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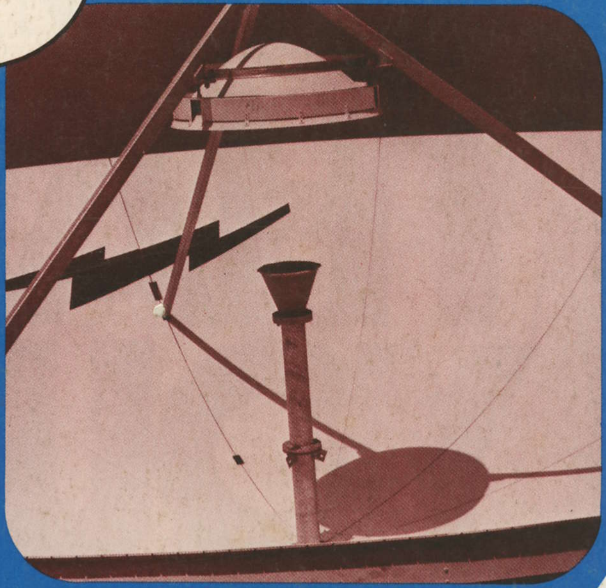
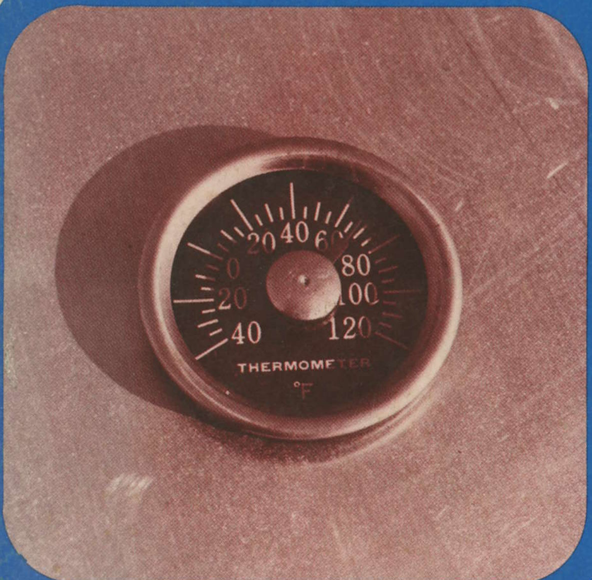


TVRO PLANNING

- Antenna Temperature
- Carrier-to-Noise
- Signal-to-Noise
- Relationships



September 1977

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VOLUME 4 NUMBER 9

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—FEATURES—

—DEPARTMENTS—

OUR COVER

TVRO PLANNING GUIDE—By employing a little sophistication in planning, the cable operator is able to erase most unknowns concerning how his new TVRO terminal will work. It starts on page 13 here this month.

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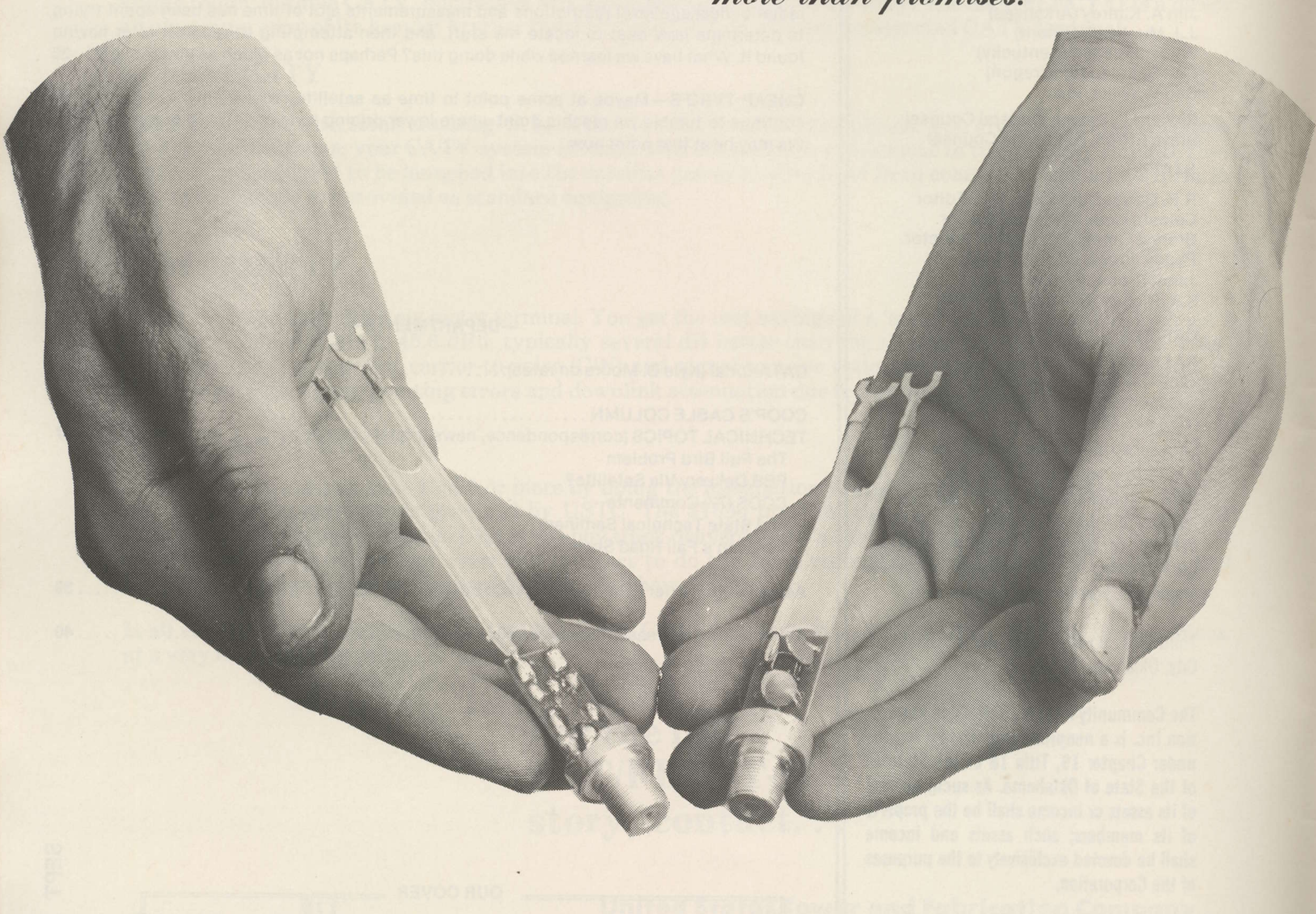

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KYLE D. MOORE, President of CATA, Inc.

The Satellite And Signal Pricing

With so many systems adding one or more satellite signals eventually you reach the point where you need to re-assess your own rate structure for cable service.

Year's ago the 'base economic index' was referenced to the year 1950. When prices went up and the 1950 year was no longer a realistic reference the economists moved into the 1960's for a base reference year. Then it became 1970. More recently, if you watch television much you see people selling products which they **proudly** proclaim **"have not increased in price since 1976. . .".**

Very few cable rates have increased **substantially** in recent years, although we note the **trend** is upward and **newer systems** are starting off in the $7.00 per month rate area. Still, the people hurting most are those who began their systems back in the 50's or even 60's and who are still saddled with rates around the $5.00 mark. If you've been through a local city rate increase request hearing recently, as I have, you know how difficult it is to get a dollar rate increase when your only argument is ". . . but the cost of living has gone up". **Everyone knows that to be true,** and everyone **also** knows that when something like the monthly cable bill goes up, the cost of living goes up some more. People can't do much about a two cent a gallon rise in the milk price at the grocery store or a 6 percent rise in the base telephone rate. But the cable rate is governed at the local level and city fathers know this well!

When you need a raise, and you do if you are still chugging along at 1965 or even 1970 rates, by far the best way to justify it is to engage in a give and take with the city council.' **"Give them"** a new channel or two of service, and "take" a rate increase in the process. It would be preferable of course to get a rate raise **without** having to spend capital investment money for new services (if you are below the national average of around $6.30 per month you are entitled to it) but in today's local climate this is not always possible.

The satellite delivery of signals offers the opportunity to do several good things for the community and for your cable system as well. Assuming you have room on the 12 channel dial to add one or more new service channels the addition of WTCG (Atlanta's independent) or CBN **or both** are very useful tools to gain a rate raise. Let's assume you have a 1,000 subscriber system and your present rate is $5.50 per month.

