of the transmission. The technique used to scramble the video is very unsophisticated. Basically, the synchronization (sync) signals are clipped (retarded in amplitude) and the video polarities are reversed. To set the video right again, you need to reshape the sync signals and reinvert the video. That's about all there is to it.

At least on stock Arunta (brand) receiver does this all by itself without planning and without malice. It did this before there was a Videocipher product on the market so it would be difficult to accuse designer Ed Grotsky of riding on the coattails of a scrambling system.

The Arunta receiver reprocesses video completely, including re-creating sync signals from scratch. Grotsky took this approach because he wanted a receiver which performed with stable pictures even when the signals are weak. He reasoned it was better to have a noisy, stable picture than a noisy, unstable picture. A person is more apt to watch and enjoy a noisy picture that stays put on the screen than one that jumps around all of the time.

If the Arunta receiver does this stock without any intent to defeat the Videocipher or Oak Orion scrambling system, does that not suggest that others could do similar things with add-on or attachment boxes that somehow retrofit into or after a standard satellite receiver? Is clear, stable, video just a sync circuit away?

Oak addressed this concept when they were designing the Orion system. Remember, the basic video encoding consists of two elements: clipping or retarding the sync, and inverting the video polarity. You will also recall that a high percentage of all satellite receivers come equipped with a video invert switch



(circuit) built-in. Seemingly, at least half of the video scrambling is handled by the proper use of the existing video invert switch. The remaining part is the sync.

Oak programs their sync inversion so that every few seconds or every few minutes, the video reinverts; what was black becomes white and vice versa. Their concept is that if they constantly, but erratically, flip the polarity of the video around, pretty soon people will tire of getting up and flipping their own video invert switches manually. In the Oak Orion descrambler, an automatic circuit detects this polarity change in the video and does the companion invert switching automatically. M/A-Com simply inverts the video and leaves it inverted. With the Videocipher system, once you have properly inverted the video polarity at the receiver to correspond to the incoming video polarity, you can leave the switch alone.

So, we have another requirement for our clandestine black box decoder:

1) It must recreate the sync signals, to replace the reduced amplitude of the encoded sync signals.

2) It must track and switch the video polarity of the demodulated video waveform on cue when the incoming waveform is inverted at the uplink. None of this addresses the audio...at this point; our objective is to create non-scrambled video only.

Black boxes that perform what we have described at this point have a total parts cost of under $12. With power supply and case, they should sell in the $79 to $99 region in small quantities.

"One possibility is to clearly label the box Video Stabilizer and in the literature with the unit, state that use of this unit for the non-authorized reception of scrambled satellite signals is a violation of Section 705 of the Communications Act, as revised," suggests the would-be entrepreneur. True, there are many video stabilizer units on the market in the home VCR field. Some are designed for only one purpose: to defeat tape security (copy guard) systems employed to keep people from re-copying taped features without permission. Copying tapes so protected, however, is not a violation of Section 705.

A press release delivered by overnight air from Anderson Scientific in Rapid City, South Dakota, in early January broke some ice. The release reported that Anderson's resident creator, Keith Anderson, had broken the M/A-Com and Oak Orion scrambling code and that Anderson might be offering their own scrambling system in the near future. From someone other than Keith Anderson, the announcement might have been tossed into the waste basket. With Anderson's name on it, a follow up was in order.

"I resisted sending out that press release," noted Keith. "It was a decision made by the new ownership of the company, and I guess we were simply testing the water."

A clarification of the release subsequently would add that the Anderson development was a half-development and perhaps not that exciting after all. What Keith had done was to correct the video portion of the scrambled signal; you get silent HBO movies and CANCOM feeds but not much else. With considerable tact, Keith would suggest that there are events on HBO, for example, which can be enjoyed even if silent; major boxing match-ups are an example.

Would Anderson be selling a box that does this?

"I doubt it very much. One of the first things we did was turn a group of high-priced attorneys loose on the problem. After several weeks of study and many telephone calls, we got their best advice. "Forget you know how to do this."

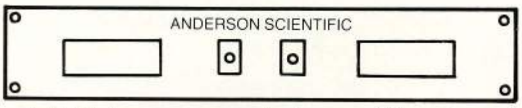
The attorneys, as is usually the case, are already making money with Section 705.

There is one novel thing Keith Anderson has done with his descrambler. He does have audio recovery, although not yet perfected, on five of the CANCOM scrambled services on ANIK D. He hopes to have it on all eight by the SPACE/STTI show in Las Vegas.

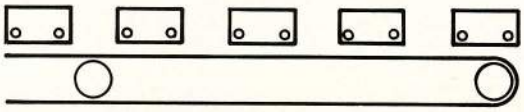
"There are some special applications and some unique circumstances related to the CANCOM feeds on ANIK," points out Anderson. "And there is a way to recover the audio from, say the CBS (WJBK) feed from Detroit, through CANCOM. I am not yet far enough along to make any kind of statement about the feasibility of doing the same thing with HBO."

Isn't Anderson on very thin ice here, by designing and

Anderson Suggests:



Establishing a special satellite feed, one hour per week, to be encrypted with an Anderson Encryption System...



Building universally available decoders for special feeds which would also decode other similarly encrypted feeds.

perhaps offering to share his design knowledge on a device that is apparently designed expressly to beat the Oak Orion (and later M/A-Com) descrambler system? Keith is obliged to follow the expensive legal advice that cost his firm $6,000, but he suggests a second way to approach the problem.

"In fact, if a person or firm was only selling a device for the purpose of defeating a scrambling system, I believe they would be in deep trouble. But there is another way to approach this. I hope to find someone out there who is interested in effecting medium security of their own transmission(s) via satellite. Let's say somebody with one hour of programming per week wanted to keep the casual viewer from tuning in. I'd supply them with the scrambling box for their uplink transmitter, and whatever number of descramblers they might require for their network. Our system would be very similar to that employed by CANCOM for the off-air US feeds they are retransmitting on ANIK D. In fact, anybody employing our scrambling/descrambling system would find that the same descrambler, purely by accident of course, worked just fine with those US originated feeds on ANIK D as well."

By accident? Anderson smiles.

Isn't that likely to be a violation of some Oak held patent or patents? "Not at all. Their digitally encrypted audio is a special format which they may or may not be able to protect with a patent. We don't care about that technique and, in fact, do not use it. We leave their digitally encrypted audio alone and make no effort to recover it. But we still get audio out of their transmission."

Attendees at the SPACE/STTI show in Vegas, February 19-21, will probably have the opportunity to see this happening in the Anderson Scientific booth. The technology will not be for sale, per se. What Anderson will be trying to do is to line up some small network interest in what Keith characterizes as a 'medium security system that is cheap.'

Early reaction to the Anderson press release was muted. "The day the first release appeared in print, we had one telephone call," recalls Keith. "It came from Showtime!" (Showtime has been scheduled to begin their scrambling tests on January 13. They were planning to scramble between 6 AM and 6 PM daily. The announced start date was moved back to January 26th because, as Showtime reported, seven per cent of the cable headends affiliated with Showtime had not received their Videocipher II cable descramblers in time for the scheduled January 13 start. The West Coast feed for Showtime was scheduled to begin its 12-hour-per-day testing around February 9).

The Audio Problem

If recovering the scrambled video is no big trick and there are likely to be any number of video stabilizer boxes offered for sale for this function, what about the audio? Some view the audio challenge as impenetrable.

The CANCOM audio, which Anderson claims successful recovery of, is somewhat unique. To say any more would be giving away how Keith does it. The same sort of audio recovery from services scrambled not with Oak Orion but rather with the M/A-Com Videocipher is problematical. Suffice it to say that for those services connected directly to their own baseband audio and video services at the uplink, clandestine audio recovery will have to follow the digital audio recovery cycle.

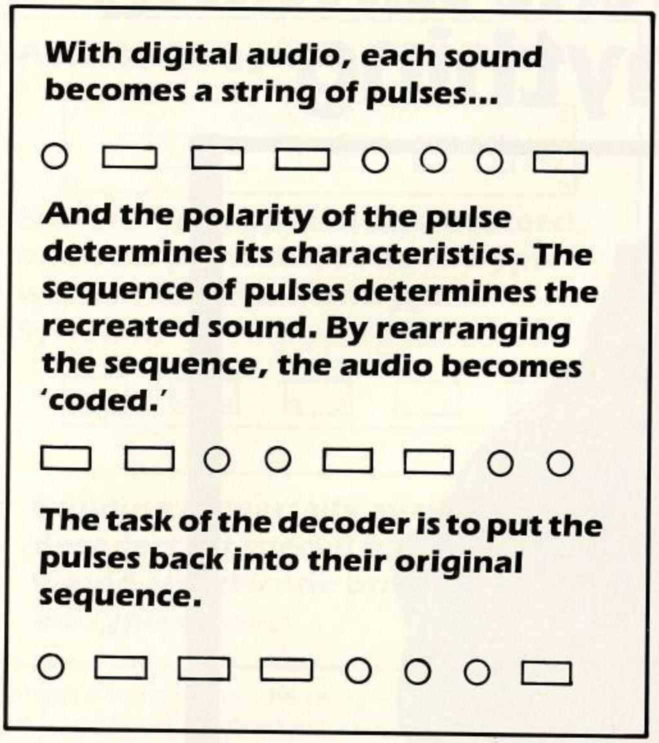
Oak and M/A-Com have elected to follow an entirely new modulation technique with their audio. There is nothing particularly proprietary with how they do it and it is only the specific encoding which is in fact proprietary. Let's see why.

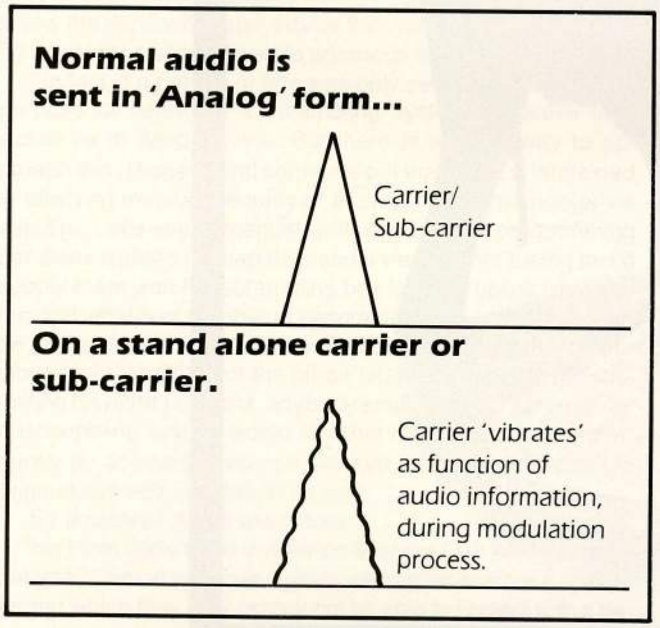
Regular audio, via satellite, is transmitted on a carrier or sub-carrier of its own. This means that a receiver created to tune in the sub-carrier or carrier can detect (demodulate) the audio information. If one uses standard carrier or sub-carrier technology, about the only thing you can do to hide or disguise the presence of the audio is to adopt some exotic form of modulation. You can count every form of modulation ever conceived on the fingers of two hands, and the corner library has shelves filled with reference books that tell you how to demodulate each of them. Exotic is not a fitting word here. Until recently, there was no truly exotic modulation.

So, if someone knows either the frequency, or the modulation format, he can decode the audio if it uses standard carrier or sub-carrier technology in short order. Even if you do not know the frequency, you can find it with a spectrum analyzer.

Then along came digital audio. Digital audio is the first new modulation format to come down the pike in a couple of decades. It is better than all of the prior forms of modulation because it can be self correcting for errors. If you consider that a crash of static or a rush of noise, interfering with a standard carrier or sub-carrier modulated (audio) signal is, in fact, the introduction of error information into the modulated signal, you can begin to appreciate the improvement possible with digitally processed audio. The original audio signal is sent not as a continuous stream of information superimposed on a steady carrier but rather it is sent out machine gun style as a series of (digital) pulses. If you don't understand digital pulses, don't worry. Not many do, yet. The key thing to appreciate is simply this:

- A receiver not equipped with a digital decoder hears the string of digital pulses as a rush of noise. In effect, there is nothing there.
- The receiver must be designed and equipped to receive each pulse and then convert that pulse from something called





digital to something called analog. Analog is the old-fashioned way of creating and sending sound (or video). Every satellite receiver, every TV receiver (et al) you have now is analog.

So, the first thing you need to decipher the audio for Oak Orion or Videocipher is a digital receiver/decoder/converter. Where can you get one of these, you ask? Are not some of the new disc players using this digital technology stuff?

They are. The newest audio system using the so-called laser discs are making use of a form of digital audio technology. That's the coming thing since one of the primary benefits of digital audio is that there is a significant improvement in the signal to noise ratio. Digital is far quieter and it eliminates background hiss in the absence of information. You have not heard quiet until you have listened to a digital audio system in a soundproof room.

Why hasn't some clever person simply butchered a digital disc player and somehow turned it into a digital audio processing system for HBO? M/A-Com is ready for that.

In the old-fashioned analog audio world, the stream of intelligence or information is continuous. Years ago, some clever people tried to build voice scramblers for police and other two-way radio users. The concept was as follows:

The person speaking says:

"Watch out for the black car."

The voice scrambler, using a preprogrammed format code, took that sentence and broke it up into parts. It then rearranged the sentence so it came out:

"bl ar wat or fc he ch ack ut o."

The decoder or descrambler at the receiver end is also preprogrammed. It takes in this garble and then tries to put it back together in the original format. The concept for audio encryption or inversion originated in the science of cryptology, refined during the Second World War when telegraph operators used character rearrangement and/or character substitution to code military messages. The concept worked with voice, but not very well because the solid state memories and reference signals, required to insure the message always went back together in the same way it started, were not very well defined. As often as not, it came out:

"Watout chfor the black car," or something equally puzzling.

Digital to the rescue. First of all, in digital, the voice message is changed from analog ("Watch out for the black car.") to digital (+ − + + − − − + + + − − + − + + − − + − − + −). Then the string of digital pulses is transmitted. But if all it takes is a digital receiver to decode this, it would not be long before everyone had a digital decoder or receiver. Since every word is now sent as a series of digital pulses, why not rearrange the digital pulses? Remember the voice scrambling that rearranges the voice patterns in an analog system? Digital encryption does the same thing. Rather than sending w a t c h o u t as + − + + − − − +, which is the sequence that will translate back to w a t c h o u t, in digital encryption the sequence is rearranged. W a t c h o u t could become − + − + + + + −. How would your receiver know to rearrange the digital pulses into + − + + − − − + before it converted those pulses back to analog form so you could hear the message? A control signal is sent along with the digital pulses. The control signal is also digital and it is also encrypted. The control signal is a set of commands, telling the receiver to "take every third pulse and store it until after every fifth pulse; then insert the store pulse in the stream after every fifth pulse. And, take every seventh pulse and store it and re-insert it in the digital stream after every 15th pulse."

So this rush of noise that is a digital stream is itself encrypted and the encryption instructions are themselves encrypted. Moreover, the instructions for rearranging the digital pulses, the actual road map for the system, is changed every few seconds or every few minutes by a master algorithm at the uplink site. In effect, if somebody was very clever (and very lucky) and actually figured out that every third pulse has to be stored and then reinserted in the digital stream after every

David Lyman distributes satellite television antennas in Salt Lake City Utah. He also serves as a volunteer leader of an Explorer Scout Post.

One of the goals of the Explorer Scout program is to help youths of high school age share experiences in areas of specific interest such as "vocational exploration." So when three scouts told David they were "very interested in satellite antennas and wanted to learn all about them", he was naturally delighted.

The young Explorers quickly qualified as part-time, then full-time members of his installation team. Highly skilled. Very proficient. So much so that Lyman was soon in touch with David Johnson, the President of Paraclipse, with a suggestion.

Why not give these very talented, high-potential young men a chance to join a Paraclipse crew for a "Major install"? Like the one that Johnson had said would soon take place at the NASA Space Facility at Cape Kennedy, Florida.

Such a trip, Lyman felt, would help guide these youngsters into "jobs of the future that probably haven't even been invented yet."

They would gain self-reliance and resourcefulness by working beside, and communicating with, older, more experienced professionals in their field of interest. And yes, in the Explorer Scout tradition, by installing antennas that would be contributing to the success of America's space program, they would be providing a "community" service, with the community, in this instance national rather than local in its scope.

David Johnson, of course, shared Lyman's enthusiasm. On September 24, 1985, Brian Weston and David Witbeck, both 18, and Shane McKnight, 16, boarded the Paraclipse plane for Cape Kennedy. Working with David Johnson, David Lyman and members of the Paraclipse technical staff, they helped to install four antennas at various NASA facilities.