A $1 rate raise would **gross** you another $1,000 per month. Now what should the **net** be?

Let's assume you add both WTCG and CBN and the total cost to you of the installation is $17,000. You go to the bank and borrow $15,000 for sixty months and your payments end up being $300 per month (including interest). If you could simply install the terminal and forget it for five years, that would be a **net** increase of approximately $700 per month to you. But we all know this is not the case. The best experience to date tells us we had better plan on repairing the LNA once every two years in medium to high lightning activity areas. On top of this there will be some minor upkeep involved for the terminal, the two new modulators and the receivers. The LNA could be a $500 repair once each twenty-four months and the balance could amount to $600 per year or $50 per month. Between the two we have around $70 per month.

So here we are adding up what the new terminal will cost us, on a monthly basis, to provide two channels of service to our 1,000 subscriber system:

1) Bank repayment on $15,000 loan—$300.
2) Monthly maintenance on TVRO, LNA—$70.
3) Payment to Southern Satellite for WTCG—$100.
4) Payment to CBN—$83.00.

That adds up to $553 per month. And what have we missed?

Well, there's the $2,000 we put up ourselves. We could look at it over the first sixty months ($167. with no interest) or we could say "That's my investment to obtain the difference between the $1,000 additional gross income and the present income". In either case it comes off of the net, which now goes from $447 ($1000 minus $553) to $280. per month.

Not much of a return, you suggest, **for a $17,000 investment?** You may be right but let's look closely at it just to be sure.

Before the rate increase/satellite terminal addition you were grossing $5,500 per month for 1,000 subscribers. Are you **netting** $1540 out of that $5,500 gross? That's what the $280 net figures out to be; a twenty-eight percent return on the additional gross income. Remember that net is the amount remaining after **all** overhead and costs have been subtracted. That should include your own salary if you work in the business because we must assume that if you didn't work there yourself you would have to be hiring someone else to get the chores done.

Now suppose you take your $280 per month net (which is after all expenses and equipment payments) and multiply it by the sixty month term of your loan obligation. It comes to $16,800. In other words, you and the bank 'profit' to just about the same amount over the term of the loan. They get their money back, with interest, and you end up netting a like amount after all expenses.

Is it a good deal? It probably is.

Is five years a safe loan period? By the present satellite technology it is probably as far down the road as I would personally care to look. I'd really hate to guess what the industry might look like more than five years from now and how the satellites will fit into our business picture. It is probably safe to assume they'll be with us for that long, but how we will be using them five years from now is anyone's guess.

Could you go for more than a $1.00 per month rate increase? There is evidence both ways. Perhaps more important than the **amount** of the raise is **where you will end up** after the raise. If you will still be at or below the so-called national average of around $6.30 per month, chances are you could squeeze enough additional to at least get into the $6.30 ballpark. But beyond that point, well, you just have to measure the water you swim in to see if it will handle the extra 'heat'.

There is a reverse danger that comes with getting the monthly 'basic cable rate' **too high**. As long as the economy is good, and people have the money to spend, an extra dollar or two is not watched very closely. But suppose we find a down turn in the economy ahead (at some point one is bound to turn up). That's when subscribers start assessing their own overhead, looking for ways to shave a couple of bucks here and there. The last thing you want to lose is their basic subscription income. If $6.50 keeps virtually everybody on line when times go sour, but $7.50 starts people thinking about ways to save a few bucks for food and other necessities, I'd hate to be in the boat of having gone too high for the basic service. Systems such as Gill Cables's San Jose operation which have married a movie channel (provided by the cable company) with a basic service rate to create a monthly **basic rate** of around $10.00 per month may wish they had not made the basic service so complex nor the rate so high if the economy slows down. Systems that have kept the basic service 'simple' and have an 'optional extra service' available (such as HBO) for a 'premium' price might be better off in the long run, even if they have to close down their premium service channel during tough times.

So the addition of TVRO service channels offers both a golden opportunity to get your antiquated rates back in line with the spiralling de-valuation of the dollar, and it presents new challenges. Through more than 27 years of basic service, basic service is the one cable commodity that has endured. During good times and bad times in the economy. There is probably a message here; keep the basic service exciting but straight forward and simple. Keep it profitable, not only in good times but plan ahead for the bad times as well. It's just good business sense.

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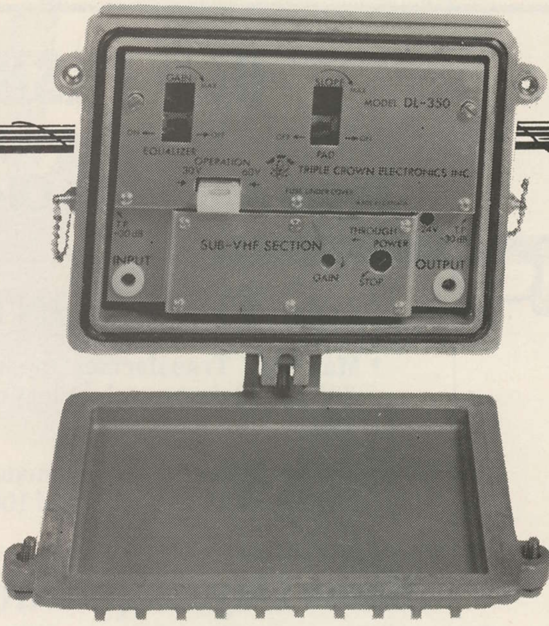

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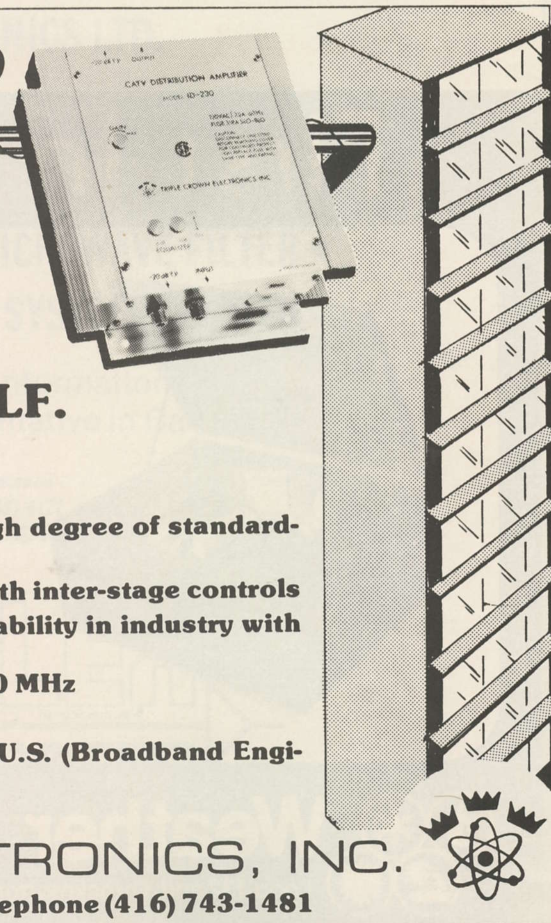

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from a to z

SMALL EARTH RECEIVING TERMINAL ENGINEERING PLANNING GUIDE

INTRODUCTION

With the advent of Domestic Satellites, the Cable Operator now has the opportunity of importing distant signals via Satellite Relay. The major differences in importing these signals are:

- The technology is somewhat new;
- The distances involved are greater;
- The signal received is of superior quality.

At the present time, the Satellite TV signals which are available and of interest to the cable operator are split between the delivery of Pay TV programming and 'open channel' programming. The Pay cable programming includes:

1) HBO with two channels operating and a third reserved
2) Specialized programs on an infrequent and non-scheduled basis from several new-via-Satellite program production firms (starting this fall).

The 'open channel' programming now available over the coming 12 months (based upon formal announcements to date) include:

3) WTCG channel 17 Atlanta, via Southern Satellite Systems
4) KTVU channel 2 San Francisco, via Southern Satellite Systems
5) WGN channel 9 Chicago, via United Video
6) CBN (WYAH-TV) Virginia Beach (Norfolk)
7) Network "One" Las Vegas.

prepared by
George A. Bell
Microdyne Corporation
Rockville, MD. 20850

Other programming sources also available, but not for CATV distribution at this time include regular NBC and CBS network feeds (approximately 8 hours per day), CBC-English and CBC-French and CBC-Northern via Anik, Spanish International Network (SIN) with Spanish Language program feeds to affiliated stations. Additional program sources for CATV and non-CATV use

TVRO Planning Guide

The CATV industry's utilization of television-receive-only (TVRO) terminals has grown measureably since first CATJ and the industry addressed the subject from a serious technical vein 23 issues ago; in October of 1975.

Our extensive CATJ coverage has purposefully stayed away from exhaustive mathematical equations and formulae as an attempt on our part to bring the real world of satellites and transponders down to a level which the average CATV technician, engineer and owner/operator could function with. However as with all new technologies, our own sophistication as users has grown and improved so that now it appears that at least some of the users are comfortable with relatively complex path-loss calculations, noise temperature versus bandwidth trade offs and the like.

This month we present a paper authored by a very knowledgeable engineer in the TVRO arena; Mr. George Bell of Microdyne. George, not unexpectedly, wants to sell Microdyne product. Our interest here is not in selling product, but rather in 'selling technology'. George knew this going in, as he prepared and revised this paper for CATJ. We believe he has done an excellent job of wrapping the serious business of TVRO terminal design into a palatable, non-commercial message. And we encourage others in this highly competitive industry to consider preparing like pieces for submission to the industry's technical and operational journal; CATJ.

For through sharing of knowledge all of the industry profits, expands and grows on an ever sounder foundation. The truly unselfish are those who give of themselves freely and openly for the betterment of a concept or industry.

are annouced at a fairly regular basis, although their actual start dates and availability is not known at this time.

Not all of the mentioned signals will be applicable, available, or even of interest to Cable Operators, but it does indicate how widespread is the proposed use of this new system of distributing TV signals.

With the December 1976 FCC Declaratory Ruling under Report No. 2218 allowing antennas smaller than 9 meters to be used for Satellite Receive Only Terminals, the Cable Operator has much more flexibility in the design of his system.

One must be careful in assuming that the smaller antenna will result in a low cost terminal or that the resultant video signal-to-noise (S/N) will be satisfactory. Several parameters must be evaluated in small aperture terminal designs to determine the cost tradeoffs versus the desired results.

The purpose of this material is to evaluate these various parameters for small aperture receive only terminals and provide guidelines for system designs.

To fully understand the use of Satellite Relay by the Cable Operator for importing distant signals we should look at the various links in the signal chain, become familiar with the terminology used, and then examine, in more detail, that portion of the signal chain which will become part of most cable companies, **The Receive Only Terminal.**

ORGINATION AND UP LINK

The origination of Satellite TV signals is usually in studios or various facilities at many different locations. These signals are transmitted via terrestrial means (cable or microwave) to uplink satellite terminals located at many different sites throughout the country. The uplink terminal

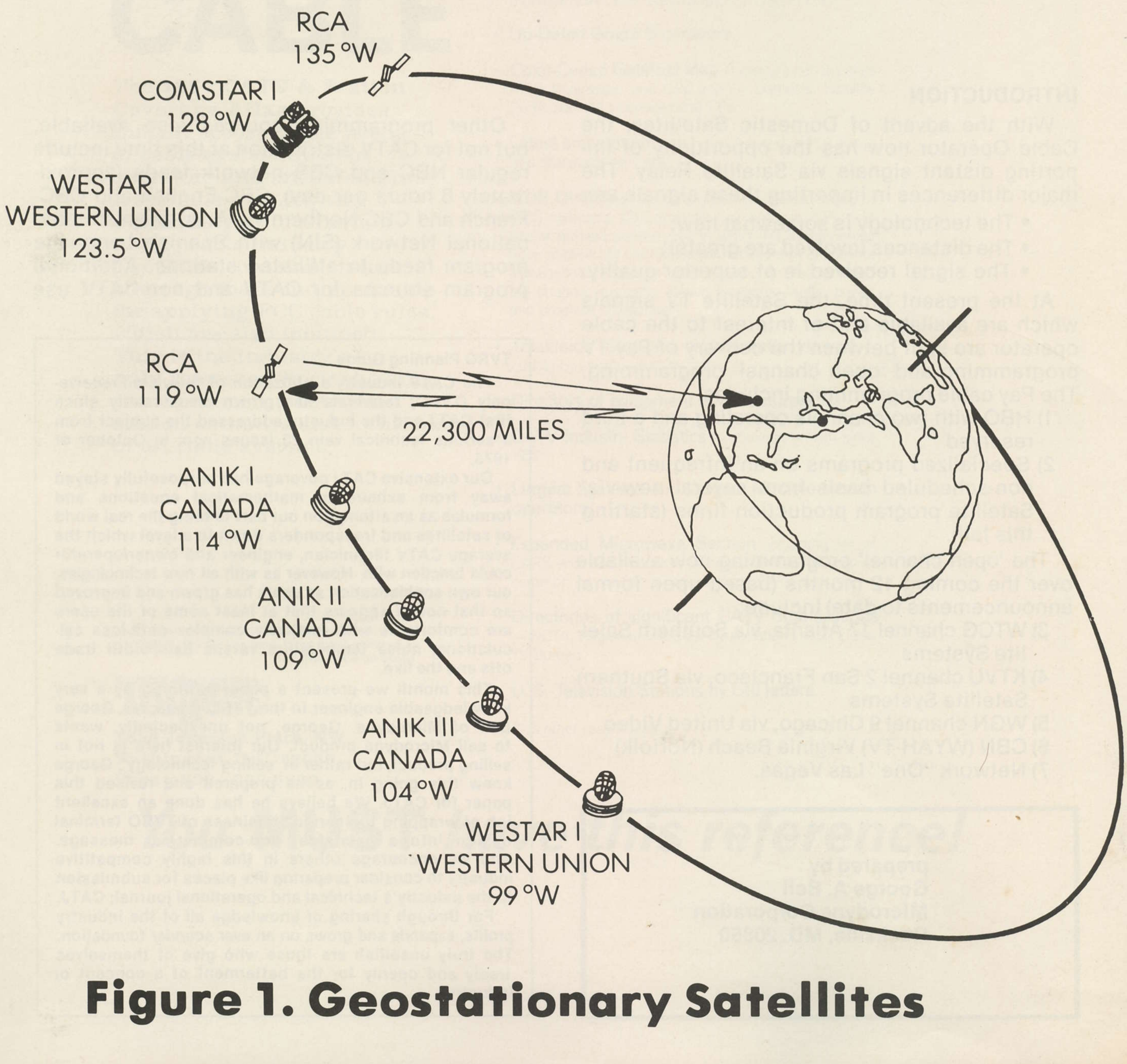
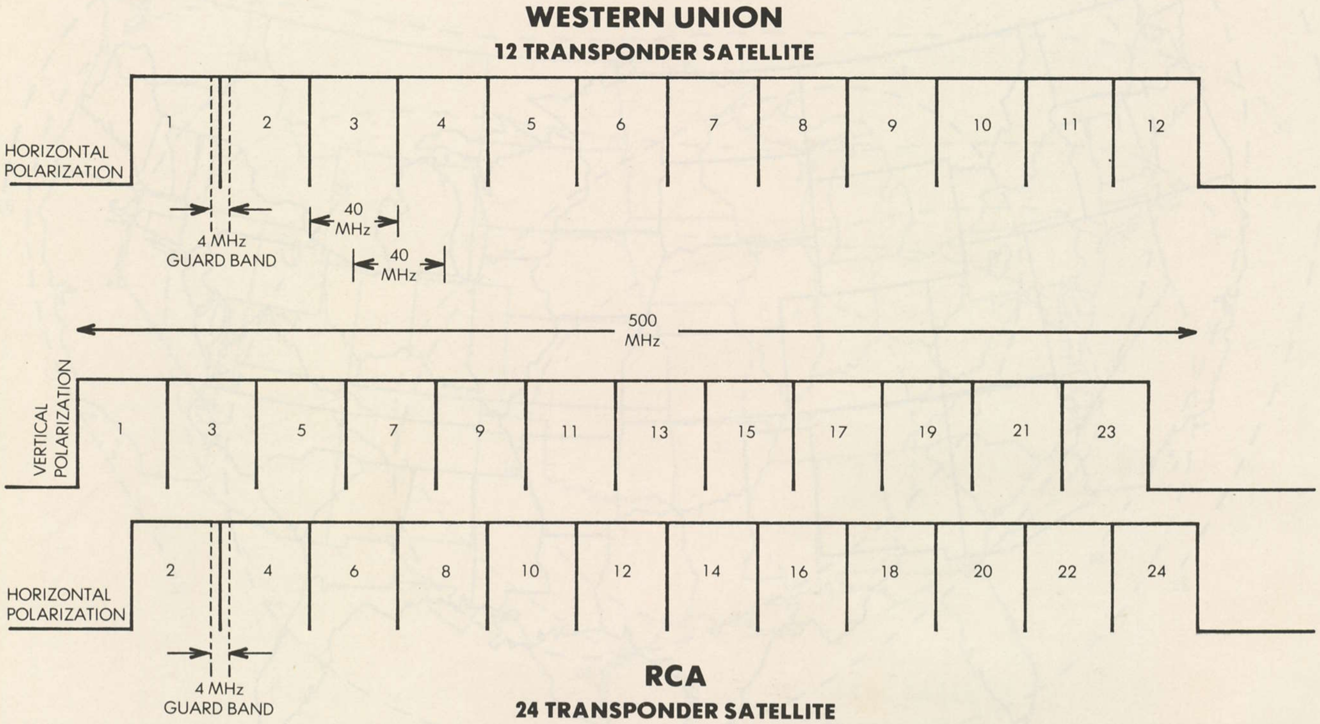