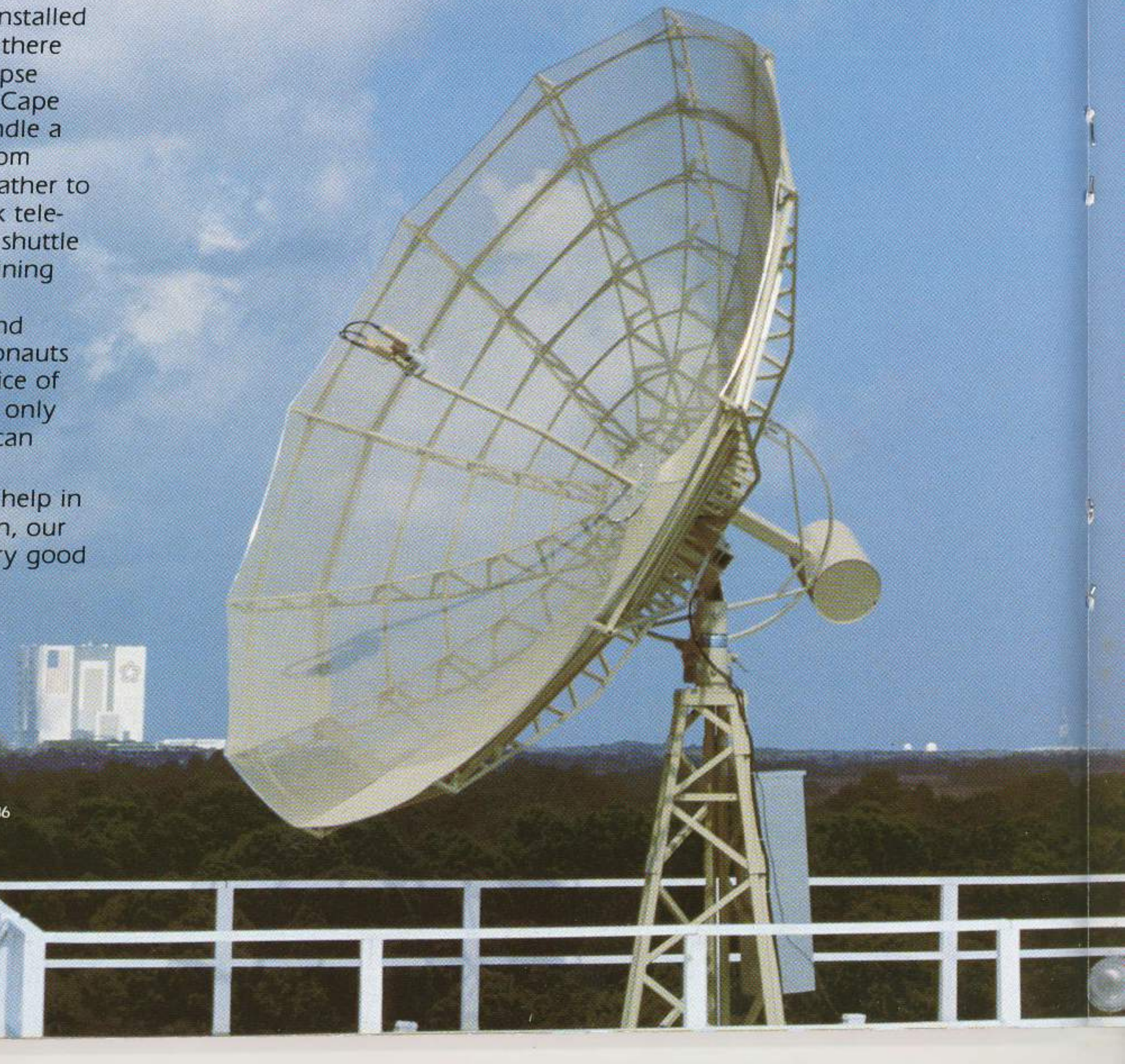
TURN PAGE FOR MORE PHOTOS

KENNEDY SPACE CENTER

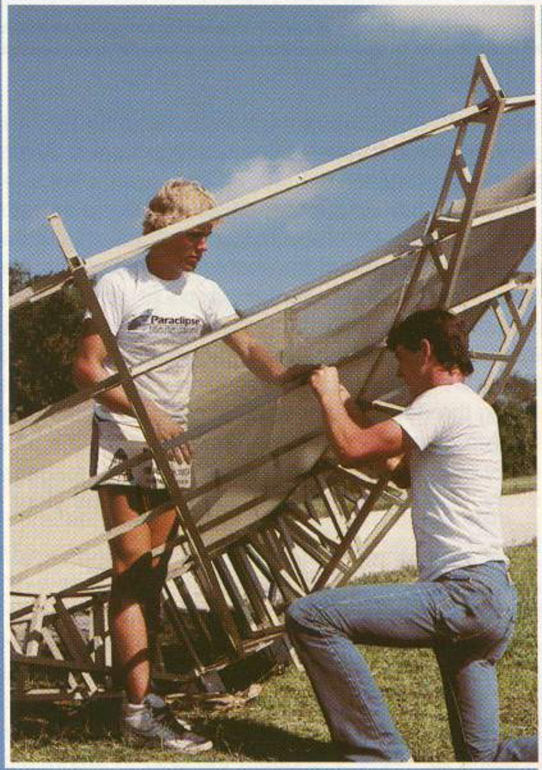
With the Vehicle Assembly Building as a towering backdrop, Dave Witbeck, Brian Weston, Shane McKnight, and David Lyman uncrate a 4.8 meter.

With two units installed on a previous trip, there are now six Paraclipse antennas in use at Cape Kennedy. They handle a variety of tasks. From monitoring the weather to facilitating network television coverage of shuttle launches. From training programs to teleconferencing and providing our astronauts with the wide choice of entertainment that only satellite television can offer.

For their valued help in making this happen, our thanks to three very good scouts.



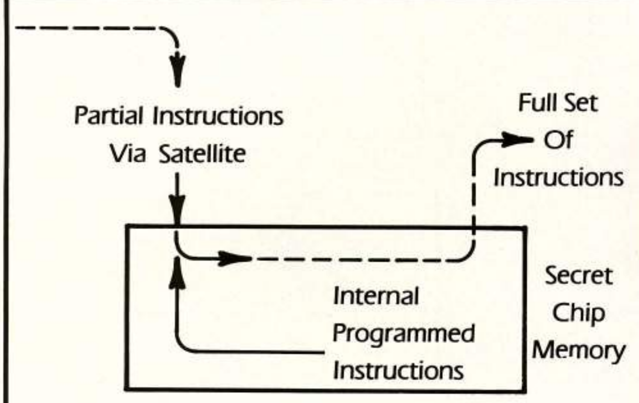
MARK FATOR PHOTO ©1986



At the "Antenna Farm", David Witbeck, foreground, and Brian Weston attach a ring truss to a 4.8 meter.

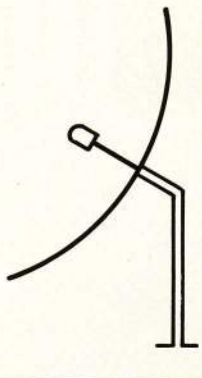
On the job training on roof of the Central Instrumentation Facility. David Johnson uses a spectrum analyzer to fine-tune a 3.8 meter with Brian Weston, left, and Shane McKnight observing.

At the Antenna Farm, a new 4.8 meter takes its place near another installed in 1983.



With Videocipher, only a segment of the road map comes via satellite. The 'sum' of internal plus external instructions equals a full 'road map' for descrambling.

4.5 meter uplink and 3000 watt transmitter might 'saturate' a Galaxy 1 transponder.



6 meter uplink and 162 watt transmitter could cause significant disruption of the Videocipher service.

fifth pulse, by the time you had this figured out the master instructions would be telling the system to now store every second pulse and use it twice after every 16th pulse and then throw away every 21st pulse because it was a false pulse. In short, the road map changes as often as the uplinker wants it to change.

So, here is this tall, string bean fellow walking around the convention floor in a rumpled suit with a tattered brief case in his hand. "You give me a check for $25,000 as a down payment and in six weeks I will start delivering black box descramblers to you at $200 each," he says in measured tones. Anyone who falls for such a line has to believe in Santa Claus and the tooth fairy.

Built into each Videocipher descrambler is a secret master chip which accepts these encrypted instructions. To make life really interesting, part of the encrypted instructions are inside of this chip. An example of how that could work:

1) Let's say the secret, ever changing encryption of the instructions (ie. the road map) are not hard instructions/they are only part of the instructions. Rather than overtly telling the descrambler chip "every third digital bit is to be stored and saved for insertion after every fifth bit, and every seventh pulse is to be stored and saved for use after every 15th pulse," suppose the instructions were just partial.

2) What they really say is "Each time you receive a string of four + + + + bits, follow command A. Each time you receive + + + − − +, follow command B." And so on. Built into the chip, permanently, are certain commands. Hundreds of certain commands. A string of + + + + − − + triggers the chip to automatically save and store every third pulse for use after every 5th pulse. A string of + + + + triggers the chip to automatically store every seventh pulse bit to use after every 15th pulse, and so on. The combinations are almost endless.

3) In this way the full instructions are never sent out via satellite. The rest of the instructions are locked up in permanent memory inside of the Videocipher. Somebody who is studying the commands on the line never gets the full instructions; he only gets a part.

4) By the same token, somebody reverse engineering the chip (ie. taking the chip apart and trying to figure out the commands locked inside in memory) never gets full instructions either. He is missing that part which comes (in encrypted form) via satellite.

All of this technology is being employed to insure that some casual (or even very talented) person sitting in their garage workshop in Hoboken does not stumble onto the magic key to decoding the HBO audio. Once again, even if somebody does get extra lucky and does find the key for a point in time, the key is changed every few seconds or minutes and now an entirely new key is required. Can somebody get lucky time after time after time? The odds are in the quadrillions to one.

Yes, you've heard stories of people who have working Videocipher knock-offs in their hands. If (and that is a significant if) Videocipher's audio encryption is knocked off, it will be because somebody inside of M/A-Com plus somebody inside of the firm that builds the secret chip that M/A-Com uses inside of Videocipher have gotten together to steal trade secrets. Not because somebody is capable of beating a multi-quadrillion to one lottery. M/A-Com is ready for that one as well.

If, by some chance, the trade secret does get outside of M/A-Com (even HBO does not have the secret key information), the system is configured so that an entirely new level of master keys can be employed. These master keys are already to go on a moment's notice and they are locked up in one safe and only one safe at the location of the firm providing M/A-Com with the special chips. Not even M/A-Com knows these back-up master keys.

American Technology

The very same basic system is used by the US military to encode voice and data transmissions worldwide. The technology of the encryption format is not unknown but the key/master key system is a very closely guarded national secret. That's one of the reasons why M/A-Com has been nervous about allowing Videocipher units to go outside of the country directly.

(That is the worst kind of fuzzy headed government thinking since the first thing a foreign spy would do is simply order a Videocipher from M/A-Com for his TVRO system, and pack the unit in a diplomatic pouch for shipment to his homeland. He certainly woudn't try to order one for direct shipment to his homeland!)

Messing Up The System

If the present scrambling is seemingly secure, and the present cable programmers are so self convinced of their need to scramble, how then might the system be aborted? Threats, or actual scrambling of the scrambling, remains a significant fear for the cable uplinkers.

In the most celebrated case of apparent interference to an uplink signal to date, Eastern Microwave reported its WOR uplink signal was severely interferred with for several days late in October. Eastern felt quite certain the interference was purposeful and related to their (then) recent announcement that WOR would be scrambled "as early as March 1st.".

Two things have happened since that occurrence:

1) The Federal Communications Commission has held a study seminar to discuss the threat of deliberate jamming of an uplink, and,

2) The FCC has issued a public notice reminding the world that purposeful jamming of an uplink signal is a federal crime punishable by both monetary fines and possible jail time.

At the same time, the FCC has issued a statement in the Eastern/WOR case which says, in effect, 'Absent any evidence to support the thesis that the interference to WOR deliberate, we must conclude that in this instance the interference was accidental.'

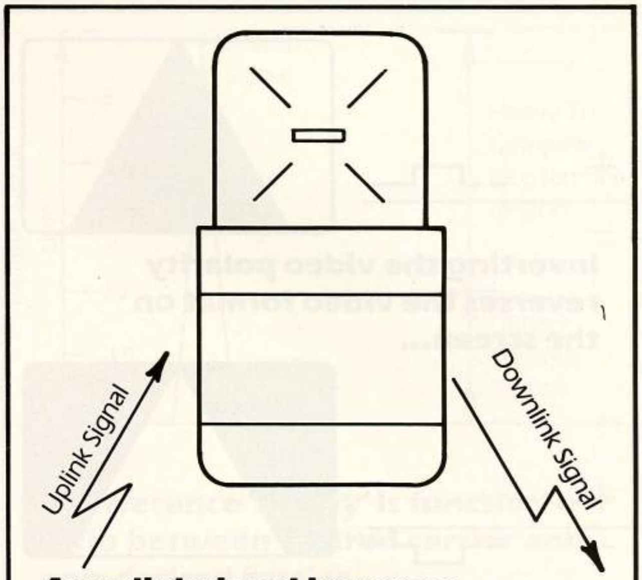
Discussions of jamming inevitably lead to charges that any publicity given to jamming as a weapon against cable programmers tends to incite people to try such things. Publications which have publicized the concept and dangers of jamming to date have been universally damned for daring to even mention jamming. Publicized or not, the threat of jamming looms very real. Here is what is involved.

1) Any radio signal can be jammed or interrupted at the intended receiving site(s) by simply creating a new signal on the same approximate frequency as the desired signal.

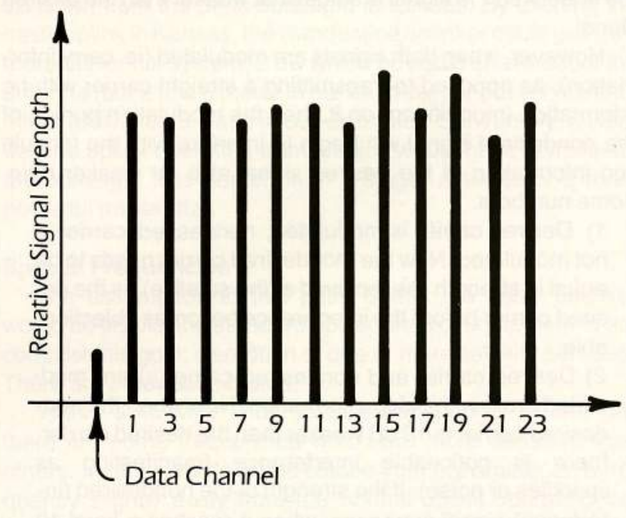
2) Jamming is a way of life for many radio services; overseas transmissions for the Voice of America, Radio Free Europe, and others are routinely jammed by nations that do not want these transmissions inside of their borders. The Russians jam VOA and RFE transmissions, for example, with transmissions located in Moscow. The local transmitters are stronger than the distant broadcasters; all they hear is the noise of the jammer transmitter. There are numerous other techniques for jamming, none of which fit the satellite situation.

3) A satellite presents a handsome jamming target because of the special parameters of a satellite.

A satellite consists of a pick-up (receiving) antenna, a receiver tuned to a specific channel (transponder), and a system



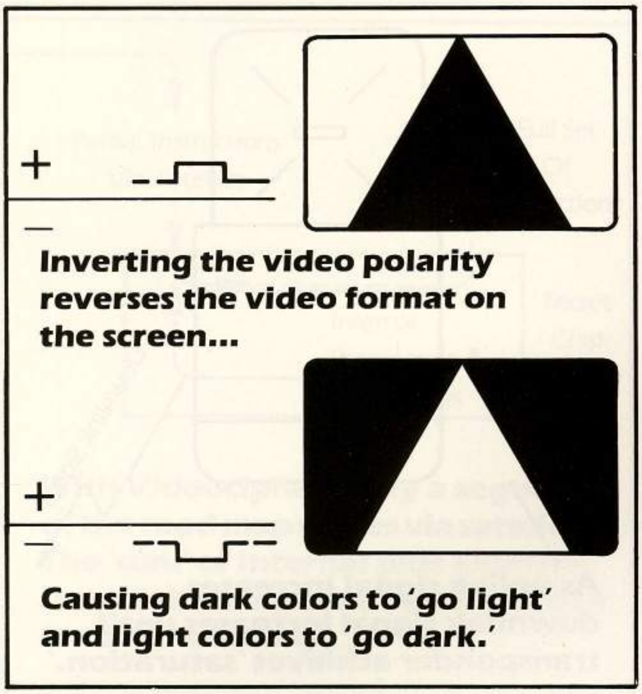
As uplink signal increases, downlink signal increases until transponder achieves 'saturation.'



Relatively weak ground to satellite data channel could easily be 'swamped' by improperly adjusted (in frequency) uplink TV transmitter.

to convert the received signal to a new (downlink) frequency/channel. Then the signal is rebroadcast on the new frequency with an antenna boresighted (pointed) back at earth.

Virtually all satellite transmissions use a system called FM or frequency modulation. With FM transmissions a (satellite) receiver is virtually immune to the presence of jamming (or an interfering carrier) until the interfering carrier comes to a signal strength level that is roughly equal to the signal level being received from the desired uplink transmitter. An FM receiver will



Inverting the video polarity reverses the video format on the screen...

Causing dark colors to 'go light' and light colors to 'go dark.'

virtually ignore the presence of another FM signal as long as the undesired FM signal is somewhat weaker than the desired signal.

However, when both signals are modulated (ie. carry information), as opposed to transmitting a straight carrier with no information (modulation) on it, then the modulation portion of the nondesired signal will begin to interfere with the modula tion information of the desired signal at a far weaker ratio. Some numbers.

1) Desired carrier is modulated, nondesired carrier is not modulated. Now the nondesired carrier needs to be equal in strength (as received at the satellite) as the desired carrier before the interference becomes objectionable.

2) Desired carrier and nondesired carrier(s) are modulated, both with video information. Now when the nondesired carrier is 18 dB weaker than the desired carrier, there is noticeable interference (manifesting as sparklies or noise). If the strength of the nondesired (interfering) signal increases, when it reaches a level 12 dB weaker than the desired carrier, the interference is objectionable. Between −12 dB and 0 dB (at which point the desired and nondesired signals arrive at the satellite at equal strength) the interference becomes steadily worse. At a point where the non-desired signal is approximately 6 dB weaker than the desired signal, it is virtually impossible to still see the desired signal.

The satellite receiver cannot tell the difference between a desired signal and a nondesired signal. It is designed to repeat or rebroadcast anything that comes into the system from the earth below. Therefore, to shut down a satellite channel requires nothing more complicated than sending a non-desired signal to the satellite at the proper signal strength level.

The FCC reports there are more than 2,000 authorized uplink transmitters now in the USA. Any one of these could be misdirected away from its intended satellite and its intended operating frequency to point at, say Galaxy 1, and to transmit on transponder 23 (HBO East). The FCC warns those licensed transmitters in the satellite uplink service to check and double check, to verify that they are indeed pointing at the correct satellite and are operating on the correct frequency before turning on their transmitters. That seems like good common sense; you don't pull onto a busy freeway from a cross street without checking to see what traffic is coming your way.

The normal procedure to insure that the frequency is clear is to zero in the transmit antenna by putting it in the receive mode. In short, you look for the downlink signals coming to your uplink dish (such dishes operate as both receive dishes at 4 GHz and transmit dishes at 6 GHz) first, and then when you have the dish adjusted for maximum received signal strength you check the frequency/transponder in question to see if it is clear. Then and only then do you begin transmitting.

How Much Power?

Some press has focused on the theory that anyone with a backyard dish could turn it into a satellite killer through the simple exercise of tacking an uplink transmitters to the dish. That is the sort of stuff that makes great romantic novels, but it hardly fits the real demands of such a system.

Recall that the interfering carrier must be modulated with some form of wideband signal (such as video) and it must be within 12 dB of the received signal strength of the desired uplink signal before there is objectionable interference. Uplinks trade off transmitter power and antenna gain to achieve something called saturation at the satellite. Because this is an FM system, there are some special rules at work here. You can increase the incoming signal only so far and then the receiver saturates. No additional increase in incoming signal will be reflected by either an increase in output power or an improvement in output signal quality. The traditional method of finding the saturation point is to monitor closely your own coming-back downlink signal. If you measure the strength of the downlink signal on one hand and turn up the power of the uplink transmitter at the same time, you will see corresponding increases in downlink signal. Until saturation. At that point, the downlink signal stops going up even though your uplink power is still being increased.

To achieve saturation is to know that the transponder in question is producing all of the watts of power that it is capable of producing. Most transponder operators run their uplink systems just below saturation (a fraction of a dB) or right at saturation.

The uplinked signal arrives at the satellite by marrying the output power of the uplink transmitter to the gain of the uplink antenna. Both are variables. It is possible to acquire uplink transmitters with output powers as high as 3,000 watts although such monsters are seldom employed anymore. Most uplink transmitters run in the 750 watt region. The rule is that if you use a lower power transmitter, you need a higher gain antenna since the sum of the two (in dB of power gain) is what adds up to arriving at the satellite as a saturated signal level.