Figure 1. Geostationary Satellites



12 AND 24 TRANSPONDER SATELLITES

FIGURE 2

consists of a large aperture (10 meters or larger) parabolic antenna which transmits to the satellite in the 5.9 to 6.4 GHz band using wideband FM. For wideband video transmissions, the uplink terminals transmit the signal in a 36 MHz bandwidth with sufficient power to fully saturate the satellite transponder.

SPACE SEGMENT (SATELLITE)

The Space Segment of the signal chain consists of a geostationary satellite located approximately 22,300 miles above the equator. This satellite orbits the earth at the same speed as the earth revolves, so in effect, the satellite doesn't move in relation to the earth's surface (Figure 1).

There are presently two types of satellites in orbit which are used for TV relay. They are the Western Union Satellites and the RCA Satellites. While both operate in the **same** 500 MHz frequency bands, the Western Union Satellites have twelve transponders, each 40 MHz wide and each separated by 40 MHz, while the RCA Satellites have 24 transponders, each 40 MHz wide, but separated by 20 MHz. RCA is able to accomplish this utilizing frequency re-use **or cross polarization.** Basically, this consists of 12 transponders vertically polarized and 12 horizontally polarized with **each adjacent** transponder being in the **opposite** polarization (Figure 2).

The Satellite receives the 6 GHz transmitted from the uplink terminal, translates it to 4 GHz and re-transmits it back to the ground in a beam shaped to cover the geographic area of interest which, in our case, is the United States.

Since the Satellite serves as a transmit and receive station, it must be characterized by a G/T for the receive or uplink side, and by an EIRP for the transmit side. This EIRP is normally specified at the saturation point for the transponder power amplifier. The EIRP for a typical domestic satellite is 30-36 dBw in the prime coverage area. Contour maps called "Footprints" for relative EIRP of WESTAR II and RCA SATCOM are shown in Figures 3, 4, and 5.

DOWN LINK OR RECEIVE TERMINAL

The Down Link Terminal is that portion of the signal chain which is of importance to the Cable Operator. It is this part of the chain, which the Cable Operator can control, design, and own, and it is this part of the System with which he must become intimately familiar.

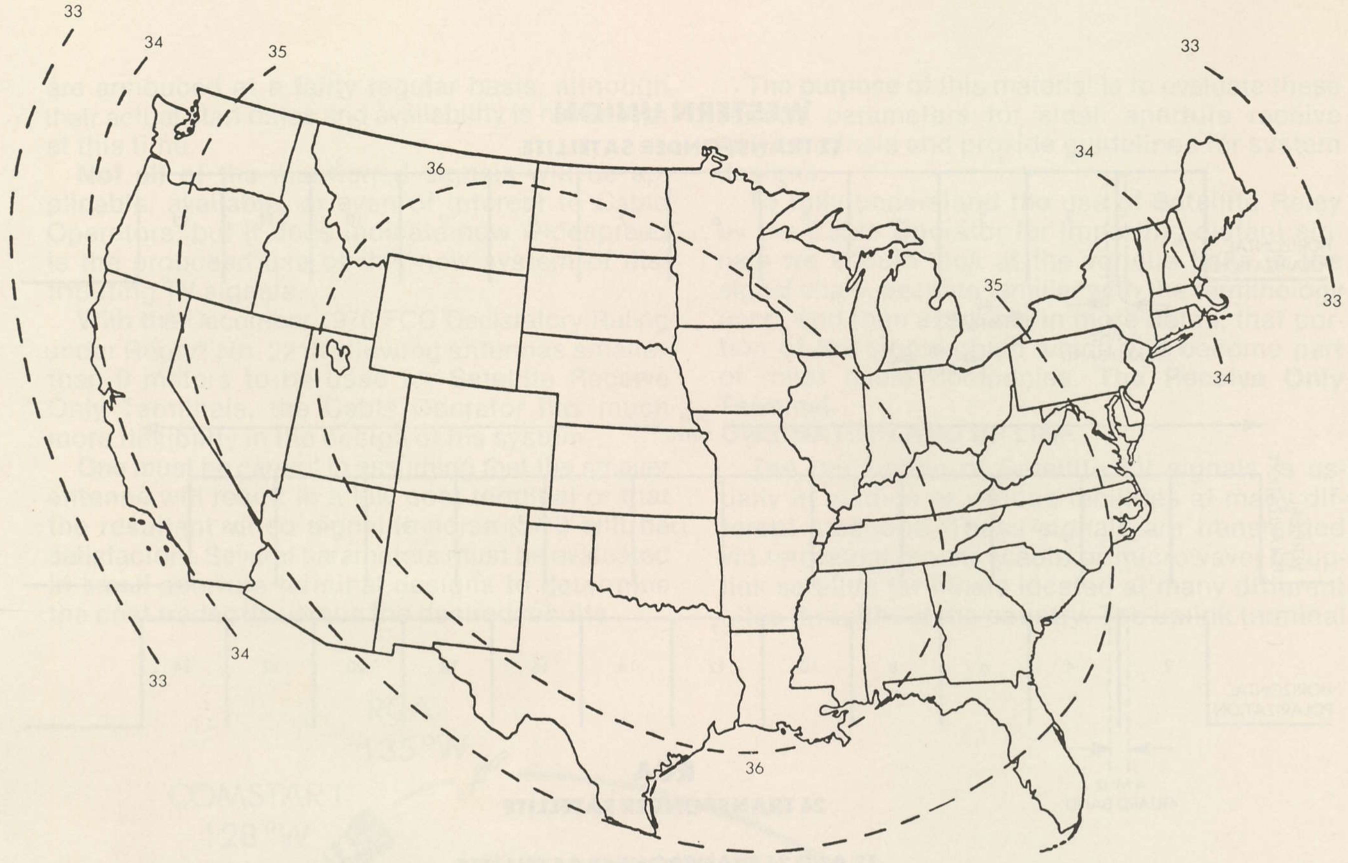
There are three primary parts to the Receive Terminal (Figure 6):

- Antenna
- Low Noise Amplifier
- Receiver

We will examine each of these components individually, look at the different types available, and the tradeoffs which can be made.

ANTENNA

As the first element in the receive chain, the contributions of the antenna to the overall system noise temperature and gain are of primary importance. For the purposes of this paper, we will consider antenna sizes of 4.5 meters (14.8 feet), 5 meters (16.4 feet), and 6 meters (19.7 feet) of the parabolic type, and 4.3 meters (14 feet) conical



Average EIRP from RCA-SATCOM spacecraft for transponders 4, 8, 12, 16, 20, 24. Spacecraft located at 119°W longitude.

FIGURE 3

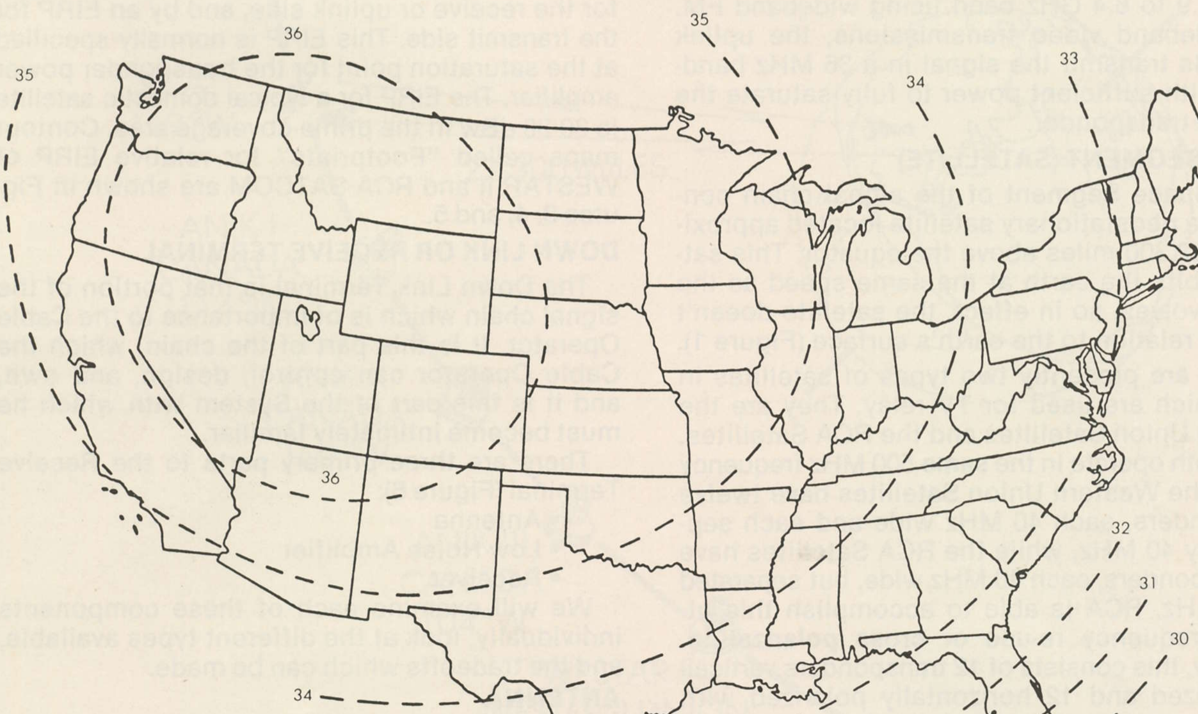


FIGURE 4

Average EIRP from RCA-SATCOM spacecraft for transponders 2-6, 10, 14, 18-22. Spacecraft located at 119°W longitude.

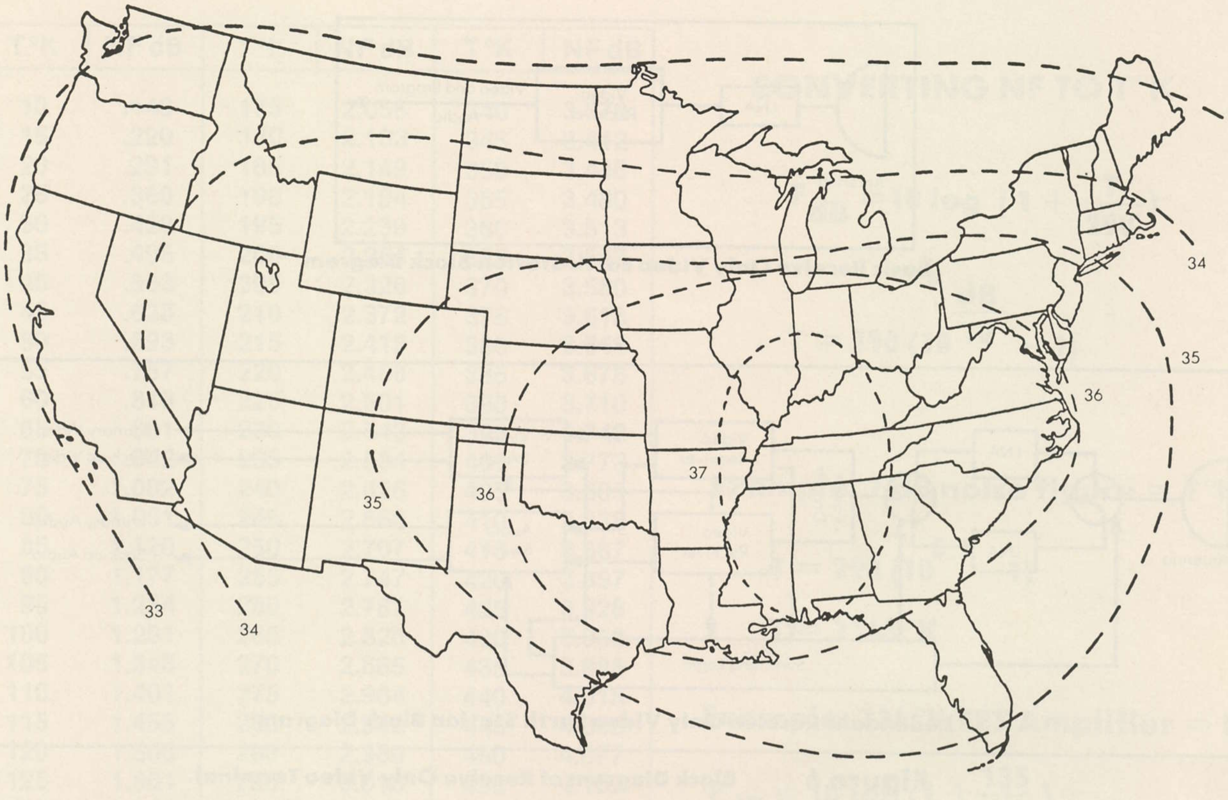


FIGURE 5 **Average EIRP from WESTAR II Spacecraft. Spacecraft located at 123.5°W longitude.**

horn antenna, because these are the stock sizes available and those which are acceptable by the FCC.

PARABOLIC ANTENNA (Figure 7)

Utilizes two different types of feed system.

Prime Focus

The Prime Focus Feed antenna uses a feed element located at the apex or focal point of the dish to extract the RF energy. There are two types of prime focus feeds.

(a) **The button hook feed** which uses a section of curved waveguide to receive the RF energy at the apex and then couple it back to the vertex of the dish.

(b) The **feed located at the apex,** mounted on struts or supporting members.

The Prime Focus Feed exhibits excellent side lobe performance, but usually has lower gain due to losses in waveguide runs to the low noise amplifier—type (a). Type (b) overcomes this loss by locating the LNA at the vertex but this offers some disadvantage when changing or aligning polarization.

Cassegrain Feed (Figure 7)

The Cassegrain Feed uses a hyperbola subreflector mounted at the apex of the antenna to reflect the RF energy to a feed horn located at the vertex of the dish. This type of feed usually provides more gain, easier polarization alignment and change, but normally has poorer side lobe performance.

CONICAL HORN (Figure 8)

The conical horn antenna is a type of antenna used frequently in terrestrial microwave systems. It is in reality a small segment of a large parabola which, because of its unique design, exhibits superior side lobe characteristics to the parabola, excellent gain characteristics, and extremely low noise temperatures.

LOW NOISE AMPLIFIER (LNA)

The LNA is perhaps the singular most important element in the Receive Terminal. As the first active component in the system, its design and characteristics can change overall system performance more than any other. These amplifiers' noise performance is specified in degrees Kelvin (°K) and for those familiar with working with noise figures, the charts shown in Figure 9 allow for the conversion from °K to NF.

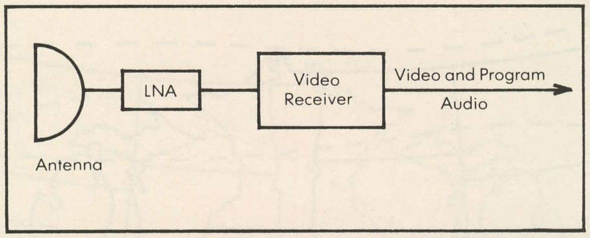
There are two basic types of LNA used.