The smallest portable uplink antennas used routinely for video work are in the 4.5 meter or 15 foot class. While it is theoretically possible to achieve saturation for some of the newer satellites with a 3,000 watt uplink transmitter connected to a 4.5 meter uplink antenna, as a practical matter such uplinks usually operate at medium power levels such as 750 watts. It takes a massive AC (primary) power source to power a 3,000 watt uplink transmitter (some portable systems require as much as 40,000 watts of AC power, 240 volt, three-phase) so it fits that if you are hauling a trailer rig around the country to do uplinks, you want to keep the quick-connect AC powering requirements to a minimum. A 750 watt uplink can get by for less than half the AC power requirement of a 3,000 watt uplink.

As a practical matter, a 4.5 meter portable uplink will not achieve saturation in most instances. Thus, as you tune through the birds you are seeing a reduced or backed off output power from such a transponder because the uplink signal is not strong enough to produce the full power output through the satellite. The amount of output power from the transponder is directly related to the amount of input signal (power) available, up the the point of saturation; less input, less output.

Different satellites have different input signal sensitivities. Galaxy 1, for example, has an input sensitivity that is about 3 dB better than Westar 5. That means that an uplink operator can use 3 dB less transmitting power, or 3 dB less antenna gain to achieve saturation with Galaxy 1 than is required for Westar 5. Generally, the newest satellites have the best input sensitivity since they are using the latest low noise amplifiers in their input circuits. Think of the input side of the satellite as a TVRO in the sky: an LNA, individual receivers for each of the 24 channels, power dividers and a powering system. It is just like designing a 24 channel SMATV or CATV system, all fed by satellite!

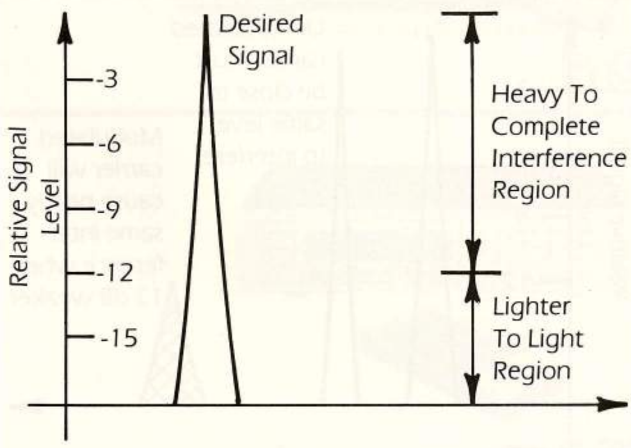
The jammer must be cognizant of the amount of power required to achieve saturation of the satellite in question, using an antenna of some definable size. Certainly it is possible for a 3 meter (10 foot) antenna to achieve useful gain at 6 GHz (the uplink frequency) and when combined with a 3,000 watt transmitter, cause interference at the satellite. But if a 4.5 meter is unlikely to achieve saturation, and it is saturation which most uplink operators strive for, then the chances that really harmful or disruptive interference will come from a 10 foot dish even powered by a 3,000 watt uplink transmitter is remote at best. Remember, however, that a signal that is even 12 dB weaker than the desired signal will still cause objectionable interference.

Some Numbers.

Let us make the assumption that with 3,000 watts of transmitter power and a 4.5 meter uplink antenna that one could saturate Galaxy 1. Now, if a signal 12 dB weaker than saturation will drive the Videocipher system bananas, just how much less power is required to be a disruptive force?

Twelve dB less than 3,000 watts is 162.5 watts. Remember, the non-desired signal will have to be video modulated in this instance, or follow a very well thought-out plan to be placed in frequency in a particularly disruptive portion of the transponder passband.

Now, if the nasty person doing this graduated to a 6 meter antenna, he could reduce his power requirements by the dB difference between a 4.5 meter and a 6 meter (call it a 2 dB). And 2 dB less than 162.5 watts is approximately 105 watts. Or, if the nasty person graduated to a 7.5 meter antenna, his power requirement would now be approximately 70 watts. Remember, this is not total wipeout of the desired signal; it is simply significant, severe, disruption of the signal.



Interference 'ability' is function of ratio between desired carrier and non-desired carrier.

There are a few more dB out there to be gained. For example, boresight. If the uplink is in Long Island, then it is already 2 dB down from the peak boresight in Kansas. By locating the nasty uplink in Kansas, the clandestine uplinker could gain two more dB for his system; 2 dB which he could shave out of the antenna (back to a 6 meter in our example) or out of his transmitter (down to 45 watts in our example). Conversely, a clandestine uplink operating from Mexico would have to make up the boresight loss penalty with a bigger antenna or a more powerful transmitter.

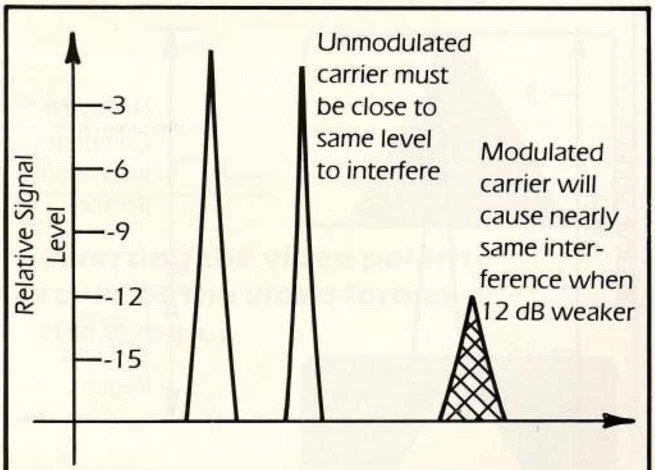
Special Frequencies

The assumption to this point is that the nasty uplinker would be employing standard uplink kinds of equipment to accomplish his goal; disruption of one or more satellite services. There are other possibilities.

Within a 40 MHz wide satellite transponder or channel, there are some frequencies which are more sensitive than others. In other words, if you placed your transmitter on a frequency slightly away from the normal uplink operating frequency, in the right direction (down or up in frequency) by the right amount (in megahertz), more severe disruption of the desired uplink signal will occur. Someone who knows their way around FM would be able to determine where these particularly troublesome frequencies might be and by doing this, the uplink power equation (antenna gain plus transmitter power) would be reduced. Or, with the same power as before, the interference would be far greater.

The assumption to this point has also been that the enemy here is the cable programmer (no names, please) and that any planned disruption would take place with the signal of the programmer in question. There is another alternative for the nasty uplinker: total disruption of the satellite itself.

All satellites are flown in space by ground controllers. Twenty-four hours per day, at one or two locations in CONUS, men sit before extensive bays of equipment monitoring CRT



Placement of the interfering carrier (frequency) or width (modulation) affects the extent of interference created.

screens which display the exact real-time status of the bird's multitude of functions. Most of these functions are computer-corrected and controlled and if the satellite wobbles a slight bit too much in one direction, a computer detects that wobble and sends corrective commands to the satellite. The man sits there to keep an eye on the computer.

This system is controlled by a method generally called telemetering or remote radio command control. The satellite measures and monitors its own functions and sends these measurements by downlink to the ground controller. The monitoring information is converted from digital to analog format and displayed on a screen. The reverse commands, from the computer or the flight contoller, are sent back to the satellite using uplink equipment.

Here's the weak point. The uplink control signals are on a special assigned frequency. The frequencies involved are known and are on file at the FCC. Anyone with a curious mind can look up those uplink control frequencies at the FCC.

Because of the narrow band nature of these uplinked control channels, far less transmitter power is required for this system than is required for transmitting a full television program through the satellite. Therefore, a continuing concern at any satellite flight control center is that somehow somebody turns on a television power level uplink by accident on the frequency normally reserved just for the uplink control data. If that happened, the satellite would become free-flying. All of its instructions would be lost because they would be buried beneath the interfering carrier. Depending upon when it happened (at the semi-annual eclipse period, it would be especially troublesome since the most critical flight maneuvers are taking place at that time), the jeopardy to the full satellite could be considerable. A satellite without any instructions for a full day could possibly be a satellite forever lost to ground control.

Tracing Mal-Contents

The FCC has recently re-advised the world that any unauthorized uplinking is a federal offense with stiff jail sentences and fines are possible. However, just to put it into perspective, the very same jail sentence and fines apply to somebody who operates an unlicensed amateur radio station or who operates a CB radio station in an unauthorized manner.

An unauthorized unlink transmitter will at best be very difficult to locate. The satellite cannot tell the flight controllers where the unauthorized signal is coming from (although under consideration are new smart satellites that could do this, at considerable expense). The only sure way to pinpoint where the interference is originating is to go out into space and look back at earth, as the satellite does, to pinpoint the source. Low altitude observations, such as from the Space Shuttle, are possible but would require retrofitting special 6 GHz receivers to the shuttle. The defense against this defense would be simple enough; don't transmit when the shuttle is flying.

Because the footprints of most 4 GHz satellites cover not only the 48 states plus Alaska and Hawaii, but also significant portions of North and Central America, the unpleasant truth is that given the trade offs discussed in transmitter power and transmitter antenna gain at the clandestine uplink, the interference source could be situated anyplace from near the North Pole to Columbia, and Barbados to Hawaii. That's a pretty big region to sweep for identification of the clandestine transmitter.

No system is in place to conduct such a search or sweep from the skies. At best, many months would go by before such a system could be created and retrofitted to suitable search vehicle (such as the Shuttle or a new low-level polar orbiting satellite). Additionally, the perpetrator could escape detection even then by simply turning off his clandestine transmitter during those periods when the sweep-search is being conducted. Anything less than full time observation, done from space, would be easily defensed against.

There is one technique that is getting serious consideration; using two other satellites, already in place, to sweep the skies. The system would work in this manner:

1) Let's say the problem crops up on Galaxy 1, transponder 16, as did happen last October. It comes on and stays on.

2) Flight controllers take over manual control of RCA F3R and F5 and they carefully direct these two satellites to sweep across North America looking for some signs of a weak signal on transponder 16. On the assumption that both F3R and F5 did find such a signal, by using simple radio navigation triangulation, the probable location of the signal source could be pinpointed. Once that information was obtained, F3R and F5 would be returned to normal duty.

There are several reasons why this concept will probably only be pressed into use as an act of desperation. First, valuable hydrazine fuel would be used in the search operation. Is it worth a year's fuel supply to find a clandestine transmitter? Next, the clandestine transmitter could short circuit the operation by simply turning off and waiting out F3R and F5. Finally, what about the normal service users of F3R and F5? How long would they sit still for a search operation if it meant they would lose ALL communications while F3R and F5 were being redeployed? That such a plan even merits discussion suggests,

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A DEALER is deserving of the most courteous and attentive treatment we can give him.

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however, the complexity of the problem and the degree of concern here.

Emotions Are High

The only thing higher than the satellites themselves these days are the emotions of the on-the-ground players in this game. Cable programmers worry that some sort of 'fringe loony' will react to the scrambling by building a clandestine uplink system. Others are concerned that the public will be mislead into purchasing black market boxes which, when received and unpacked, do nothing more than recover stabilized video from Videocipher and Orion transmissions. They worry that this sort of additional disruption in the marketplace will set back the eventual stabilization of the new scrambled marketplace by a year or more.

The near-term (or short-term) interest of the TVRO hardware suppliers is in considerable jeopardy since the uncertainty of scrambling and the failure by M/A-Com to provide the promised Videocipher descramblers in the quantities promised before January 15th has further eroded public confidence in the transition to scrambling. By being late with their promised units, M/A-Com has compounded an already difficult marketing problem for both themselves and HBO.

You may not have found any hard answers to your difficult questions in this overview of the science of scrambling but at least you now have a better appreciation for some of the nut and bolt challenges being faced by our industry.

Roots of TVRO/PT 18

THE BROADCASTER'S MYTH OF TV BEING FREE IS SO MUCH HOT AIR!!!

A MORAL ISSUE

Unquestionably, the broadcasters of the United States are the most adept packagers of concepts that have ever walked the face of this earth. They are slick, polished, and skillful at their art. They package neatly and professionally, and the American public buys their wares.

So skillful are they that for nearly two decades the powerful broadcast lobby has been selling the concept that over-the-air television is "free television" and anything else (i.e. cable) is non-free television. CATV has been called pay television, rented television, and CATV has been painted as un-American, immoral and contrary to motherhood and apple pie.

Naturally, it is all a skillfully contrived, smoothly delivered lie. *The wonder of it all is that the cable industry has allowed it to be repeated over and over and over again.*

The basis for the lie is that CATV systems charge money. And, to the shallow thinker, television broadcasters do not. *"Television broadcasts are benevolent gifts from the sponsors of programs,"* we are told, "while CATV service costs you money right out of your pocket every day of the week."

Broadcasting stations—even ETV stations—cost money to operate. They cost money to construct. Naturally, since they are not government owned and operated, as they are in many countries, *that money must be coming from someplace.* Basically, it comes from advertising. And advertising is a *cost of business.* The man operating the local Coca-Cola franchise has an advertising budget which he spends in local media to promote his product; so does the man with the local Ford dealership. Advertising expenditures by the Coca-Cola distributor and the Ford dealer are *part of the cost* of doing business.

When the Coca-Cola distributor and the Ford dealer sell products, they carefully analyze *all of the costs* that go into their products, add to those costs a "profit" figure, and this determines the end selling price to the buyer.

Any direct expense to the seller is reflected in an increase in the price paid for the product (or service) by the purchaser. This includes the syrup in Coca-Cola and the headlights in the Ford. If the Coca-Cola man could take the syrup out of his soft drink, and still sell his product, he would do so. At the same time, he *could afford* to cut the selling price of his soft drink by the direct cost per unit sold of the syrup he would leave out of the mixture; and that would bring the price the purchaser pays down also.

So it is with advertising. If the Coca-Cola distributor or the Ford dealer could *eliminate* the expense of advertising *from the total expenses* associated with the sale of his products, the price the purchaser pays for their goods would be lowered accordingly.

The consumer pays for advertising every time he purchases a product. Large companies which sell nationally (Ford, Coca-Cola, etc.) spend money advertising at several levels, usually simultaneously. They sponsor national television programs, and they purchase advertising space in national magazines. Then they spend money regionally, say within a state or a part of a state, on behalf of those distributors/dealers in that region. Finally, through matching advertising funds, they encourage individual distributors and dealers to advertise the product within the local marketplace. Every time advertising dollars are spent, the price of the product to the consumer increases; *because every dollar spent,* divided by the number of units of the product sold nationally, regionally, and locally, *ends up being tacked on to the end price the consumer pays* at the local level for the product.

Virtually *everything* you purchase, no matter where you buy it (on the open, legitimate market), has some cost factor included for advertising. The exact percentage of the total cost of the product bought varies greatly, from as low as 1% for mass-produced commodities such as soft drinks, to as much as 40% for hand-made specialty items.

Every time you purchase a case of Coca-Cola, *you are picking up a few pennies of advertising expense* paid by Coca-Cola (at the national, region, and/or local level) for television advertising. So if the Coca-Cola 30-second commercial at the 8 PM station break helped *offset* some of the *direct costs* of operating channel 4 for that evening, *your few pennies* (built into the case of Coca-Cola you purchased) *has gone to the people at channel 4 that evening* for your television enjoyment.

There is nothing free about television!

The problem is not convincing people it is not free; the problem is determining *how much* it really costs you every day, week, or year. We'll come back to that shortly.

The FCC was charged with the responsibility in 1934 of promoting the efficient use of the public airwaves, for *all* of the public to enjoy. A man in New York City purchases a television receiver, takes it home, and turns it on.

The built-in VHF rabbit-ear antenna and the built-in loop antenna for UHF produce nine television signals. The man is satisfied, and the $299.50 he paid for the television receiver now goes to work for him. If he keeps the receiver for five years and averages $10 per year for maintenance, his cost of enjoying television (less the electricity consumed) is five years times 365 days (1,825 days) divided into $299.50 plus $50 maintenance, or 19 cents per day.

Now a man in DeQueen, Ar., buys the *same identical* receiver, takes it home and plugs it in. Because he is located *outside of all television station coverage patterns,* he receives *nothing* on either VHF or UHF. Now he has a choice as to how to make his $299.50 receiver perform.

(1) He can install a rooftop antenna, with rotor, and when the weather conditions are right, he will receive between two and six television stations, although only two of these with any degree of regularity. The man in New York who bought the same identical receiver would turn up his nose at the quality of reception on those two stations, if that is what he received for his $299.50, and promptly haul his receiver back to the dealer!

The cost to the man in DeQueen, Ar., for such an antenna will be $150, installed. The antenna will last an average of three years, so in five years he will pay for 1²/₃rds such antennas.

The man in DeQueen will average two channels of reception, while the man in New York will select from nine stations.

If he pays the same $50 for maintenance for five years, plus $250 for five years worth of antennas plus $299.50 for the receiver, this man will pay $599.50 for 1,825 days of television; or 33 cents a day (vs. the 19 cents a day for the man in New York).

(2) Or, our pilot example in DeQueen can hook his $299.50 receiver to the local cable TV company. This will cost him $25 to be connected to the TV cable service, and $4.95 per month. In five years he will spend $322 for his cable service, $50 for maintenance, and $299.50 for his receiver; a total of $671.50. This works out to a total of just over 36 cents per day, but now he is receiving six channels of television rather than the two he received on a regular basis with his antenna. And, he receives all six channels all of the time, with the same clarity the man in New York has with his nine channels of television.

The man in New York and the man in DeQueen, Ar., both contribute to the same Coca-Cola advertising fund everytime they buy their separate cases of the soft drink. But the man in New York receives 50% more television than the man in DeQueen, and the man in DeQueen pays nearly twice as much per day for his television enjoyment.

Clearly, *the man in DeQueen is paying a territorial tax* for his television. He is paying a *premium* for his television service because the FCC has so allocated television service regions that his town is *outside of any and all television service regions.*

This series Re-visits the history of terrestrial/broadcast television, from the perspective of the 70's "ultimate technology," cable TV. This series first appeared in **CATJ** magazine in 1975, and its publication forced many changes in **FCC** policy vis-a-vis cable TV.