Parametric Amplifiers 45-120°K

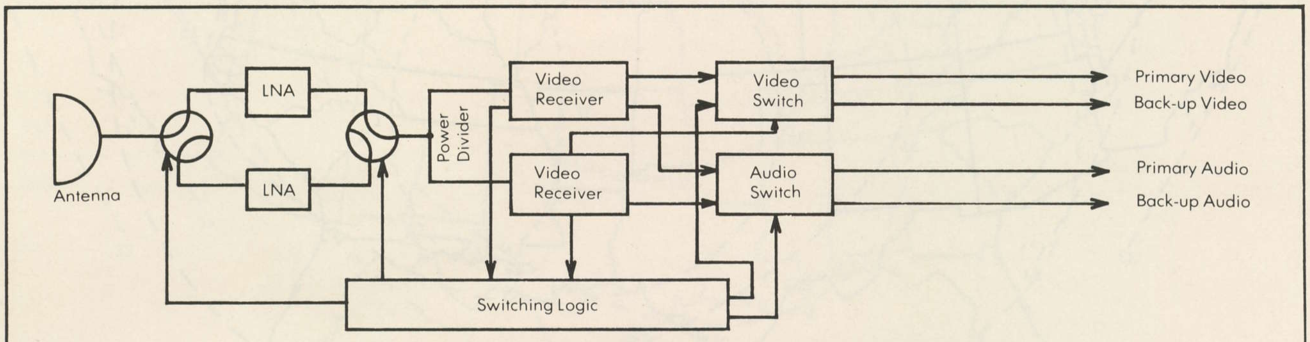
A parametric amplifier makes use of the negative resistance characteristics of varactor diodes to achieve high gain and extremely low noise temperatures. These amplifiers are normally expensive and, for the very low temperature units, quite bulky.

Gallium Arsenide Field Effect Transistor Amplifiers (GaAsFets) 90-300°K

The GaAsFet amplifier usually consists of a low noise GaAsFet input amplifier followed by a transistorized amplifier to achieve low noise tem-



Basic Receive Only Video Earth Station Block Diagram



Redundant Receive Only Video Earth Station Block Diagram

Figure 6 **Block Diagram of Receive Only Video Terminal.**

peratures and high gain. This product area has seen significant technology advances in the past year which have improved the noise temperatures of these units while lowering their price.

VIDEO RECEIVER

The video receiver in the system selects the desired satellite transponder, provides attenuation and isolation for unwanted signals, down converts the signal, extracts audio and video information, processes it and provides the base band (video and audio, or, composite) inputs to the cable head end equipment.

With the recent availability of so many different signals from the satellites, there has been a change in philosophy in regard to receiving equipment. Some manufacturers are now offering a mix of low cost dedicated receivers and frequency agile receivers which results in a lower cost system for multiple channels.

Whatever the type of receiver used, it should exhibit the following characteristics:

(a) **Reliability**
(b) **Modular construction** for ease of maintenance

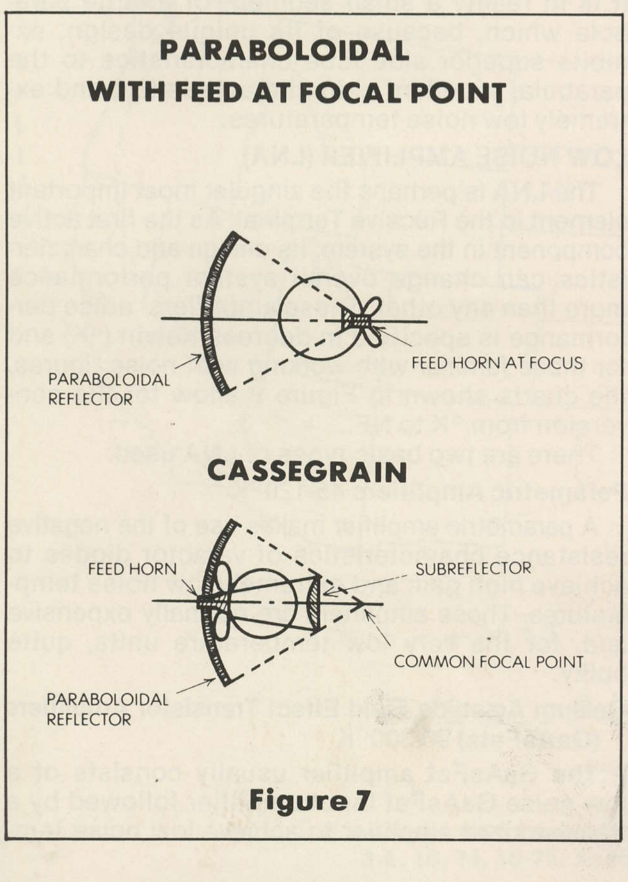
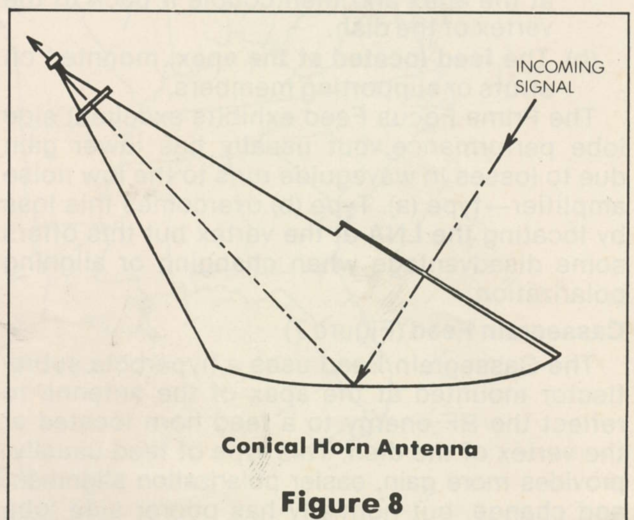


Figure 7



Conical Horn Antenna

Figure 8

T°K	NF dB	T°K	NF dB	T°K	NF dB
10	.148	175	2.056	340	3.378
15	.220	180	2.103	345	3.412
20	.291	185	2.149	350	3.446
25	.360	190	2.194	355	3.480
30	.429	195	2.239	360	3.513
35	.496	200	2.284	365	3.547
40	.563	205	2.328	370	3.580
45	.628	210	2.372	375	3.613
50	.693	215	2.415	380	3.645
55	.757	220	2.458	385	3.678
60	.819	225	2.501	390	3.710
65	.881	230	2.543	395	3.742
70	.942	235	2.584	400	3.773
75	1.002	240	2.626	405	3.805
80	1.061	245	2.666	410	3.836
85	1.120	250	2.707	415	3.867
90	1.177	255	2.747	420	3.897
95	1.234	260	2.787	425	3.928
100	1.291	265	2.826	430	3.958
105	1.346	270	2.865	435	3.988
110	1.401	275	2.904	440	4.018
115	1.455	280	2.942	445	4.048
120	1.508	285	2.980	450	4.077
125	1.561	290	3.018	455	4.107
130	1.613	295	3.055	460	4.136
135	1.665	300	3.092	465	4.165
140	1.716	305	3.129	470	4.193
145	1.766	310	3.165	475	4.222
150	1.816	315	3.201	480	4.250
155	1.865	320	3.237	485	4.278
160	1.913	325	3.273	490	4.306
165	1.962	330	3.308	495	4.334
170	2.009	335	3.343	500	4.362

CONVERTING NF TO T°K

$$F_{dB} = 10 \log \left(1 + \frac{T}{290}\right)$$

$$T = 290 \left(10^{\frac{F_{dB}}{10}} - 1\right)$$

Example: 7 dB noise figure = T°K

$$T = 290 \left(10^{0.7} - 1\right)$$

$$T = 1163\,°K$$

Example: 135°K FET Amplifier = NF dB

$$F_{dB} = 10 \log \left(1 + \frac{135}{200}\right)$$

$$NF_{(dB)} = 1.66 \text{ dB}$$

Figure 9

LOW NOISE AMPLIFIER CONVERSION CHART

NOISE TEMPERATURE IN DEGREES KELVIN TO NOISE FIGURE IN dB

(c) **High quality video** characteristics
(d) **Low threshold** performance.

Most receivers being offered today can provide items a, b, and c above, but some receivers have problems with item d which, in **large** aperture systems where they operate at high C/N ratios, is **not** important. However, in small aperture systems where we operate at lower C/N ratios, we need as many system margins as we can get. For this reason, the threshold characteristics of the receiver used are important.

The nominal threshold point of an FM receiver with a 30-36 MHz IF bandwidth is approximately 10-11 dB C/N (see Figure 10). As we will see in our system calculations, this is fine in some locations on the primary satellite but doesn't provide sufficient margin in other locations where we have a lower signal from the prime satellite or alternate satellites.

To overcome this problem, some manufacturers have developed threshold extension techniques to lower the threshold in their receivers by several dB (see Figure 11), and offer this as an option at an increase in price ranging from $500 to $2,000 per unit. These techniques are usually in the form of extra modules which utilize phase lock loops, bandwidth shrinkage or tracking filters to accomplish their task. All of these systems work and offer not only more system operating margins, but also an increase in system complexity and perhaps a decrease in equipment reliability.

(One manufacturer offers an FM threshold of less than 8 dB C/N as a standard at no additional cost by using a patented technique which has been in use by this manufacturer in all of its equipment supplied to earth stations for video reception.)

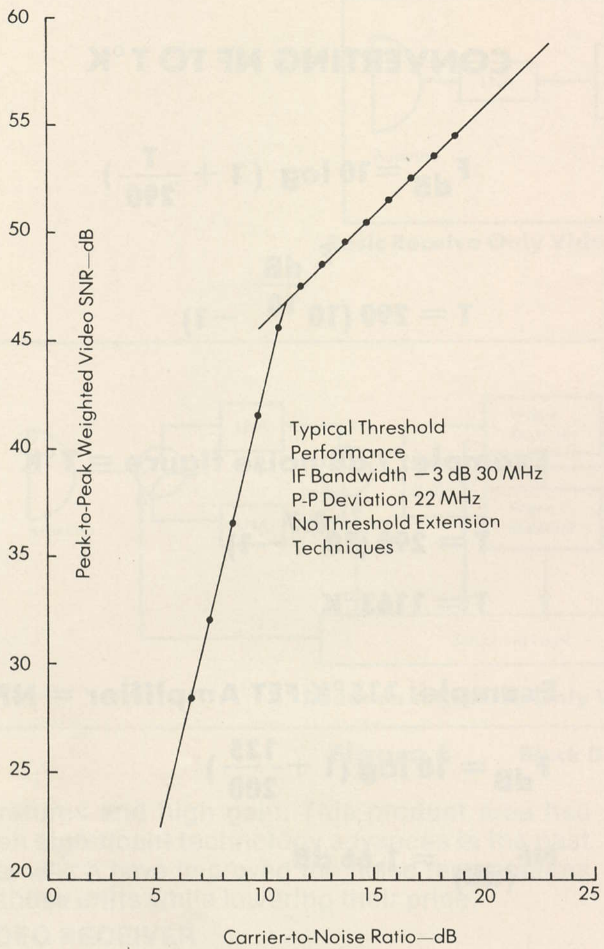


Figure 10.

At any rate, one must be careful not to be misled when we talk about threshold performance. Although it has been demonstrated by several suppliers that the static threshold can be extended to 6 dB C/N or lower, because of the type of signal we are concerned with receiving, we must be aware of a phenomena called "impulse noise". This consists of black and white "sparkles" on the video picture **and occurs between** 8 and 9 dB C/N **regardless of what the threshold extension characteristics of the FM receiver are,** and between 11 and 12 dB C/N with a receiver threshold of 10 dB C/N. The degree of annoyance from impulse noise is a function of C/N after the onset and certainly a receiver with threshold performance of 6 dB will provide a less objectionable picture than one that thresholds at say 8 dB C/N, but is this the type of picture you want to deliver on your system? Ideally, you should be able to deliver a noise-free picture under all operating conditions. If you can't, then the overall system design is deficient.

SYSTEM DESIGN CONSIDERATIONS

The mystery of satellite communications is decreased by relating it to well-established microwave radio engineering principles. Antenna gain, path losses, transmitted power, and other transmission parameters are directly related to experience gained in point-to-point terrestrial microwave radio.

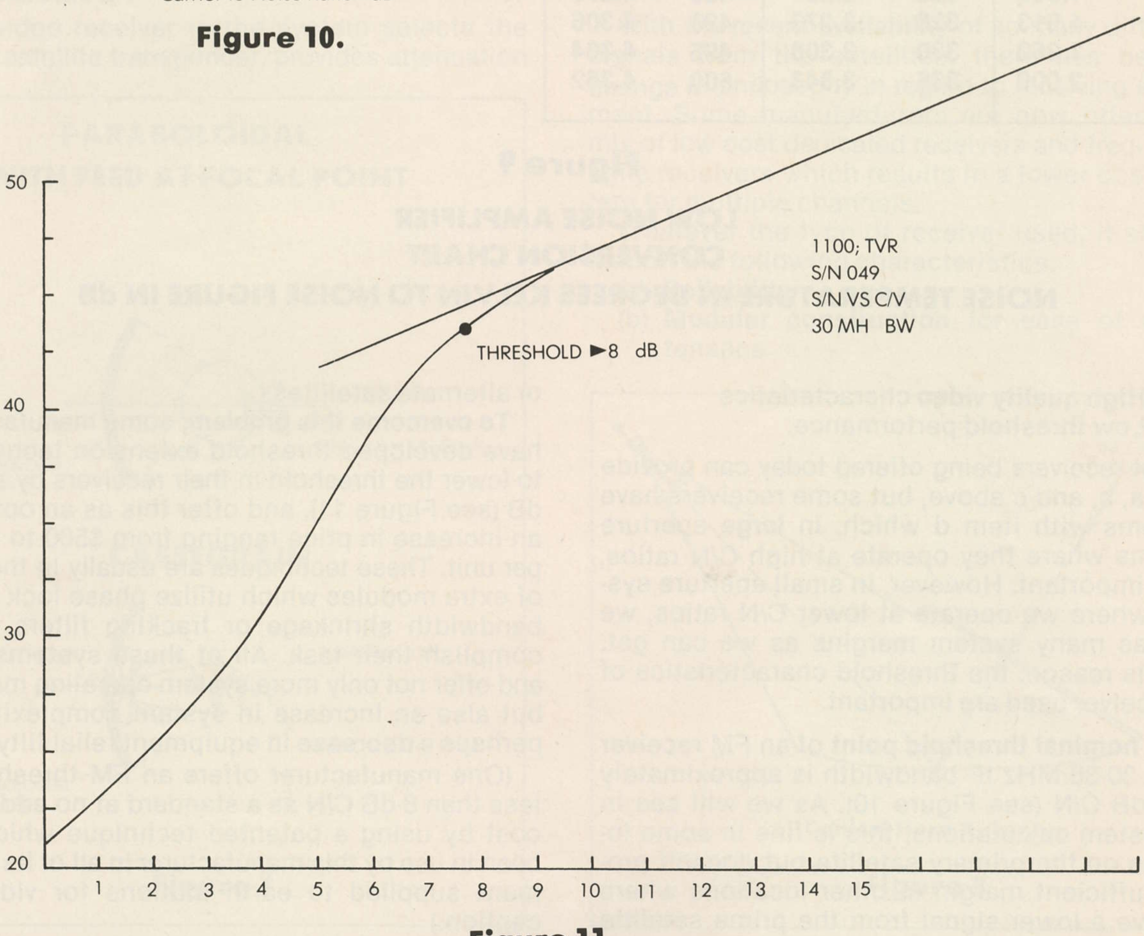


Figure 11.

The microwave signals on the down link from the Satellite are much lower than normally experienced in terrestrial systems. To overcome the noise problems associated with the reception of low noise signals, high gain antennas, and low noise amplifiers are used.

Because the satellite relay link from the uplink transmitter to the downlink receiver is a cascade system, we must consider the noise contributions of the up link, **and** because we use a shared frequency band with other satellites and terrestrial microwave, we must consider the noise contributed by interferring sources.

We must also consider, in our design, those contributions to system performance degradation which are random, cyclic and beyond the control of the operator. These include:

- Atmospheric Absorption
- Rain Attenuation
- Pointing Errors
- Satellite Positional Movement
- System Degradation
- Polarization Losses.

Finally, the design must also consider what performance will be obtained in the event the alternate satellite has to be used. If, for example, the RCA F2 Bird fails, then the operator may be forced to move his antenna to the F1 Bird which has a different EIRP contour. If his system is not adequately designed, he and his customers will suffer the loss.

Several steps are necessary in the design of a small aperture earth station for the reception of TV signals, and we will do a trial design to identify the steps.

Step 1—Frequency Coordination

Before we go to the trouble of doing our system analysis, the first thing we must do is obtain a frequency coordination study to determine the following:

(a) Can our selected or alternate sites be frequency co-ordinated for a TVRO Terminal in the 3.7 to 4.2 GHz Band?

(b) If so, what kind and what size of antenna can we use, i.e. 10 meter, 6 meter, 5 meter, 4.5 meter or conical horn?

Once we completed step one, we have established one element in our Receive Terminal.

Step 2—Design Objectives

Now, we must specify our design objectives. These include:

(a) **Which satellite** do we intend to use and transponder (program) do we wish to receive?

(b) **What video** signal-to-noise ratio is desired?

(c) **Do we wish** to receive more than one video signal simultaneously?

(d) **Do we want** system redundancy and if so, do we want automatic switchover?

Once these parameters are defined, we are ready to start our system analysis.