CITY BORN...
SPANNING THE COUNTRY

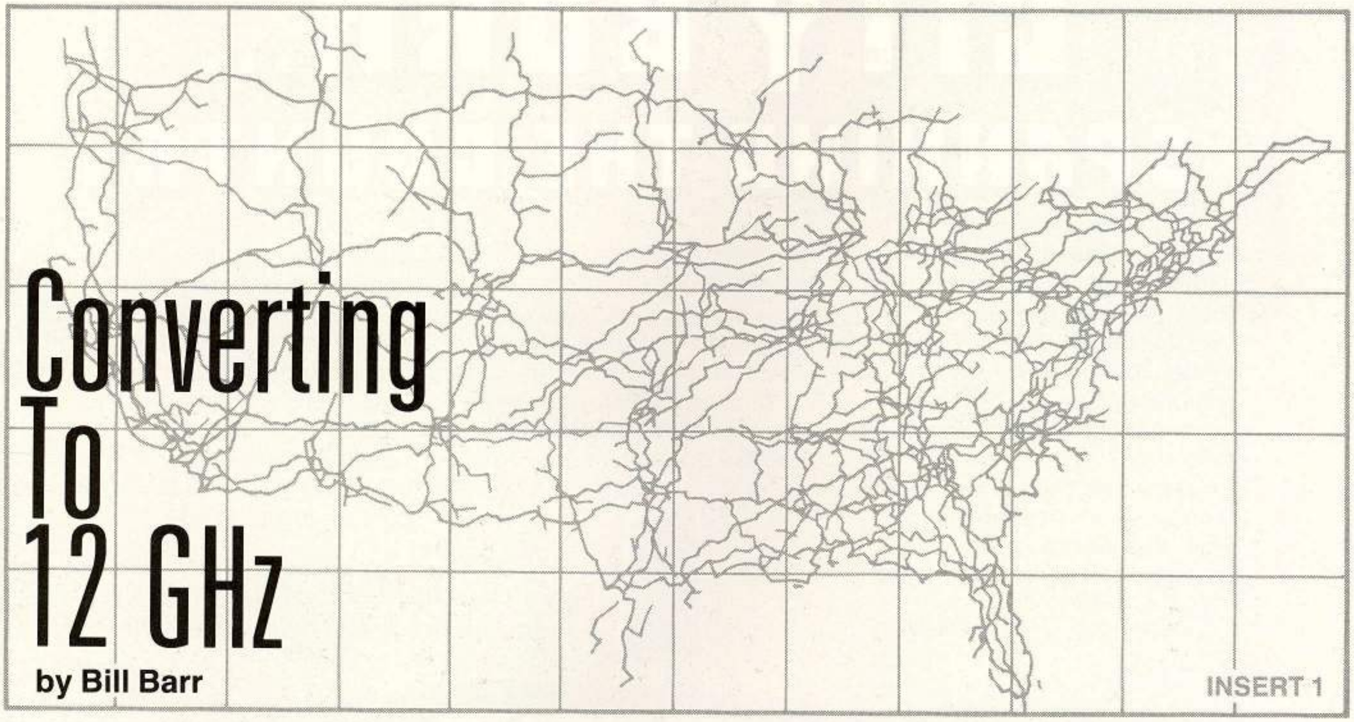
Born in Detroit, the city that defines production, is one of America's best produced satellite dishes, the Saturn Model 108. This 3.1 meter dish is made by one of Detroit's leading specialized manufacturers.

Saturn Satellite Communications Incorporated has many years experience in developing prototypes and specialized parts for companies such as General Motors, Ford, Chrysler, and American Motors. This same production expertise is maintained in the Saturn Dish. It is manufactured by a stamping process which guarantees an essential parabolic curve from the support struts to the independent web members.

The Saturn's quality construction produces a dish capable of C and Ku band reception beginning from 2° main beam. Features like this, plus a superior manufacturer's warranty insures a state-of-the-art product for many years.

From the city thru out the country, one of the best dishes available.

Common Carrier 4 GHz Radio Relay System



Converting To 12 GHz

by Bill Barr

INSERT 1

The questions I am asked most often concern the 12 GHz satellites. When NBC moved to Ku-band it created a stir. Viewers could no longer view their soaps and sports fans lost out on the Sunday football games. Confusion abounds as to whether a Ku-band or C-band antenna is best, what receivers are compatible, and where to get the electronics. The best start is to understand the transmission scheme for the Ku-band satellites.

Ku-band was chosen exclusively for the transmission of satellite signals by the ITU (International Teleconference Union). The C-band that you now watch, 3.7 to 4.2 GHz in frequency, is also used by many Earth bound common carriers. These terrestrial microwave transmissions relay video, voice and data, and sometimes interfere with the lower level satellite transmissions.

If you look at a microwave map the lines all run toward a hub, like spokes on a bicycle wheel. The center of these hubs is usually in the middle of large cities. This causes a problem as the studios of network affiliate TV stations are located in these cities. Because of interference, 190 affiliates of the four major networks cannot install a C-band satellite antenna to receive the feeds. The 'No Go' areas create blank spots in a distribution plan which relies heavily on satellites. In the problem areas, TV stations are forced to continue with older, expensive microwave links.

To get universal coverage, networks are moving to 12 GHz. In coming months look for many of the now familiar C-band soaps and sports to move over to Ku-band. All of these 12 GHz satellites are within the reach of most people in all parts of the continental United States and Canada.

Most present satellite receivers have 24 channel agility; 12 channels horizontal and 12 channels vertical. There are several 12 GHz transmission schemes. On the Anik C2 and C3 birds the channel capacity is 32, the SBS birds have 10 channel capacity. Most of the early 12 GHz compatible receivers have 24 channel readouts. The General Instruments receiver, made for the now defunct USCI DBS reception, had 100 channels on its display. In the programming guide for USCI the channels were advertised as 57, 75, and so on. A format like this is very practical as it can adapt to all transmission schemes.

The message here is that the channel number is very subjective until we arrive at a standard. A well-known international programming guide shows channels in the 32 channel Anik format. This is only an approximation. As you tune the nearest equivalent C-band channel, the Ku center frequencies are offset as much as plus or minus 9.9 MHz. (See inserts 2 and 3.)

The Ku transponders 1 to 32 are shown on the left, the 2nd column shows the nearest C-band transponder for a low end injection 12 GHz LNB. Column 4 lists the same concept for a high side injection oscillator. Columns 3 and 5 show the amount of tuning compensation required from the nearest C-band channel.

Upper And Lower Oscillator Injection

What is the significance of upper and lower oscillator injection? A present C-band block receiver works with a high end injection oscillator running at 5150 MHz. If this oscillator frequency is beat with the 3700 MHz signal from the satellite, into a microwave mixer, the result will be a band of 12 satellite channels, equally spaced in a 950 to 1450 MHz spectrum (500 MHz wide). (See insert 4.)

Should you purchase a 12 GHz LNB which also uses high

Ku-Band Transponders	LOW SIDE LNB OSCILLATOR f_{osc} = 10.75 GHz		HIGH SIDE LNB OSCILLATOR f_{osc} = 13.15 GHz	
	NEAREST C-BAND	VFT OFFSET (MHz)	NEAREST C-BAND	VFT OFFSET (MHz)
1	24	−3	1	+3
2	23	+3	2	−3
3*	21	−2	4	+2
4	20	+4	5	−4
5	18	−1	7	+1
6	17	+5	8	−5
7	15	0	10	0
8*	14	+6	11	−6
9*	12	+1	13	−1
10*	11	+7	14	−7
11	9	+2	16	−2
12*	8	+8	17	−8
13	6	+3	19	−3
14	5	+9	20	−9
15	3	+4	22	−4
16	2	+9.9	23	−9.9
17*	23	−9.9	2	+9.9
18*	22	−4	3	+4
19*	20	−9	5	+9
20*	19	−3	6	+3
21	17	−8	8	+8
22	16	−2	9	+2
23	14	−7	11	+7
24*	13	−1	12	+1
25	11	−6	14	+6
26*	10	0	15	0
27	8	−5	17	+5
28	7	+1	18	−1
29	5	−4	20	+4
30	4	+2	21	−2
31*	2	−3	23	+3
32*	1	+3	24	−3

*Indicates Active Transponder—Occasional and Continuous

INSERT 2

Ku-Band Transponders	LOW SIDE LNB OSCILLATOR f_{osc} = 10.75 GHz		HIGH SIDE LNB OSCILLATOR f_{osc} = 13.15 GHz	
	NEAREST C-BAND	VFT OFFSET (MHz)	NEAREST C-BAND	VFT OFFSET (MHz)
1*	24	+5	1	−5
2	21	−6	4	+6
3*	19	+3	6	−3
4*	16	−8	9	+8
5*	14	+1	11	−1
6*	11	−9.9	14	+9.9
7*	9	−1	16	+1
8*	7	+8	18	−8
9*	4	−3	21	+3
10*	2	+6	23	−6

*Indicates Active Transponders—Occasional and Continuous

INSERT 3

side injection, (oscillator is running at 13.15 GHz), this LNB will work without having to invert the video of your present C-band receiver. Unfortunately, most 12 GHz LNBs now available use low side injection (oscillator running at 10.75 GHz). You need to flip the inversion video switch on your present C-band receiver. The consequence of this is that the channel format is flipped also. Channel 24 becomes channel one and vice versa. This can get confusing when trying to reference a channel number against a programming guide.

To help complicate the issue, some 12 GHz LNBs are not industry standard 950 to 1450 MHz. One popular Japanese make uses 930 to 1430 MHz. This has the result of putting Ku channel 1 beyond the reach of the receiver's internal downconverter. This is not presently a problem as there is no video transmitting on channel 1.

The requirements for your present C-band block receiver to successfully operate at 12 GHz are as follows:

1) It must have a video invert switch on the rear panel.

2) It should be able to fine tune plus or minus 10 MHz from center frequency of the C-band 24 channel format. Some synthesized receivers have no fine tuning. An ideal 12 GHz receiver is a block type with a single turn pot for channel selection. I use a Goldstar CSR-420S as a dedicated 12 GHz receiver. This is detent tuned but every channel has a varactor tuning slug on the rear panel that can be preset to the 12 GHz channels.

Noise Factors

Now the question is where can you get the LNBs and what noise factors are available? Early 12 GHz LNBs had a typical noise factor of 3.0 dB. The industry standard is now 2.5 dB and for a price you can purchase a 2.3 dB hot unit.

Listed below are several manufacturers of 12 GHz LNBs. I suggest you call and get the location of the nearest outlet to your location.

DX Communications Inc.
10 Skyline Drive
Hawthorne, NY 10532
Phone: (914)347-4040

General Instruments of Canada
70 Wingold Ave
Toronto, Ontario, M6B 1P
Phone: (416)789-7831

Scientific Atlanta
Box 105027
Atlanta, GA 30348
Phone: (404)925-5000

M/A-Com
1375 Lenoir Rhyne Blvd.
Hickory, NC 28601
Phone: (704) 324-2200

The DX and Scientific Atlanta LNBs have a WR75 waveguide input and General Instruments' uses a circular type, the transition to WR75 is internal of the LNB. When you order a 12 GHz feed for the LNB from Chaparral, be sure to specify what type of waveguide opening is on your LNB.

Antenna Size And Type

The Anik C2 and C3 Canadian 12 GHz EIRP map is shown below. The dotted line shows the half-Canada beam used by Anik C2. The East and West beams carry 16 channels each. The four spot beam configurations of Anik C2 are known as quarter-Canada beams, (East, Center East, West, Center West). There is eight channel capability on each spot. (See Insert 5.)

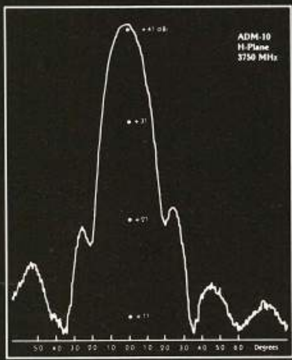
To get above threshold pictures within the dotted lines of the Anik C3 with a 2.5 dB LNB will require a 6 foot antenna. On the smaller more powerful spot beams of Anik C3 you can operate above threshold with a 3 foot antenna.

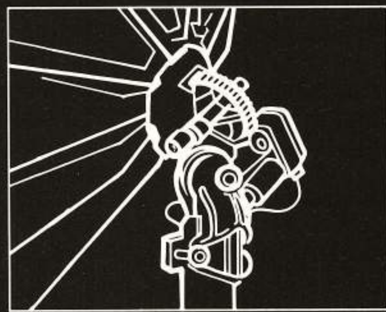
Few people will use a dedicated antenna for Ku-band reception. A more logical approach is to simulcast on your present C-band antenna. Add the Ku feed off to the side of your polarizer scalar at the polar axis angle for your location.

Another approach is to buy one of the dual band feeds which are now available from Chaparral or Pico Products Inc. Once again, it is important to align the waveguide opening with the polar axis angle.

The GAIN Is Always ADM QUALITY

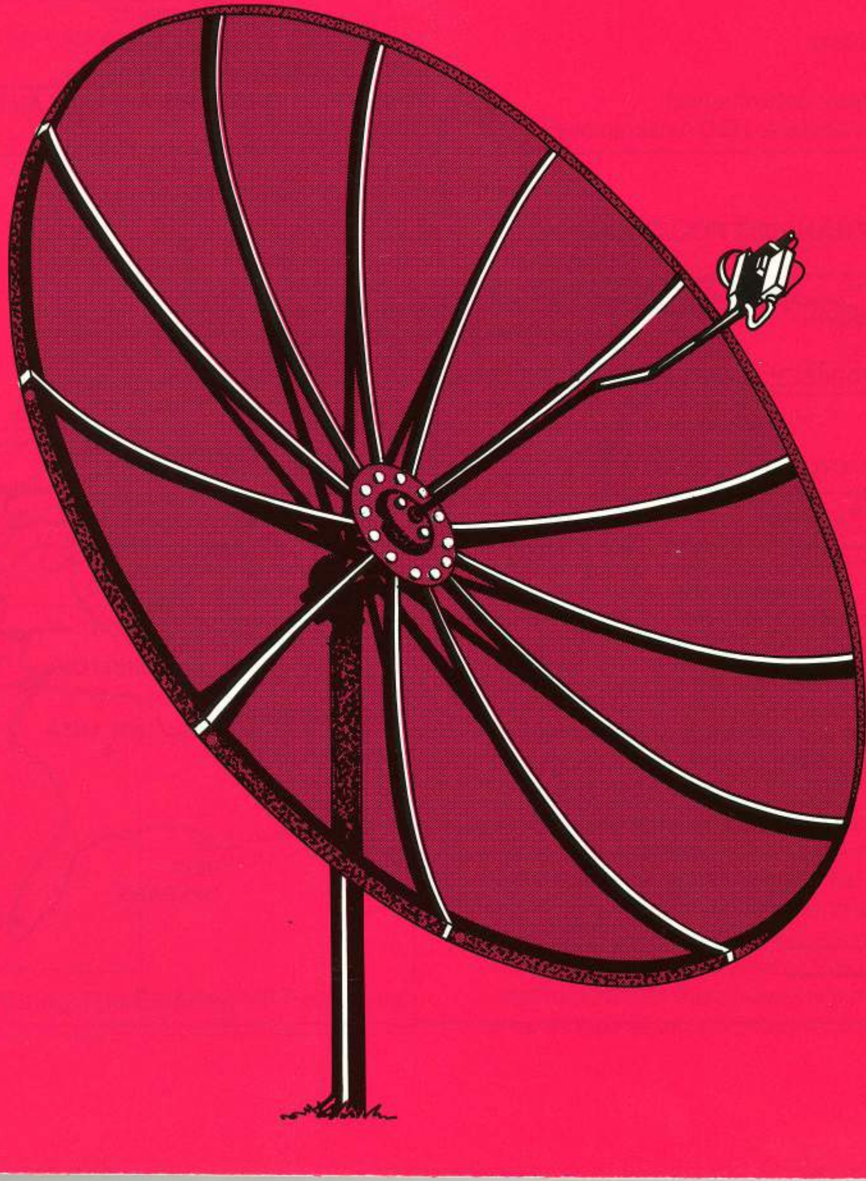
The Model ADM-10′ perforated dish offers attractive see-through advanced design with the added plus of fast assembly and exceptional performance even at 12 Ghz. A motorized





horizon to horizon mount with control, .050 aluminum perforating at 1/8 x 1/4 staggered and interlocking rim band for maximum strength are just some of the features. The Model ADM-10′ perforated antenna is a major advancement in the performance of see-through antennas and best of all makes ADM quality affordable. ADM also manufactures a 10′ steel and 10′, 11′, 13′, 16′ and 20′ aluminum models to round out a comprehensive selection. Call an ADM representative for more information and experience for yourself the benefits of the ADM quality tradition.

Antenna Development & Manufacturing, Inc.
P.O. Box 1178, Hwy. 67 South
Poplar Bluff, Mo. 63901
[1-314-785-5988]



There are two ways of feeding the additional Ku-band block signal into your home. The simplest way is to run another RG6 cable and put an A/B switch at the rear of the receiver. This alternately feeds the 12 or 4 GHz signals to the receiver input.

Another approach that avoids running another RG6 cable is to add a H/V switch out at the two LNBs and use a voltage to switch the input. Inside at the receiver add a two-way splitter to feed each receiver. Remember that one receiver has to be active to power the LNB up the cable. Make this the 4 GHz unit and switch on the 12 GHz unit. Now flip the A/B switch to route the RF to the TV set. (See Inserts 7 and 8)

Some hype is flying around that mesh antennas do not work at 12 GHz. The efficiency of the mesh or perf antennas is low, typically 28 percent. The gain at 12 GHz from the large 8 or 10 foot surface will insure good pictures on the 12 GHz birds.

As a rule of thumb, people above the 40 degree latitude will receive good pictures with their offset 12 GHz feed on the Anik C3 bird with a 10 foot antenna. Those below 40 degrees should shoot for the SBS or G-Star bird which blankets all of the US, up as far as the 50th parallel into Canada.

What is On .....

Anik C3 117.5 ...All Audio at 5.41 MHz

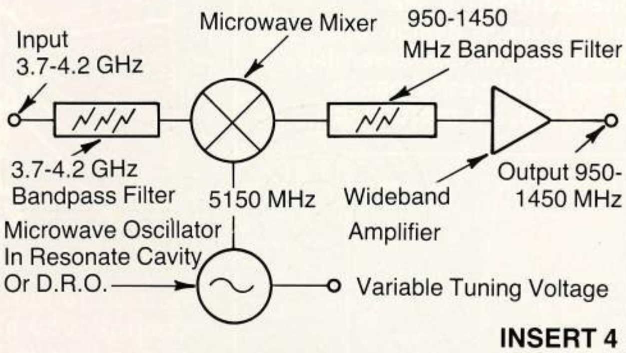
West Beam

(14) Channel 8 Knowledge Network
... Educational TV

(12) Channel 9 Alberta Access
... Educational TV

(8) Channel 12 First Choice/ Superchannel
... First run movies similar to HBO (unscrambled)

Schematic Of High Side Injection Block Converter



INSERT 4

East Beam

(22) Channel 18 Atlantic Satellite Network
... Superstation

(20) Channel 19 Premier Choix/TVEX
... First run movies/French

(13) Channel 24 La Sette (TVFQ)
... French Superchannel

(10) Channel 26 TV Ontario
...Educational TV

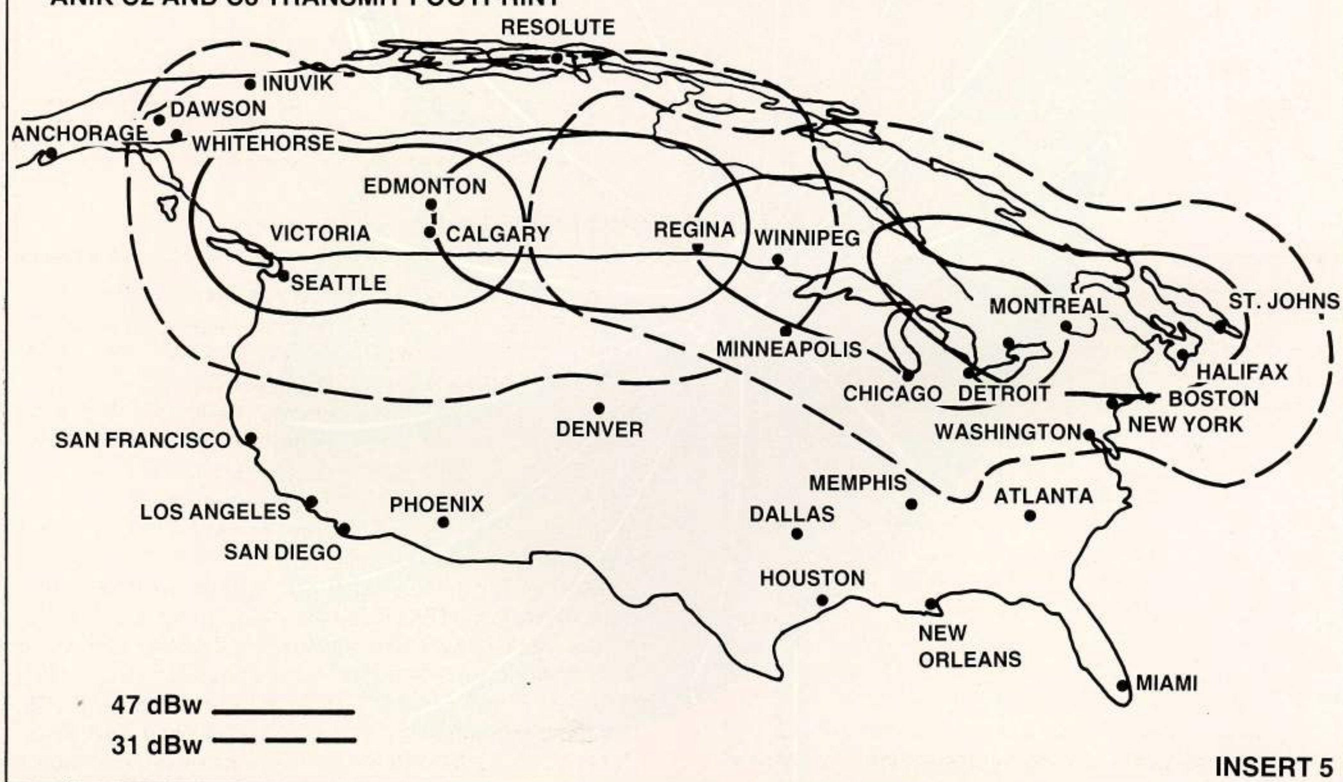
(2) Channel 31 First Choice/Superchannel
... Same as channel 12

(1) Channel 32 Radio Quebec
... Educational TV (French)

G-Star 1 ... 105 Degrees Wst ... All Audio 6.8 MHz

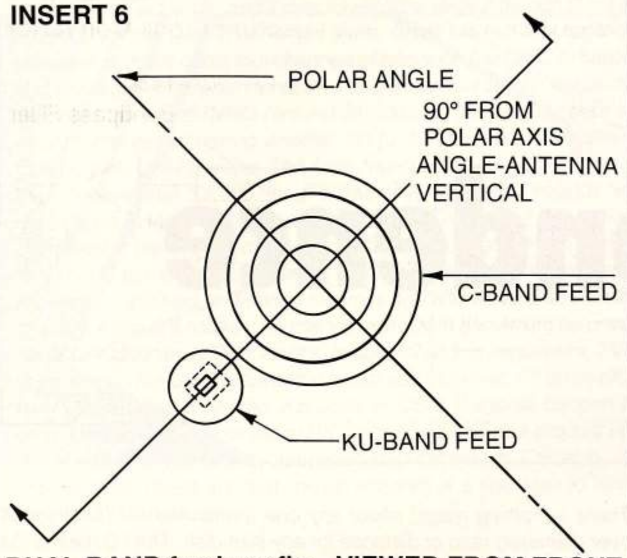
(18) Channel 5

ANIK C2 AND C3 TRANSMIT FOOTPRINT



INSERT 5

INSERT 6



DUAL BAND feed config—VIEWED FROM FRONT

... Satellite Education Network
... Educational TV
(12) Channel 9
... Satellite Education Network
... Educational TV

SBS 3 ... 95 Degrees West ... 6.8 Audio

(19) Channel 3 NBC Pacific
... Network Feeds
(11) Channel 6 NBC Central
... Network Feeds
(7) Channel 8 Private Satellite Network
... Scrambled
(4) Channel 9 NBC East
... Network Feeds

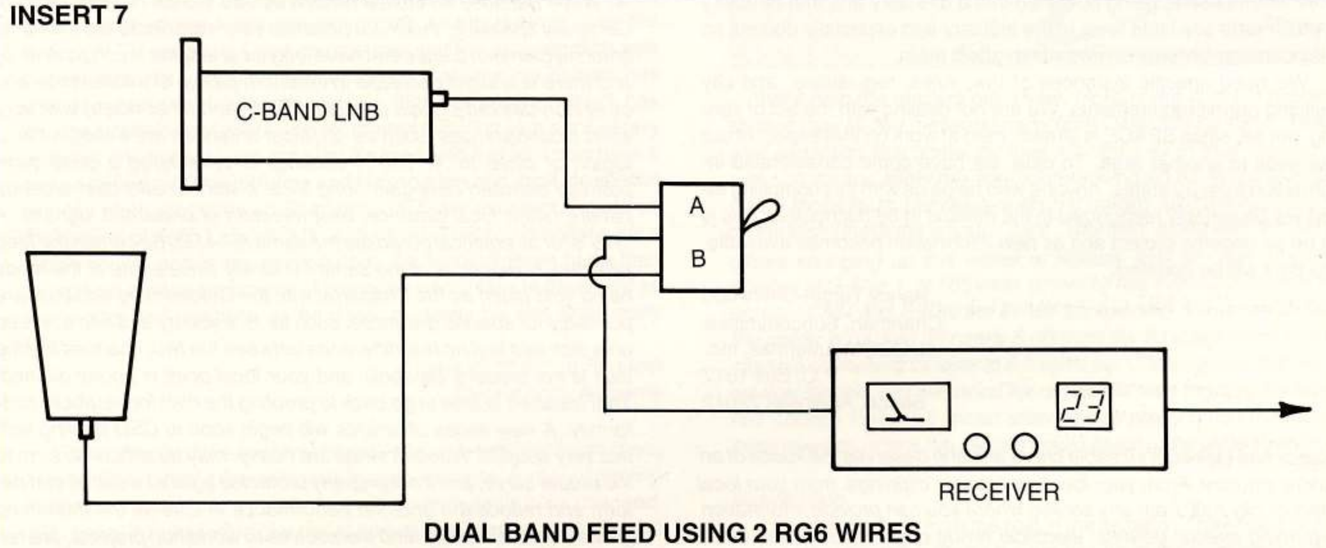
Numbers in brackets are the nearest C-band channel on your present 24 channel receiver (when using a low end injection of 12 GHz LNB).

There are other occasional video transmissions on these three birds but a hit and miss attitude must be used.

The total number of 12 GHz birds is now 10.

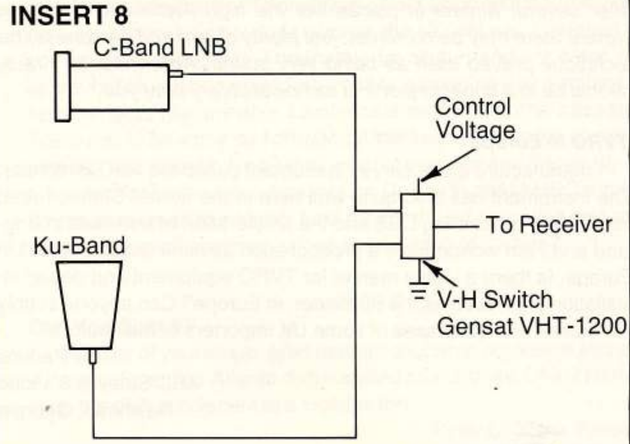
1. Spacenet 1... 120 degrees west
2. Anik C3......... 117.5 degrees west

INSERT 7



DUAL BAND FEED USING 2 RG6 WIRES

INSERT 8

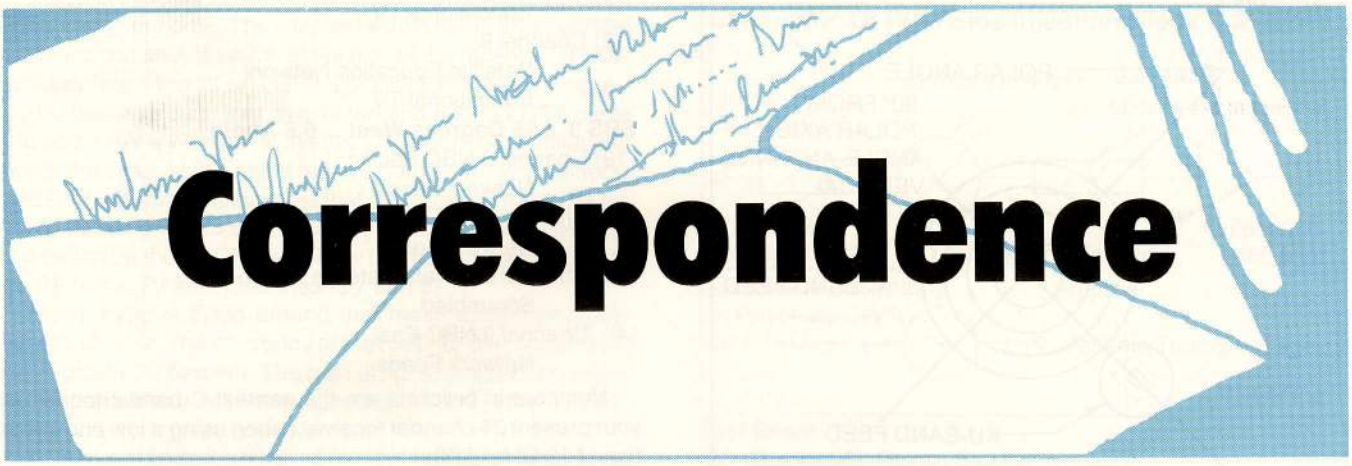


Dual Band Feed Using The Existing RF Feed Line

3. Anik C2......... 112.5 degrees west
4. Anik C1......... 107.5 degrees west (mothballed.. For Sale)
5. Gstar 1......... 105 degrees west
6. SBS 4........... 101 degrees west
7. SBS 1........... 99 degrees west
8. SBS 2........... 97 degrees west
9. SBS 3........... 95 degrees west
10. Spacenet 2... 69 degrees west

(Notice the two degree spacing)

There are not many programs of interest on 12 GHz presently. Perhaps the NBC feeds are a big enough attraction for you to spend money for this update. If and when all the major movie networks on C-band scramble, there will be a good free alternative called First Choice/Superchannel on Anik C3. They show the same movies as HBO or Showtime. The investment to scramble this channel is out of the question for some time, as their accountants buy a good stock of red pens.



Effects Of Law

As Chairman of the Subcommittee for the Aggregation and Dissemination of Laws and Regulations in the Earth Station Industry for the Industry Standards Committee, I am requesting the assistance of all dealers and distributors nationwide in collecting data on all laws now in effect (or subsequently proposed) which affect our industry. This information is being compiled into a directory and that directory will be made available to all of the industry and especially dealers so they can stay abreast of laws which affect them.

We need specific instances of law, rules, regulations, and city building permit requirements. We are not dealing with the act of zoning, per se, since SPACE is already hard at work on that aspect of our business in another area. To date, we have some considerable information from 30 states. Anyone who helps us with this compiling effort will be suitably recognized in the manual to be distributed. This is to be an ongoing project and as new information becomes available, the data will be updated.

Nancy Turpin-Sherwood
Chariman, Subcommittee
℅ ODOM Antennas, Inc.
P.O. Box 1017
Beebe, Arkansas 72012

Nancy has tackled a sizeable chore and she deserves the kudos of an entire industry. From your local newspaper clippings, from your local town or city hall, from any source where you can provide information regarding special permits, electrical wiring requirements, and other material relating to the installation of a TVRO (less zoning requirements), we suggest that you make copies of what you have or can locate, and bundle that off to Nancy.

TIV-ROW

I am 23 years old and am very interested in the TIV-ROW industry. I am an installer for a local cable company but want to learn more about the excitement and challenges of satellites. To date I have built four of my own dishes; three 10 footers and a 12 footer. A 20 foot dish has been running around in my head for quite some time. For the 20 footer, I have plotted the curve for an f/D ratio of .375 using the Nelson Ethier antenna manual. Would an f/D of .375 be proper for a dish of this size? Are there any reference manuals dealing with the construction of dishes of this larger size?

My belief is that the ribs could be made of wood just like Jim Vines has built in the past. I have also decided on making it an Az-El mount because of the additional tracking accuracy.

Brian Black
Courtright, Ontario
Canada

There is nothing magic about any one (particular) f/D (focal length over diameter) ratio or distance for any size dish. The f/D means that the distance from the very center of the dish to the feed mount entrance will be some distance (f) divided by the actual antenna diameter (D). A 10 foot dish with a focal length of 48 inches would have an f/D of .4. Why? Because 48 inches divided by 120 inches (10 feet) is 0.40. Generally speaking, there is a potential very slight increase in overall antenna gain with dishes that have long focal lengths (such as .5 or .6) and there is a slight decrease in feedhorn pickup of interference and other non-desired signals (including Earth and other noise) with very short focal distances (such as .3). Most antennas are either in the .3 region or close to .4. The .4 distance is considered a good compromise between best gain (long focal distance) and best antenna pattern (short focal distance, best rejection of unwanted signals). A .375 is for all practical purposes the same as .4 f/D. Be certain the feed selected, however, is of the same f/D family since some of the feeds being sold (such as the Chaparral with the Golden Ring addition) are pointedly for specific distances, such as .3. If you try a .3 and a .4 feed on a dish and find no real difference between the two, chances are the dish is not properly parabolic and your focal point is poorly defined. That means it is time to go back to proofing the dish for parabolic conformity. A new series of articles will begin soon in CSD dealing with this very subject. Wooden struts are heavy, may be difficult to form to the proper curve, and if not properly protected against weather can deform and reduce the antenna performance in time as the deforming grows worse. But, they lend themselves to workshop projects, are relatively inexpensive and are forgiving of mistakes. Laminated wood was the choice of Jim Vines for his Paraframe series of antennas and after several winters in places like the high Arctic and Honduras (where there may be no winter; just plenty of rain and dampness) his technique proved itself as being very sound. ***Antennas****, by Kraus, should be in a bookstore or in a technical library near you.*

TVRO In Europe

I manufacture a site survey instrument called the ABC Birdfinder. The instrument has sold quite well here in the United States. I read your article concerning DBS and the proliferation of terminals in England and I am wondering if a product such as mine would sell well in Europe. Is there a viable market for TVRO equipment and dealer installation aids, such as the Birdfinder, in Europe? Can anyone supply the names and addresses of some UK importers or distributors?

Bill Perkins
ABC Satellite & Video
Newhnan, Georgia

The European TVRO market is pretty much confined to the UK (United Kingdom) at the present time (see CSD for January 15, 1986). The *market is not yet large, and it may never grow large although there are potentially more than 23M homes there. Given the fact that terrestrial television consists of but four channels of television (two BBC or national and two regional independent), one would suspect that for the price of an English 3-4 foot TVRO (around $1,500 US) there would be a significant interest in having another 10 to 15 channels from all over Europe plus CNN/Europe. The facts seem to be contrary. While we may believe that $1,500 for a terminal (US dollars) sounds very reasonable in the USA there is a considerable wage and income level difference in the UK. We don't usually associate England with poverty-level living but the comparison to US living standards is stark none-the-less. In addition to reduced incomes and a lower overall standard of living, there is a marked reluctance to invest in something so untraditional or radical as a TVRO there. In spite of all this negativism, TVRO is growing in the UK at least at the public visibility level. If it takes off, as we reported and projected last June in CSD, it should happen this year. Perhaps one of our many UK readers will find your product of interest and write you directly about handling it in the UK. Certainly, finding the birds (there are now two of interest) is a first step to having satellite TV reception!*

First K2 Reception

I first noticed RCA Ku-2 bird reception here on December 17 with video on horizontally polarized transponder 12. The bird was located at 81.4 west on this date and drifting. In your December 15 issue, CSD published my letter concerning my strong feelings over the Boresight TV program. I had commented that the programming was childish and not very professional. Since that time my opinion has changed because I honestly believe that the program itself has changed. When I last wrote, I had just seen their first year anniversary program and frankly I was not very pleased with it at all. I now have a higher regard for Shaun Kenny and his program and think his special Sunday night programs on Spacenet, TR7, are excellent. However, my opinion of Keith Lamonica is unchanged. This guy is nothing but a rabble-rouser and in my opinion does the industry more harm than good. I am always suspicious of someone who claims to have held as many jobs and positions as he does; evidently he was fired many times.

Name Withheld on Request
Birmingham, Alabama

Shaun Kenny does seem more laid back and reserved these days. Maybe Shaun had a few wild oats to sow, and after a year of playing the part on Boresight, his attitude and long term goals have changed. We repeat that any effort like this to convey real, impartial information to the industry should be applauded. Heaven knows Shaun is not making any money at Boresight, and his dedication to keeping it on the air must be admired even if one does on occasion take issue with what he says or how he says it. As always, the easiest way to protest is to not watch the program. Fortunately for Shaun and his crew, most agree that he is doing a good job and are supporting it by watching and helping out as they are able. Lamonica is certainly another case study. There has to be some sort of subsidy that keeps him on the air with his rantings and ravings. He trips all over his own ego and frequently mistakes fact for fiction and fiction for fact. Do you suppose HBO would be so mean to us as to secretly fund his continued operation just so we (as you suggest) continue to look like a bunch of crazies?

Can You Spot It?

Can any of your sharp-eyed readers spot what is unusual about the 4.2 meter Scientific-Atlanta dish installed near Sidney, Ohio? Here is a clue, the dish is adjacent to a Holiday Inn.

Peter C. Sutro, President
MPI Satellite, Inc.
Bernardsville, NJ

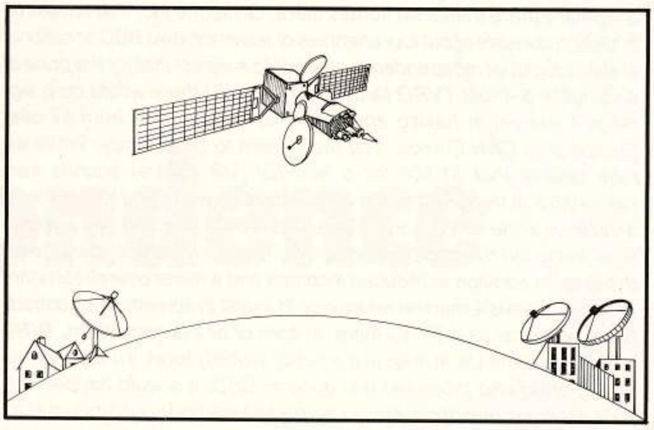
We'll help the readers out, Peter. Holiday Inn is in the process of shifting their Hi-Net (network) away from C-band to Ku-band. They are also expecting that someday they will equip all of their Holiday Inns with uplinks and allow two-way conferencing from one Inn to another. Given those facts, our readers should quickly spot the Ku-band feed on the dish (that's the unusual part). This dish, along with hundreds of others springing up this winter at Holiday Inns all over America, is pointed at G-Star 1, at 103 west, where HI has five video signals in operation. CNN and ESPN are in half transponder format on G-Star so the power is backed off nearly 5 dB from the 20 watts which G-Star is capable of (making it closer to 6.5 watts per video signal). Between the weaker signals and the need for rain/snow fade margin, Holiday Inn has chosen these 4.2 meter antennas as pretty much the standard even in areas where the signals would seem to be quite strong.

Needs Help

I need some help from the rest of the industry. The enclosed newspaper story relates a problem I am having in the community where I live; Lake St. Louis, Missouri. SPACE has helped by supplying me with documentation of similar cases where antennas for TVRO have been discriminated against.

Michael R. Pecoroni
ESM, Inc.
219 Wharf Street
Lake St. Louis, MO 63367

Mike's problem is that he installed a dish in his yard in 1984. A year later his community adopted an ordinance against dishes. Mike first ignored the ordinance although he participated in the hearings for the ordinance and vigorously opposed it. The city notified him he was in violation and that he required a special variation/permit to keep his dish. He applied for the same and was refused. He appealed the decision to a higher board and lost again. Then the city told him he would be fined $500 a day and spend five days in jail for each day he continued to violate the ordinance. In short, he was to take down his dish and give up TVRO. Mike is in the industry (previously he was with In-



tersat) and has a more than passing interest in keeping his dish. Others in his community do have dishes although members of the City Alderman board have stated repeatedly that ALL dishes must go because they look poorly. With the approval in mid-January of the FCC of preemptive zoning rules, it would seem that any community that has in the past blatantly opposed dishes on aesthetic grounds (like Lake St. Louis) would be forced to back off. However, Mike will probably have to fight it in court and pay the considerable court fees and lawyers' fees involved. Anyone with copies of court decisions in other areas where aesthetic anti-TVRO zoning has been defeated in the court system should send Mike copies of what happened. He will need all of the help he can get before he gets done with this one. Good Luck, Mike.

Tanzania TVRO?

I would like to send a satellite dish to my brother who is in Das-es-Salaam, Tanzania. This is on the equator, in Africa. What kind of dish should I purchase and what type of equipment should I include with the dish? Please also bear in mind that Tanzania has 240 volt electrical mains rather than the 110 volts of North America. Finally, if I do this for him, what type of programming will he receive?

Amir Kamali
Calgary, Alberta
Canada

Neither the equatorial location nor the 240 volt AC mains will present insurmountable problems. What will be tricky is the lack of high quality, strong satellite signals in this region of Africa. No antenna smaller than 5 meters should be considered (Paraclipse 15 foot, ADM 20 foot, Hero 16 or 20 foot). All reception will be from either Intelsat or the Russian Gorizont satellite and will be right hand circular in polarization, requiring a feedhorn adapter available from any of the antenna sources listed or Chaparral Communications. The receiver should be a switchable half or full transponder receiver since Intelsat transmissions often occupy only half of a channel/transponder and when tuning in such a signal with a regular (full transponder) receiver, you must eliminate (as in filter out) the half of the transponder not in use for the video program of interest. Avcom of Virginia, Inc. manufactures a line of such receivers, while Phantom, Arunta, and others offer special filters which can adapt most standard (70 MHz IF type) receivers to half transponder reception. Purchased from the various sources given here (see advertisements for each in CSD), you will have between $7,500 and $8,500 (US $) in the equipment before it leaves the US. An export license to ship to Tanzania will also be required, usually obtained for you by the (antenna) supplier. A system in Tanzania will receive between 6 and 10 channels of reception, including Cable News Network through AFRTS.

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Transponder Watch

FCC decision favoring federal preemption of local zoning ordinances which restrict the use of TVRO and other satellite antennas finally released. Decision allows direct court tests now when communities fail to limit dish antenna placement purely on health and safety reasons. FCC's decision will result in hundreds of lawsuits from communities, and appeals to court system will be quick to follow. We are not out of the woods yet.

EUROPEANS are concerned by indications primary Eutelsat 1 bird is having output amplifier TWTA tube problems. The 20 watt transponders are speced at 3 dB power loss (half power) over seven year nominal life. Several transponders, including that used by British Skychannel, are experiencing output power losses as high as 1.0 dB per month.

Space has formed programming cooperative with Kaul-Tronics to program Spacenet 1, transponder 19 each Tuesday night at 9 PM eastern. Alternate week programs are produced by Bob Behar for SPACE, and Nova Video Productions for Kaul-Tronics.

CNN/Europe having difficulties getting permission to deliver program into European locations other than hotels. CNN now says they will encrypt service (eventually) to prevent unauthorized home reception. Several (not identified) countries have rejected Turner's proposal.

DUTCH cable firms will be prohibited from carrying new ITV Superchannel proposed in UK if the network is not available to cable homes within UK. ITV service is proposed only for outside of UK to maintain BBC control of UK television market there.

INTELSAT has begun process of selling off spare transponders in C- and Ku-bands by announcing sale of three transponders to West Germany in Ku-band. The last of the Intelsat V series birds (F-13 and F-15) and all of the major VI series birds to be launched will have increased Ku-band powers and tighter spot beams, including spot beam coverage into eastern USA for direct connection to Europe for business communications and video.

HARRIS Corporation will supply Ku-band terminals to AT&T. Terminals will be 1.2 meters in size, will handle video, data, and voice, and will function through the pair of Ku-2 transponders which AT&T has leased from RCA.

RUSSIA charging that US has plans to expand service of Worldnet government program into Russia by providing technical details to Russian citizens using Voice of America radio transmissions. Russia not pleased with prospect of expanded US television programming in USSR.

DONALD Berg, Channel Master, in his annual business predictions for TVRO, suggests system sales in industry should average no more than 25,000 per month through June and then rise to around 41,000 per month after June for balance of the year. If Berg is correct, total ouput of industry for 1986 would amount to around 400,000 terminals; down 20% from best guesstimates of 1985.

TCI, largest cable MSO with 3.9M subscribers in 43 states, will offer home TVRO channel packages shortly. They plan to offer around 10 program channels for base fee in $12 region, first premium service at $10 and each additional premium at $6.50 each. TCI may also provide (Videocipher) decoder for around $8 per month.

ENGLISH TV rental firm is now offering NEC (brand) Ku-band systems for approximately $70 per month for first year, $65 per month in second year, and $20 per month for third year. Installation is included; programming costs, when established, extra.

RCA Service Company not announcing how it will use two Ku-3 transponders. As part of deal between RCA Americom and HBO to package 16 transponders on Ku-3 for cable use, service firm gained use of two Ku transponders. Prospect is for motel and hotel entertainment channels using both transponders.

FCC could slap violators with $10,000 fines and two-year prison terms if they are caught interfering with uplink transmissions.

UNITED Video apparently will use M/A-Com scrambling system for encryption of KTVT, WPIX, and WGN services. No date announced yet but late 1986 earliest plausible period. Heavy sub-carrier loading on WGN transponder still presenting significant problems and may require moving many of the sub-carriers to other transponder(s).

PANAMSAT, would-be provider of international video services from 45 west, has sold off six Ku-band transponders on innovative satellite to Cygnus Corporation. Latter will use transponders for trans-Atlantic corporate communications. Satellite should launch by November and be in service by December this year.

HBO will use four transponders on Ku-1 bird while RCA Service Company will use single transponder as interim move until Ku-3 bird is launched in 1988.

TEST scrambling of WOR service, probably in early AM hours, due to be underway. Intended target date for full-time scrambling, March 1, will depend on ability of WOR affiliates to have the Videocipher descramblers installed by that date.

SHOWTIME expects to announce its TVRO marketing plan at or during SPACE/STTI show. Test scrambling, now underway, will probably only be for brief daytime periods of 15 minutes or less for next few weeks.

ARIANE scheduled to launch flight 17 (G-Star #2, Brasilian #2) and Intelsay V (#F14) during next 45 days. Next scheduled flight is in May with launch of ECS-4 (Europe) and Spacenet F3.

NASA broadcast highlights of Voyager 2 Uranus flyby January 22-28 on RCA F2R, transponder 13.

HARRIS will have assistance of Japanese Matsushita Electric in creating Ku-band terminals for AT&T and others. New agreement gives Harris direct link to Japanese manufacturing expertise.

HUGHES has filed patent infringement suits against Comsat, Intelsat, and Ford claiming they violated 1973 invention held by Hughes' employee in creation of satellite system design.

ABC will field 50 mobile Ku-band terminals, ostensibly on basis of one per state, to provide complete live coverage from virtually any

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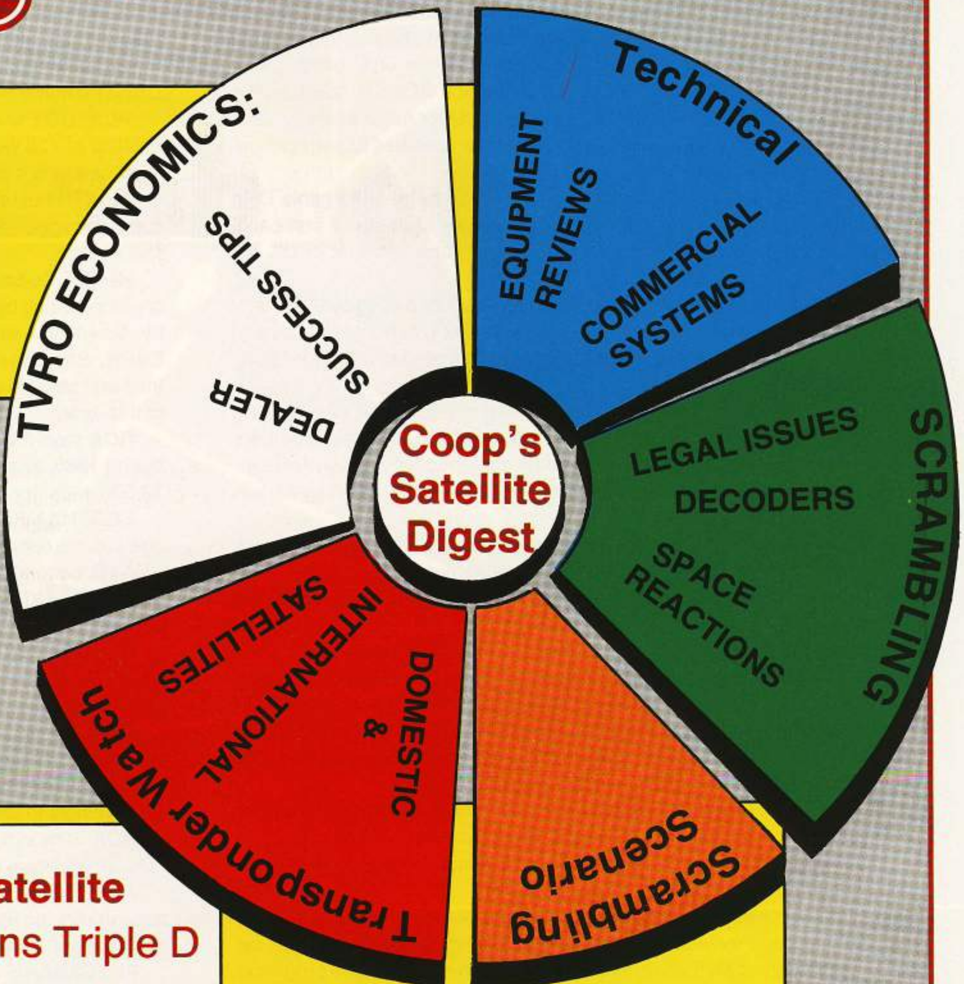

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spot within USA. Network calls new service ABSAT and will also expand seven day per week satellite news feeds to affiliates this summer by launching new ABC News One satellite service on C-band.

GOES 7 will be launched in May to replace GOES 6, now used for Central US view. Six-bird will be moved west for more westerly view. Ford is creating next series of three weather satellites based upon Indian INSAT design.

UK cable tenders, first step in franchising new areas for cable TV in England, have been delayed, reflecting poor showing of first cable firms authorized more than a year ago. Future of cable in UK not bright.

KU-band patch array antenna measures 3 inches square and is ½ inch deep. Intended for mobile use by vehicles in experimental mobile satellite service, unique antenna is to be mounted in roof of vehicles participating in tests.

HOLIDAY Inn experimented with test marketing of The Meeting Channel over past Christmas holidays. For $100 per hour, members of family can gather at any of six sites equipped for two-way teleconferencing to share views and comments. About 20 families participated.

UK Skychannel service recently passed 5,000,000 home mark with addition of new Scottish cable TV system.

REUTERS expected to announce start-up of World News Network channel for Europe, in direct competition to CNN, shortly. Service is expected to begin early in 1987 and use ECS-4 transponder.

GABON, African country, installing new national data and radio and television network using full leased transponder from Intelsat.

STUDY shows that on value-added basis, slightly over 71% of all dollars spent at TVRO dealer level for hardware from suppliers ultimately goes back to offshore traceable origins.

BANK of America, California's largest, planning 932 bank network of all California branches by end of 1987. Ku-band service is likely.

CABLE TV is now into 46.2% of all US homes, or slightly more than 40M, according to report issued by NCTA.

SIX separate firms are now offering or plan to offer pay-per-view early-release movies to cable subscribers, via satellite. Services on F3R (TR5) and G1 (TR12) are most visible. Viewers receive programs on demand, services feature back-to-back showings of same early release movie for week or so at a time. Charges are typically in $3-5 region per movie and intention is to compete with movies available through rental arrangements at local VCR house.

LUXOR parent Nokia has restated its commitment to satellite TV and pledged firm will expand TVRO marketing activities outside of USA as well as increasing efforts here. New corporate division, Salora-Luxor, will oversee expanded efforts.

JAPAN planning communications trade fair April 2-5 in Tokyo and China planning similar expo, October 16-22.

PLAYBOY will be providing special pay-per-view feeds from ASC satellite at 128 west according to recently signed agreement. ACS-1 satellite has not previously been employed for cable video services.

ZENITH has made official its plans to sell TVRO systems through dealers; suggested pricing is $1495 for 6 foot system and $2495 for 10 foot system.

HI-NET Ku-band service on G-Star bird is scheduled to begin encryption testing by March provided hardware is delivered as promised by Scientific-Atlanta. Service is providing CNN, WTBS, BizNet, ESPN, Showtime, and a special pay-per-view package to Holiday Inns and should reach as many as 500,000 hotel/motel rooms by end of this year.

RCA says it will enter home TVRO business cautiously but firmly during 1986. Firm projects 500,000 TVROs, at average retail price of $2,000 each, for all of industry during 1986.

EASTMAN Kodak plans a 50 station satellite network linking sales and service operations to Rochester (NY) headquarters by this July.

ATC, second largest cable television MSO, still claiming it too will offer home TVRO service package sometime in 1986 but no details yet.

R.L. DRAKE Company says it is no longer interested in selling off privately held company and its search of more than six months for a buyer is now called off.

CBN, Disney, and USA Net have announced their intentions to scramble their programming services by end of this year.

CANADIAN Spar Aerospace has completed sale of more than 50 TV terminals to China in deal reported to be worth over $20M (US).

RCA, now virtually sold out for Ku-1 to three birds, is pushing on FCC for approval to launch fourth Ku satellite.

JC PENNY is establishing new internal division to market videoconferencing time and services; company is also expanding its own commitment to internal satellite store-to-store interconnection.

PHYSICIAN'S Radio Net, TR21, Satcom 1R, supported by medical advertising, now going into doctors' offices via FM subcarriers in broadcast band. Service found on subcarrier of TR21 for direct reception.

FRENCH TDF-1 satellite, effort to create DBS for Europe, now put off officially until late 1987. Satellite has been delayed largely by problems associated with high power amplifier tubes (TWTA) design.

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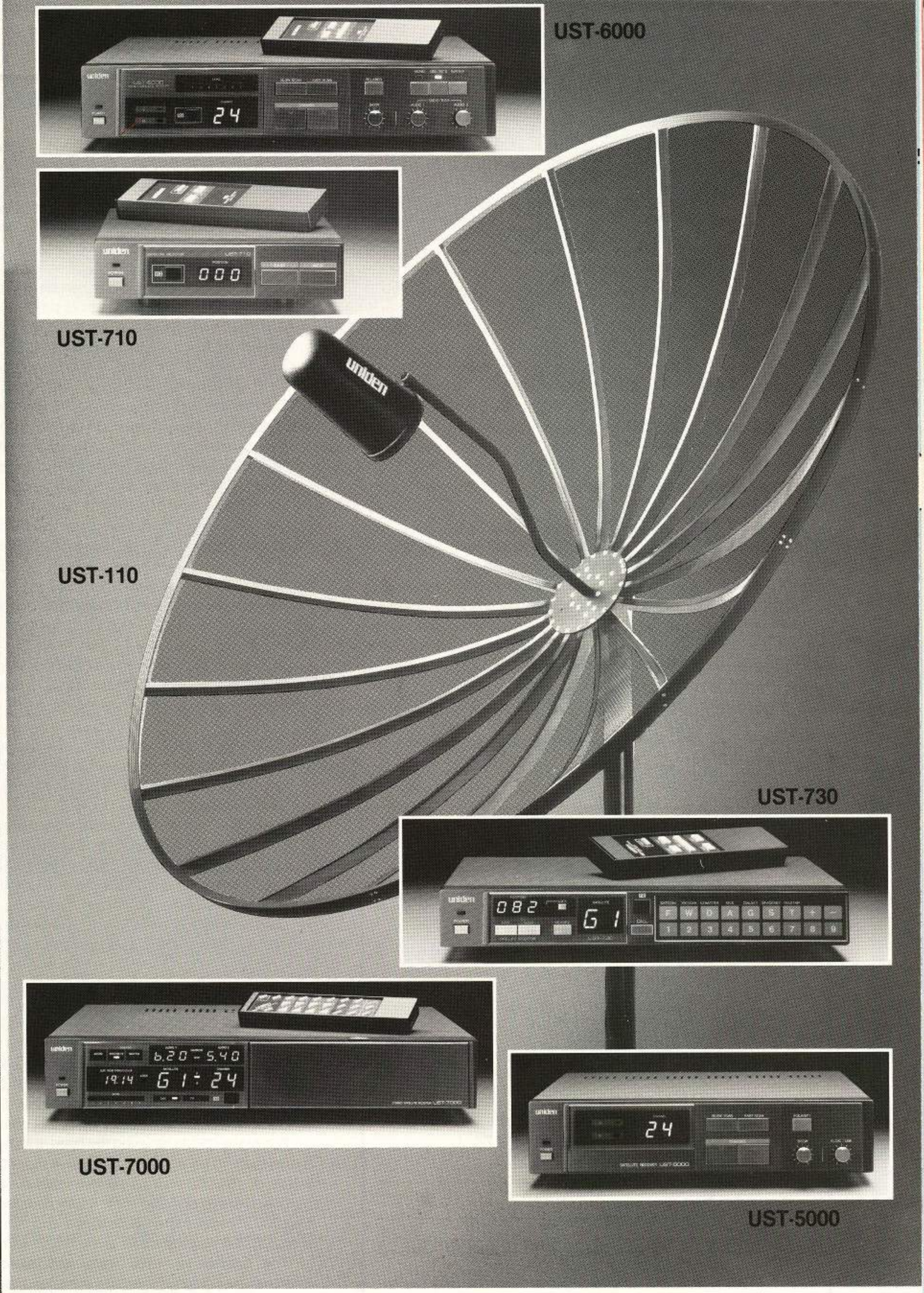

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Coop/continued from page 6

Cinemax service for less money than HBO sells it for. So:

1) You call this number (800/833-3610) and you say you wish to have your VC2000E turned on. "Are you outside of a cable franchised area?" you will be asked. The answer should be yes.

2) They will charge you an initiation fee ($2.50) and then for $12.95 per month, they will see that you receive both HBO and Cinemax.

So, we already have a price war for HBO and Cinemax services. Good. I predict that by mid-year you will be able to buy the combination of the two services for as little as $9.95 per month. By the time we have 15 to 20 services scrambled, you'll be able to buy all of them for no more than $30 a month.

Problems. If the VC2000E units and the pricing seemed to be working far better than anticipated, in mid-January, there were a few problems to be resolved.

"I don't want the Cinemax service," you tell the HBO operator. You are told that it is not presently feasible to turn off Cinemax. "But, we won't charge you for Cinemax," they say. Then, you discover that the HBO service is available to you on both the east and western feeds.

Moreover, you discover that the VC2000E, which you bought just to have HBO (east), also decodes the Showtime test on transponder 16 of Galaxy 1, plus the new early-movie release service on TR5 of F3R. In fact, it will decode everything in sight with the exception of the Oak Orion services.

As we all know, each of the VC2000E units has its own unique address code. There is also a universal code which applies to every unit in the field. The system is configured to allow one button to be pushed and all units in the field, home or cable, will turn on. Then the system is configured to allow, as a separate function, only those units which have been specifically addressed to be turned on. When the system is mature, certain services, such as ESPN, will be able to selectively black out home (and cable) viewers in certain areas of the country. If a sporting event is being played in Washington, DC, and the terms of the television agreement for that event specifies no TV coverage within 75 miles of the stadium, then all receivers within 75 miles will be turned off for the duration of the event.

Additionally, without some way to individually remind people that their satellite television bill is due (or overdue), the system would crash at the end of the first month. Apparently, as the first units were turned on in mid-January, the system to individually address certain units was not fully operational. Would it be by mid-February? We'll see.

So, the report card for the first days of full time scrambling follows:

A) HBO: They get an A for making it work but an F for the way they handled the promotion. HBO got tons of press January 15th, from the New York Times front page report to the ABC World News Tonight evening report. All of the reports and all of the stories treated home TVRO viewers as pirates who just had their ships scuttled. HBO gets an F for being so negative, and for showing their true colors in favor of cable TV.

B) M/A-Com: They get a B+ for delivery of a brand new product that worked for most people right out of the box but they get a D for getting it into distributor hands only hours before HBO went to full time scrambling.

C) Cable Firms: Most get an F for continuing the lies about the skies going dark; a handful, however, get an A for being innovative and cutting the prices for HBO and Cinemax service.

Business Trends

The winter months have always been slower for TVRO than most other seasons of the year. Certainly we all understand why; the challenge of properly installing a dish antenna when it is 10 degrees above zero and snowing is considerable. Even the consumers seem to realize that midwinter is not an ideal time to be digging trenches across the yard to bury cables. Clever dealers in the north have found temporary methods of installing terminals in cold weather using such tricks as leaving antennas on trailers and laying cables on the ground or setting temporary A-frame mounts on frozen ground to await the first thaw.

Still, inspite of these ingenious efforts, business grinds down during January and February. Some dealers actually close up shop. When the dealers slack off in their selling, the entire pipeline backs up all the way to the OEMs. Every winter period from 1980 to now has been slow although 1984 did have an unusually light and unusually short winter down spell. Percentage wise, this year could be the worst yet.

Too many OEMs believed the hype of early 1985 and had prepared themselves to be a part of a massive industry team effort to sell upwards of 750,000 new home terminals during 1985. When the real number is finally counted, if it is finally counted, and it comes in around 550,000 at most, there will be those who can show you where the unsold 200,000 plus terminals are sitting in warehouses.

The failures for 1985 were multilayered. First, and I believe foremost, has been the terrible injustice created by the cable television industry's scrambling policy. At all levels, including cable programmers and cable operators, there has been an intelligent and well coordinated program during all of 1985 to inform the buying public of the dangers involved in purchasing a TVRO. That hurt because some of what they were telling the consumers was the truth. We misstated our own cases in our own advertising; we did suggest to buyers that the purchase of a dish was a free ticket to unscrambled programming forever. Shame on us.

The cable system advertising and the HBO directed public relations campaign also hurt us because it focused on some basic cable untruths as well. HBO created the '(the) skies are going dark' story line. That is one of those great, inspired, advertising slogans, like "Ford Has A Better Idea" or "Where's The Beef???" With a line or headline like 'The Skies Are Going Dark', you can talk complete gobble-d-gook in the rest of the report and people will still get the message. It's like reading the last page in the last chapter of a good novel before you start on page one. You know how it all turns out before you begin. Indeed, 'The Skies Are Going Dark.' Bah humbug!

So, here we are in January, one of the two potentially slowest months of the year. Let's see what is on cable's satellites this month. We'll start by leafing through the January issue of Orbit. Hum, it seems thinner than normal. Does that mean there is less to watch this month? Hardly.

From more than 100 advertising pages per month a year ago, here we see the January issue of Orbit struggling along at fewer than 25 advertising pages. Good grief; CSD has more advertising pages than Orbit! There is more here than a slow month; there is a strong inkling of just how slow it is out there this year.

If Orbit has dropped to less than 25% of their year-ago advertising load, just how is the rest of the industry holding up? Perhaps Orbit is an isolated example of poor managment. Sadly, that is not the case. A check with some OEM friends suggests that from the peak month of last fall, January shipments were between 18 and 32 percent. Worse than that number, from January a year ago, business volume at distributors we talked with was down by 15 to 70 percent. More isolated examples, a reflection of how many more distributors there are now fighting over the limited business remaining? Unfortunately, this is not the case. Business, a number suggested, has never been worse in TVRO.

That will not make very good reading in mid-February. But wait; are we not all headed for that great show of shows, with the annual Las Vegas blow out? Not too worry; STTI and SPACE will bail us out by bringing in another 10,000 brand new people to load down with dealer starter kits.

Alas, the TVRO industry has never held its big spring show quite so early. There is a significant difference between holding a spring show in mid or late March (when, indeed, it is truly spring) and holding the same show in mid-February, when, indeed, it is still mid-winter. Will people who have been locked up all winter in front of wood burning stoves be ready to bust out for Las Vegas in mid-February and gamble upwards of $5,000 each to become TVRO dealers? Will the continuous stream of HBO diatribe against home TVRO keep those expected buyers at home this year? It is all very 'iffy' for the first time since our industry began convening in Las Vegas each spring.

Then, to further muddy the waters, we have a group trying to put together a second show in Las Vegas for the same general period of time, and we have an eastern publisher planning an April show in Nashville at the Opryland Hotel. I have the distinct feeling that just when we need every wagon in the industry circled around our dimming campfire, half of those with wagons still running are off someplace watching a fireworks show. We just can't seem to get the hang of working together, even when times are bad and getting worse.

Good journalism pleads with me not to issue any self-righteous forecasts for how many of the present suppliers will still be in place a year from now. I could be a victim of my own accurate forecasting. Rather, I suggest that we concentrate not on who has gone out of business but rather on those who are doing innovative and creative things to stay in business.

Some products are selling. It may well be 20 percent or 25 percent of the total product selling this past November but it is still product, nonetheless. That means some consumers are getting new TVROs and they, in turn, are infecting their friends and neighbors with TVRO fever. There are some success stories out there, even if we drop to selling 1 percent of what we were selling a few months ago. Naturally, I want to share those successes, where possible, with the balance of the industry. I'd like to hear from you if you have something positive to contribute. Really. We need some positive news to balance the obvious problems we are facing. Another month like this and we'll sound like the six o'clock news in Miami where the lead five minutes most nights recounts the latest 17 murders, knifings, and drug related bombings.

Hurricane Damage/Two

In the last edition of CSD, we reported on the extensive losses during Hurricane Kate as it rode over the top of our Providenciales antenna test range in the Turks and Caicos Islands. Basically, we lost operational duty on all but about 10 percent of the dishes installed here.

Some people read too fast and skip over relevant facts. Any antenna supplier with an antenna in the islands probably picked up that story with some trepidation worried how we would handle the failure (or success) of their product to maneuver through the storm. Some firms came out quite poorly since antennas ended up in the scrap heap after Kate's 105 mile-per-hour winds moved on towards Cuba.

In addition to writing about the damage here in CSD, I also touched on the same subject in a number of other publications. Home Satellite TV, the consumer newsstand magazine, was one of those. Doug Dehnert of USS (United Satellite Systems) was not very pleased with what we said about his 16 foot fiberglass dish in HSTV. No wonder.

As those who read CSD in January know, we lost the 16 foot USS dish but not because of an antenna failure; rather, the bolts holding the mount to the concrete pad failed. We simply had not installed long enough bolts deeply enough. USS cannot be blamed for this misjudgement on our part. The HSTV story did not come out that way.

After some graphic prose that described how the antenna beat itself into shredded glass in the winds, the publication neglected to retain a paragraph which explained why this happened. The original text placed the blame squarely on our shoulders. The edited text (yes, even my copy gets edited on occasion!) left out the full explanation. Doug Dehnert was not pleased with the impression left with readers and I cannot blame him. I'm sure when Doug has finished with the folks at HSTV, they will have a new appreciation for using every single word and sentence in a story such as this.

Another antenna that did not come out well in my reports was the ADM 20 footer. This one really tore me up since Jamie is one of my better friends (well, he was until this report appeared in print) and moreover, he really does build a good antenna. I have privately recommended his antennas hundreds of times through the years and still feel today, in spite of their failures in Hurricane Kate, that the ADM 20 footers are the best buy in the 20 foot size in the world. Jamie was hurt by the reports, both financially and as a friend. I am sorry for that. I would be a less than totally honest person, however, if I somehow neglected to report that four of the five ADM 20 footers on Provo collapsed like giant clam shells during Kate.

More important perhaps than the ruffled feathers and the hurt feelings attached to the report on Kate is that everyone involved learned a great deal about antenna and antenna mount/system weaknesses during the Kate episode. From what we now think we know about antenna failures, we can all profit in future antenna designs that may hold up even when the eye of a storm such as Kate pounds over a TVRO site.

I drive my Corvette in a reasonably safe and sane manner when I am putting about town. But, every once and a while I open it up to the red line on the tachometer. More often than not, I blow a hole in a muffler or knock it out of timing when I do this. Each time I run it to the redline, I discover something else in the car which is not performing to specification, and I fix it. Hurricane Kate is just like red lining my Corvette. Having those ADM 20 footers collapse on us is just like the time I redlined my '60 vette and blew a hole in the exhaust manifold. The leaking, hot exhaust gases flowed over the air intake and set the carburetor on fire. Sixty seconds later the fiberglass hood had melted, and the top third of the engine was a charred mess. The car had been

pushed to its limits, and it failed. I fixed the car back up and never again drove it with a leaky manifold. We fixed the broken ADM 20 footers in the same manner and believe that now they will withstand the next Kate.

Let Me Help

It is human nature to offer assistance to someone who is having problems. Boy Scouts help little old ladies across streets. The US sends grain to drought striken nations, and the Red Cross brings in emergency relief when a hurricane strikes. The satellite industry needs this type of help right now.

We are the unfortunate victims of our own success. I am reminded of an event that happened some 20 years ago in a city council meeting in Santa Barbara, California. A (then) major cable television entrepreneur had just won the city's permission to wire this medium-sized California community. In the audience was a small-time cable operator from Sonora, California. "I don't know why you are so excited about winning this franchise," exclaimed the Sonora cable system owner. "What you have just done is kill the CATV industry!"

The franchise winner was puzzled. How could the granting of a franchise for Santa Barbara 'kill cable'? The man from Sonora explained, his voice rising in emotion as he did so. "Until now, we (cable TV operators) have always stayed in small towns. We never got involved in big cities like Santa Barbara. The broadcasters liked us because we extended their service reach to shadowed areas they could not directly reach. Now here you are getting a franchise for a big city where you plan to challenge the local TV station head to head for its audience. You will do very well here in Santa Barbara, and you will be a financial success. But the cable industry will pay for your greed for years to come!"

The Sonora cable operator died of cancer shortly after his emotional speech. Santa Barbara turned out to be a nice, successful cable TV system area just as he forecast, and the rest of his prophecy also followed.

1) The TV broadcast industry rallied to the support of the Santa Barbara television station. A series of broadcaster created battles began, which ultimately doomed cable as cable existed in the mid-60's.

2) The broadcasters looked for a way to stop cable's growth, to halt the expansion of cable while they (the broadcasters) wrestled with methods to take over the cable industry.

3) Through a series of court cases, and by lobbying with their broadcast trade association in Washington for new cablecontrol legislation, the broadcasters in the late-60's managed to throttle cable growth and brought it to a standstill. For a period of nearly three years, there were virtually no new cable system starts anywhere, nationwide.

4) Suppliers of cable system equipment scurried to find ways to stay in business. With no new systems being built, orders for new cable amplifiers and cable and attachments all but stopped. Dozens of early firms, with names like Spencer-Kennedy Labs, simply disappeared from the marketplace.

When the battle was over, in the period 1972-73, the cable industry had been restructured. Now all the major cable players were broadcasters or big media companies such as Time, Inc. Gone were most of the 'Mom and Pop' cable TV leaders and the 'Mom and Pop' hardware suppliers. The new cable TV industry was leaner and meaner and most of the fun of participating had disappeared during those cable TV freeze years.

This is a true story. This is a true bit of fairly recent history. Most people in the satellite industry were not involved in cable at the time it happened and many today are far too young to even have been in business 18 to 20 years ago.

Cable TV was stopped dead in its most exciting growth period by a broadcast TV industry that simply outsmarted the upstart cable. The broadcasters knew they could not kill cable, so they created a series of hurdles which could be manipulated to simply cause cable to grind to a halt for a while. The broadcasters saw in cable a good money-making machine and, because broadcasters are money-making people, they saw in cable a golden opportunity to participate in that money-making machine. But first they had to stop cable's growth long enough to figure out how they were going to 'take over' cable. It worked. And cable, now driven by broadcaster ownership, came alive in 1973 or so and began its present growth cycle.

Cable TV started life as a plaything, a toy. It was a technical curiosity that a fellow in a suburb of Portland, Oregon, could erect a large antenna and share his distant reception from Seattle with a handful of neighbors. It grew out of the plaything or toy stage with firms, such as Jerrold and Blonder Tongue Labs, building the hardware because people will beat a pathway to the door of a man who can offer them television reception where previously no such reception existed.

Satellite TV started out as a plaything. My first home dish in 1976 drew the attention of major magazines and major television networks. Everytime I opened my mouth to talk about my dish in a public forum, I was innundated with queries and questions. Each such appearance resulted in three or four new appearances. I quickly tired of being on the lecture and show and tell circuits of America.

During 1984, satellite TV passed the same threshold that cable TV passed in Santa Barbara, California, back in the mid-60's. Our numbers approached the 1,000,000 mark and we were attracting the same type of fearful interest which cable caught from the broadcasters. Only now our fearful interest was coming from the cable TV people.

"Cable TV is dead; TVRO is a final technology which will put cable out of business." How many times have you heard that statement in the last year? They said the same thing about radio when TV came along. They said the same thing about broadcast TV when cable came along. I suspect they may have said the same thing about newspapers when radio came along (but that predates me).

Horse and buggy transportation was an interim technology. People selling buggy whips either switched to automobile running boards or fender skirts or, they had to close their doors. Horse and buggy transportation died because it was incompatible to peaceful coexistence with the automobile. You could not operate a horse and buggy on the same highways as gasoline propelled vehicles. It simply was not practical.

Radio did not die when television blossomed. Radio did change when television grew, however. You may find it hard to fathom, but radio, once upon a time, did not play 'three in a row' or the latest 16 top hits back to back over and over. Radio, as recently as the mid-50's, used to talk to you. Not the talk show format radio of today, but rather with a blend of mysteries and adventure and children's programs. Radio was once a very foreground service, commanding your attention and presence. Radio adapted in the late-50's and 60's because television wrestled with radio and won the foreground attention of the American public.

Cable did not kill TV because cable became an adjunct, even an ally, of broadcast TV. Cable delivery made it possible for hundreds of UHF TV stations to coexist with their more powerful-in-reach VHF competitors. There are hundreds of TV stations on the air today, making money because of cable. Only a handful of TV stations, probably less than five, in places such as Casper, Wyoming, have ever gone dark because of cable TV. Overall, cable has been good, even excellent, for the long term success of broadcast TV. The broadcasters recognized this fact in the 60's and they set out to deliberately 'buy into cable.' Ultimately, these same broadcasters who felt threatened by cable in the 60's would own and control cable in the 80's.

Satellite TV is perceived by cable with the same sort of disdain in the 80's which broadcasters felt for cable in the 60's. Satellite TV obviously works. It is obviously a better mousetrap. Someday, someone may even figure out how to make money from satellites. However, from cable's point of view, the unfettered growth of the satellite industry could make financial life very difficult for cable TV, perhaps as soon as 1988. Cable, to maintain its position in the marketplace, had to find some way to slow down or freeze the satellite industry's growth. Cable needed to buy some time in the marketplace; time to arrange for cable interests to own and control something which would ultimately prove crucial to the continued growth of the satellite industry. The answer, of course, would be the programming.

Surveys, many of them provided by the headstrong satellite industry itself, proved cable's point and highlighted cable's fears. More than 80% of all home satellite owners watched HBO at least once every three days. More than 50% of all satellite owners admitted they bought their dish systems to watch movies.

"What might happen to satellite TV," cable pondered, "if all of the most popular programs and programming services suddenly were not available via satellite?" And so scrambling was born.

"We have to stop the satellite industry from growing; we have to create disruption in the marketplace and put these equipment suppliers out of business. If we can stop the programming from being available, sales will plummet and only a handful of the existing suppliers will survive. Perhaps none will survive. Then, while there is a two or three year cooling off period we can structure an entirely new home dish service which will be designed from the start so that it is controlled by the people who own the programming, not by the people who own the factories that build the (clandestine) equipment!"

The fliers crossing my desk in early January sadly reflected upon the degree of success attained by the cable folks in their 12 months of concentrating on putting us out of business.

"Fifty dB gain LNAs, with isolators, $24.95 each, any quantity," said one flier. Four years ago the big news in the satellite industry was that the price of a single GaAs-FET transistor had just dropped to $25. Now you could buy an entire LNA, with a bunch of these transistors inside, for less money.

"Complete satellite TV receiver with motor drive controller, $99.95," said another flier. One year ago, a controller was over $250 all by itself.

"RCA and HBO have teamed up to purchase all 16 transponders on the late 1987 to-be-launched RCA Ku-3 satellite," read the cable TV newsletter. "HBO says that it will switch its present C-band feeds to Ku-band and that ALL Ku-band services will be scrambled from day one," the report went on.

The same report went on and stated that HBO's switch to Ku-band was conditioned on two premises:

1) Home satellite service would be made available only on C-band, and that the Ku-band service would be for cable and related commercial feed users only.

2) RCA Service Company, the same firm that tried to peddle and install the ill-fated United Satellite Communications five-channel (ANIK fed) Ku-band service, would play a part in the new project.

Other trade reports indicated that TCI, the cable MSO that has offered home satellite users a package of C-band cable program services, is also negotiating for Ku-band transponders. I already knew that and in fact wrote about it in CSD for January 15th. There were some interesting alliances being formed here.

Suppose:

1) Suppose M/A-Com, who in recent months has watched its stock interest fall to the lowest level in years, was acquired? Suppose M/A-Com became Boeing, for example?

2) Suppose HBO became a part of some other corporation, RCA perhaps?

Actually, the interesting alliances started to fall into place last spring. RCA, during July, held a most unusual press conference where they announced the firm's decision to begin offering top-end television receivers with satellite reception capability. There was more; the new high-end RCA products would have Ku- (and C-) band ability, and, include a built-in Videocipher decoder. Only a few thousand such sets were to be produced, however, so the announcement was more puff than power.

More significant than what the announcement said was that there was such an announcement (and press review) at all. M/A-Com engineered it, of course. They needed RCA's endorsement of Videocipher at a time when the Videocipher system was under direct attack. You may recall that after United Video conducted Videocipher tests with the WGN signal (see CSD/2 for August 15th), things were looking pretty bleak for M/A-Com's scrambling system. Why might RCA endorse a product such as Videocipher? What did they have to gain?

M/A-Com has been through a series of faltering declines with its stock value of late; Wall Street is simply turned off by the performance of the company and they have shown a degree of hostility towards the high tech firm. One way to get Wall Street turned back on is to earn a

few commendations. The RCA endorsement could help. There is another possibility.

M/A-Com earnings have been down, another reason for the lowered interest from Wall Street. There has been persistent talk that M/A-Com was ripe for a major merger or perhaps someone would acquire the firm. RCA could be a possible candidate for acquisition of M/A-Com. Boeing has been another name linked to the firm. Simply put, M/A-Com has not impressed the Wall Street brokers with its recent performance and if the firm is taken over by a much larger, multinational operation, all bets are off on the future of the Videocipher system.

Through all of this ongoing uncertainty over scrambling, a trend is developing. That trend points strongly at the emergence of Ku-band as a primary force in the home satellite business.

Speaking Of Which

The HBO announcement, that it (teaming up with RCA) had acquired all 16 transponders on Ku-3 (due to launch at the end of 1987), was no shocker. HBO has been talking with RCA about leasing a significant number of transponders on one of the Ku-band birds for more than a year. Way back in 1984, when RCA was just getting interested in selling off Ku-band transponder space, HBO was out talking with cable programmers (such as United Video; WGN) about coming on board. HBO painted a picture of a "totally prime-cable bird, taking the best of the best and bunching them on one satellite with the ability to deliver up to 16 prime cable programs to cable headends all over North America." The dollars involved are significant, however, RCA gets more than three times the annual rental for a transponder on its Ku birds as it does on C-band. Of course over the past six years C-band rates have tumbled because there are so many birds up there now we have something of a transponder glut. RCA sees the period through 1990 or so as being transponder scarce at Ku-band, and they are going to get as many bucks as they can for the Ku transponders they have available in that interim period. By taking on RCA as a partner in the ownership of Ku-3, HBO in effect reduces its cost per transponder by agreeing to split the profits from the transponder rentals with RCA.

Years ago, way back in 1978, there was a glitch in cable history and for a few months HBO was quietly 'threatening' to take its programming away from RCA and haul it over to Western Union. That was when RCA was being especially stubborn about coming down to transponder rates HBO felt they could live with. The feeling in the cable programming industry at the time was that, "If HBO moves from RCA most of the major programmers will follow HBO." The logic behind this is found in cable statistics.

1) HBO, by a sizable margin, is the most popular premium (movie) service in cable. That's today. Back in 1978, Showtime was merely a gleam in Viacom's eye.

2) WTBS, and other satellite services are nice but HBO is the one that is making cable operators (new) money. No cable operator is about to risk losing his HBO income.

3) If HBO moved to a new satellite, those thousands of affiliates would (will) promptly redirect their dishes to the new satellite. And:

4) Those other programming sources, such as WTBS et al, who were with HBO on the new satellite would be favored with continued cable carriage. Those who stayed behind on the old satellite would be left off the majority of the cable systems.

That leadership role has not changed all that much in the interim years. If HBO jumps ship from C-band to Ku-band, and there are 15 other available transponders on the new satellite which HBO itself will not be using, you'll see something of a scramble by the other programmers to get on board with HBO.

HBO sees the new Ku-3 bird as a cable only bird. The press release from Home Box Office says:

"Unlike HBO's C-band transmissions, Ku-band transmissions of HBO and Cinemax will be scrambled from their onset and are intended to be received only by cable affiliates. (And) Since our Ku-band signals will be encoded and there is no installed base of consumer equipment to receive Ku-band transmissions, HBO currently plans to offer its services to home TVRO owners only through C-band satellites as outlined in our previously announced C-band Direct program."

Is HBO abandoning C-band? If the true answer is yes, they are careful to disguise that fact in their press release. It says:

"Collins (HBO President Joe Collins) explained that Ku-band technology offers cable operators lower reception equipment costs, virtual elimination of interference problems caused by terrestrial microwave transmissions, and the ability to accommodate 2-degree (satellite to satellite) spacing. (And) HBO and Cinemax will continue C-band transmissions of its services."

Let's analyze why HBO (and those camp followers that fall in line behind HBO) would want to stay on C-band if the Ku-band feeds work out as anticipated:

A) There are thousands of C-band terminals already in place at affiliates all over the USA.

Ku-3 will not be able to provide Alaskan and Hawaiian coverage. That's one reason to maintain a C-band feed. On the other hand, future Ku-band birds will spotbeam to both states and long term there will be no such problem.

B) Rain attenuation can cause some problems at Ku-band; NBC affiliates in areas such as Miami have found outages of up to 10 minutes when it rains hard at the downlink.

NBC has also found that over a period of a full year, those outages amount to less than 30 minutes time. Not a very good argument for retaining C-band feeds.

C) There are no more good reasons for maintaining the C-band feeds.

In favor of Ku, we have smaller antennas, better quality signals, an end to TI, and low costs. By starting off scrambled, HBO (and the others that follow HBO to Ku) can stop piracy before it starts.

A Scenario

Let's create a scenario. One that would seem to make sense to a top executive in the cable business. The premise is that cable wants to kill C-band DBS before it gets any bigger, and then out of the ashes create a new type of DBS which is controlled first and foremost by the cable programmers and their partners, the major cable MSOs.

Killing C-band DBS is no big trick; just take away all of the most desirable programming. How do you take it away? Simply scramble every channel you can. So what if the scrambling system is expensive and difficult to administer? If you want CBD (C-band DBS) killed off then you don't really expect there to be much of a market for CBD descramblers anyhow. So if the price turns out high, and the net effect is that nobody buys the overpriced services, cable wins anyhow!

By withdrawing cable's best programming from satellite TV owners for say two years or so, the CBD industry goes down the tubes. From 500,000 terminal systems per year, the marketplace drops off to a much smaller number; say 100,000 per year. All of those firms that have geared up for the bigger numbers are left with big production capabilities and warehouses filled with products. Within a year, no significant suppliers are left in the field and those still selling products are forced to raise their prices to reflect the smaller volumes.

Let's remember that C-band DBS was never supposed to happen. When the nations of the world sat down in 1979 to approve an (international) DBS service, the service was approved at 12 GHz (Ku-band); not 4 GHz (C-band). American/Canadian know-how created C-band DBS, now law. We are now paying the price for our creativity by finding ourselves in the position of trying to write law which sanctions what we have done. We may be more legal today than we were in September of 1984 (before the most recent law was enacted) but we are hardly

out of the woods. Worldwide, with very limited exception, C-band DBS is so illegal that no market for it has developed at all.

Yes, there are strong, even persuasive arguments which will support the death of C-band DBS. But, before it can be killed, before it goes away on its own, there has to be a replacement service.

C-band DBS happened because there was a need, and that need was overwhelming. Moreover, there was no other service in place ready to provide television to rural Americans and Canadians. The cable industry, both the programmers and the MSOs, see a way to correct this error. Enter the RCA Ku-band birds.

Let's run some numbers.

1) An RCA Ku-bird has 16 transponders on board. If a package of programs could be carried on these 16 transponders, with an average retail value of $2 per channel per month, there would be a potential income per user-family of $32 per month.

2) If 1,000,000 US homes subscribed to this package of services, there would be a monthly gross income of $32,000,000 and an annual gross income of $384,000,000.

3) The satellite itself costs $110,000,000 to create and put into orbit. Over a seven year life it will cost another $70,000,000 to maintain it in orbit and support its marketing. That gives us a total cost of $180,000,000 for seven years.

The satellite owner (RCA) shares the gross revenues with the programmers. They have some sort of limited partnership which divides the revenues and apportions the risks according to an agreed-to schedule. In seven years time the revenues total $2,688,000,000 against a direct (RCA) operational cost of $170,000,000. There is plenty of room here for slippage before the project is in financial jeopardy.

The key to all of this? Kill off C-band DBS so the new Ku-band DBS can move ahead.

The methods of killing off C-band DBS? Simply scramble all the most desirable programming on C-band making the usefulness of C-band terminals far less attractive.

The HBO release also goes on to note:

"Prior to the availability of the Ku-3 satellite, RCA Americom will lease interim capacity on its recently launched Ku-1 satellite to HBO, Cinemax, and others."

In other words, testing of the Ku-band DBS package could begin at almost anytime. But didn't HBO say that their Ku-band feeds would be strictly for cable; that only C-band terminals would be able to receive the scrambled feeds at private homes? That is what they said, but it makes little sense to do it that way. Another scenario makes far more sense.

The cable industry is the largest single user of satellite transponders. Bigger than the commercial and public networks; bigger than the US government. Bigger than everyone. The best satellite-cash-flow machine RCA can have is to have the bulk of the cable industry's business, long term. RCA once had that with C-band but with the advent of Galaxy and other satellites, RCA no longer controls cable's (C-band) delivery business. If RCA could convince the cable industry to move off of C-band to Ku-band, where RCA now has and will have for some time into the future, a lock on the available Ku-band transponders, RCA could build for themselves a nice new empire. The HBO release went on to state:

"Just as HBO and RCA revolutionized the cable industry 10 years ago by inaugurating regular satellite transmissions of programming, this joint venture is another historic step that will provide the cable industry with superior delivery capabilities well into the next decade...."

With Ku-1 being used on an interim basis by HBO (et al) to deliver programming to cable headends, and Ku-3 scheduled for use late in 1987/early in 1988, how does their master plan for the satellite industry fit in?

1) By scrambling the C-band services now, it will be early 1987 before the impact of 15 or so scrambled services really sets in on the home satellite marketplace. Business during 1986, as the reality of scrambling takes hold, will be soft. "If we have a flat year, identical to 1985, I will be elated," remarks one marketing chief in the satellite industry.

2) With C-band business faltering, limited testing of Ku-band services on Ku-1 can take place during 1986 and 1987. During this period, C-band scrambled services will be available but only at high decoder and monthly rental figures. The majority of the existing home satellite marketplace is not likely to find the decoder costs nor the programming costs comfortable and there is not apt to be a favorable response from the marketplace.

From cable's perspective, that's alright. They want to see C-band DBS wither on the vine and if the prices are too high and few people buy, that suits them just fine.

3) With Ku-3 ready for service no later than early in 1988, cable's primary feeds can be moved off of Ku-1 and Ku-3 and that will leave Ku-1 available for home satellite packaging.

The logic is inescapable; smaller dishes, lower cost terminals, and a marketing plan through firms such as TCI and ATC with the cable programmers and cable operators controlling the delivery of the hardware and software to the American homes.

"Remember, we (the cable industry) own this programming you are using. Nobody has more right than we do to create and operate a marketing plan for this programming. If SPACE tries to take us to court on this, we will win because the programming is ours to begin with!" responds the cable programming executive. And he means every word of it.

Human Nature Repeats

When AM radio first developed, there were few stations to be heard and pioneering listeners erected huge long-wire antennas on tall masts to drag in those distant stations. When television first came to America, there was a significant business in 100 foot towers and huge antenna arrays. All of this died when the station network developed to the point that most locales had adequate reception with small antennas and less sophisticated receivers. Where this did not happen for television, cable television filled in the holes.

The first six years of the satellite industry is analogous to the first decade of AM radio or the first decade of television. Big antenna, and complicated motor drive systems have become the norm because we are all in fringe areas. Ku, with its considerably more powerful satellites, will change this direction. America's love affair with 10 and 12 foot dishes and motor drive systems will not die, but fewer and fewer people will find this an attractive alternative to 3 foot dishes fixed on a single satellite, delivering 16 high quality program channels.

Cable has a significant advantage here. They have been marketing multiple channels of television for a decade now, using satellite delivery.

Hundreds of viewer marketing studies tell cable programmers that more than 99% of all viewing time centers around 15 channels or less. In other words, most homes find 99% of the program choices they want with 15 channels. That's a powerful argument in favor of a $700 range Ku-band terminal that delivers 16 channels of television. Cable can sell that message.

Cable marketeers are counting on the strength of that message to launch the newly born home satellite service over the next couple of years. The challenge to the present C-band hardware marketplace is to either battle what is happening, through SPACE, or to learn how to adapt to the scrambling steamroller that is about to overtake us. C-band is not dead, but it faces some significant challenges in the next two years to stay afloat. When RCA, HBO, and M/A-Com put on a 'dog and pony show' this past July, and RCA endorsed the M/A-Com created Videocipher scrambling system, the handwriting was on the wall. The big time players, the masters at market creation and manipulation, are here.

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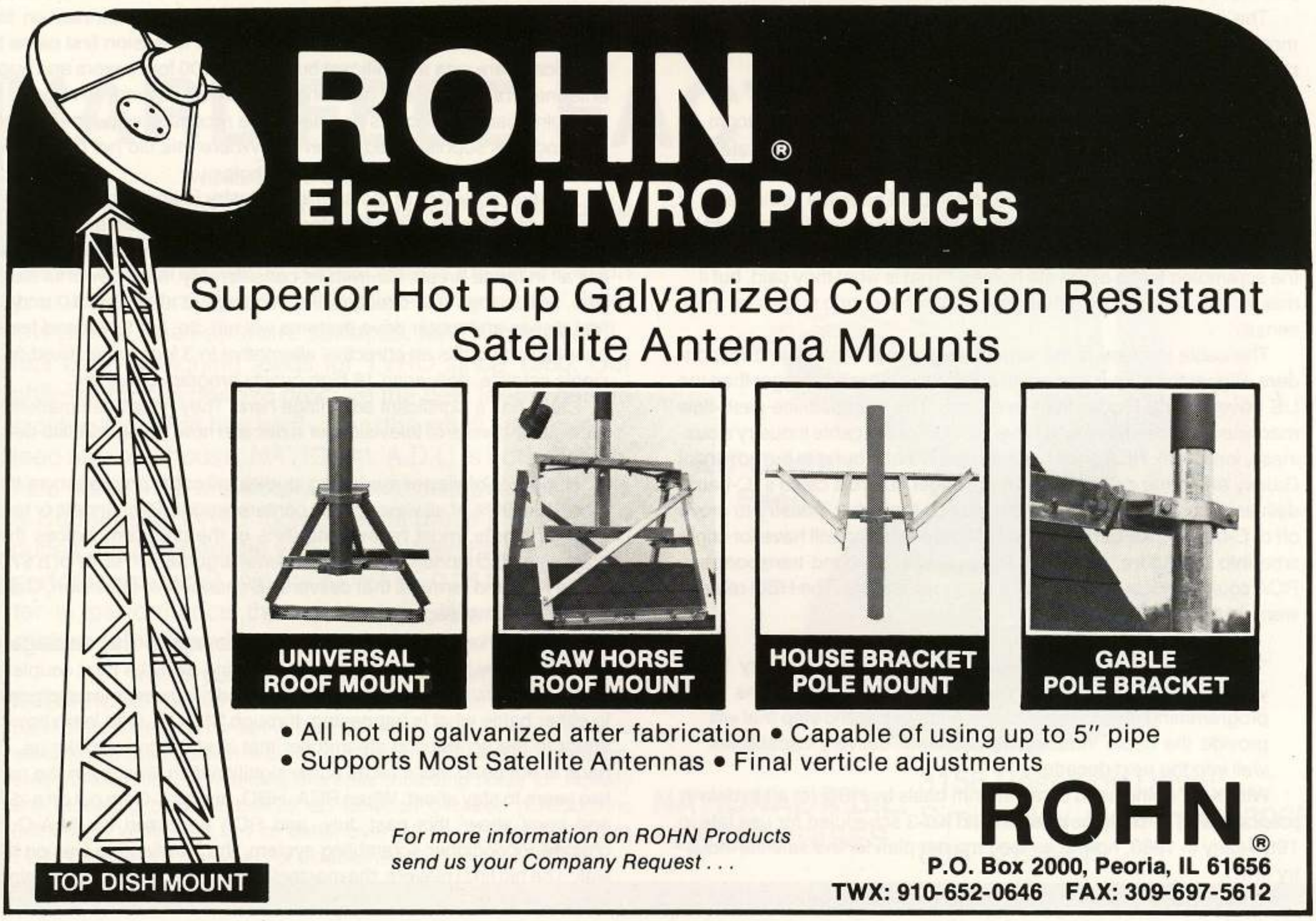

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