As in any system design, certain established mathematical models have been developed to perform a system analysis. It is not the intent of this paper to show the derivation of these equations as they are handled in other readily available literature for those who wish to investigate further. For our purposes, we will make use of the following technical analysis for Orlando, Florida.

SUMMARY SHEET
TECHNICAL ANALYSIS OF SMALL APERATURE
TELEVISION RECEIVE ONLY EARTH STATION

Customer: **Demonstration**

Site Location: **ORLANDO, FLORIDA; 28.53** °N. Lat. **81.37** °W. Long.

Primary Satellite: RCA Satcom F2 119°W. Long.

Look Angles **238.22** °AZ **37.19** °EL

Alternate Satellite: RCA Satcom F1 135.8 W. Long.

Look Angles **251.14** °AZ **22.74** °EL

Antenna: **RF SYSTEM 6 METER** Gain **45.5** dB at 4 GHz

Antenna Noise Temperature (Primary Satellite): **28** °K at **37.19** °EL

Antenna Noise Temperature (Alternate Satellite): **37.5** °K at **22.74** °EL

LNA: **AMPLICA**; Noise Temp. **120** °K; Gain **50** dB

Receiver: Microdyne Corporation Model 1100-TVR(VT)

Noise Temperature: 2610°K; IF Noise BW: 30 MHz; FM Threshold: 8.0 dB

Performance Data

	Primary Satellite		Alternate Satellite	
Transponder	6	8-20-24	6	8-20-24
EIRP dBm	31.5	35.0	30.7	32.2
Nominal Performance				
C/N dB	11.96	14.46	10.85	12.07
dB Above FM Threshold	3.96	6.46	2.85	4.07
S/N Video dB	49.44	51.94	48.33	49.55
S/N Audio dB	49.81	52.32	48.70	49.93
Worst Case Performance				
C/N dB	10.55	13.31	9.38	10.67
dB Above FM Threshold	2.55	5.31	1.38	2.67
S/N Video dB	48.03	50.79	46.86	48.15
S/N Audio dB	48.40	51.16	47.23	48.53

SYSTEM CALCULATIONS:

(a) $T_{syst}\ °K = T_a + \dfrac{T_{LNA}}{G_{feed}} + \dfrac{T_{Rcvr}}{(G_{feed})(G_{LNA})}$

T_a = **28.0** °K (antenna noise temperature in degrees Kelvin)

T_{LNA} = **120** °K (LNA noise temperature in degrees Kelvin)

T_{Rcvr} = 2610°K (receiver noise temperature in degrees Kelvin)

G_{feed} = .98 (VSWR losses of feed to LNA coupling)

G_{LNA} = 100,000 (gain of LNA 50 dB)

$T_{syst}\ °K = 28 + \dfrac{120}{.98} + \dfrac{2{,}610}{98{,}000}$ = **150.48** °K

(b) G/T dB/°K = G_a − 10 log (T_{syst}); (system figure of merit)

G_a = **45.5** dB @ 4.0 GHz (gain of antenna)

T_{syst} = **150.48** °K; 10 log T_{syst} = **21.77** dB

G/T dB/°K = **45.5** − **21.77** = **23.73** dB/°K

(c) C/T dBw/°K = EIRP − L + G/T

L_P = **196.09** dB (Free space path loss at 4 GHz)

EIRP = **31.5** dB = output from satellite in dBw − obtained from footprints

G/T = **23.73** dB/°K

C/T dBw/°K = **31.5** − **196.09** + **23.73** = −**140.86** dBw/°K

(d) Down Link Carrier-to-Noise (Nominal)

C/N_d = C/T − J − B

C/T = −**140.86** dBw/°K J = −228.6 dB (Boltzmann's constant)

IF BW = **30** MHz; B = 10 log (IF BW) = **74.77** dB Hz

C/N_d = −**140.86** + 228.6 − **74.77** = **12.97 dB**

(e) Up Link Carrier-to-Noise

$C/N_u = G/T_{sat} - L_u - L_{mu} - J - B + EIRP_{es}$

G/T_{sat} = −6 dB/°K (includes 2 dB end of life margin, RCA data)

L_u = Path Loss = 200.15 dB @ 6.258 GHz, averaged for Atlanta and New York

J = −228.6 dB (Boltzmann's constant)

IF BW = **30** MHz; B = **74.77** dB Hz

EIRP = 83 dBw

L_{mu} = Miscellaneous Losses = 1.2 dB worst case (RCA data)

Atmospheric Absorption	= 0.2 dB
Pointing Loss	= 0.2 dB
Rain Attenuation	= 0.7 dB
Polarization Loss	= 0.1 dB
	1.2

C/N_u = −6 − 200.15 − 1.2 + 228.6 − **74.77** + 83 = **29.48** dB

(f) Carrier to Interference:

C/I (total) = C/I adjacent sat $\boxplus$ C/I (terrestrial $\boxplus$ C/I (internal)

C/I internal = 26.0 dB — FCC data document

C/I adjacent sat = 21.9 dB — FCC 6-1169-43700

C/I terrestrial = 25.0 dB Terrestrial Frequency Co-Ordination

C/I (total) = 21.9 $\boxplus$ 25.0 $\boxplus$ 26.0 = 19.17 dB

(g) Effective Carrier-to-Noise at TVRO (Nominal)

$C/N_{eff} = C/N_d \boxplus C/N_u \boxplus C/I\ (total)$

C/N_d = **12.97** dB

C/N_u = **29.48** dB

C/I (total) = 19.17 dB

C/N_{eff} = **12.97** $\boxplus$ **29.48** $\boxplus$ 19.17 = **11.96** dB (which is **3.96** dB above Rcvr FM threshold)

$\boxplus$ denotes power addition

(h) Video Signal-to-Noise (Nominal)

$\dfrac{S_{p\text{-}p}}{N_{rms}}$ (weighted) $= C/N_{eff} + 20 \log \dfrac{\Delta F}{F_{vm}} + 10 \log \dfrac{B}{F_{vm}} + 10 \log 6 + EW$

C/N_{eff} = **11.96** dB

ΔF = Peak Deviation = 10.75 MHz

F_{vm} = Top Video Baseband = 4.2 MHz

B = IF Noise Bandwidth = **30** MHz

EW = Emphasis and Weighting Improvement = 13 dB

$\frac{S_{p\text{-}p}}{N_{rms}}$ = **11.96** dB + 37.48 (for 30 MHz 3 dB IF BW) = **49.44** dB

$\frac{S_{p\text{-}p}}{N_{rms}}$ = —— dB + 38.72 (for 36 MHz 3 dB IF BW) = ——dB

(i) S/N (Audio Unweighted) =

$$C/N_{eff} + B + 10\log 3/4 \left(\frac{\times^2\, \Delta F_{sc}^2}{F_A^3\, F_{sc}^2} \right) + E_A$$

$\times$ = Deviation of Carrier = .6 MHz

ΔF_{sc} = Deviation of Subcarrier = 75 kHz

F_A = Top Audio Baseband = 15 kHz

F_{sc} = Subcarrier Frequency **6.8** MHz

E_A = Emphasis Improvement = 13.2 dB

C/N_{eff} = **11.96 dB**

B = 10 log (IF BW) = **74.77** dB Hz

for 6.8 MHz Subcarrier:

S/N (audio) = **11.96** + **74.77** − 50.12 + 13.2 = **49.81** dB

for 6.2 MHz Subcarrier:

S/N (audio) = —— + —— −49.32 + 13.2 = ——dB

(j) In the event that the TVRO at **ORLANDO, FL.** is subjected to the following worst case miscellaneous down link losses averaged as shown, the resultant C/N, video and audio S/N ratios will be as indicated for the calculated transponder:

Miscellaneous Down Link Losses	**Nominal**	**Random**
Satellite EIRP Variation (daily)	—	0.15 dB
Atmospheric Absorption	0.10 dB	0.10
Polarization Losses	0.10	0.10
Rain Attenuation (average climate)	—	0.50
Pointing Error	0.30	0.40
Antenna Gain (from nominal)	—	0.20
LNA due to use of typ. spec.	—	----*
LNA long term degradation	—	----**
Satellite long term EIRP degradation	0.40	0.40
	0.90 dB	R.S.S. = 0.81 (Root Sum Square)

Total Misc. Down Link Losses = 0.90 + 0.81 = 1.71 dB

*LNA used with Noise Temperature specified as maximum.

**There is no evidence at present time to indicate that GaAs FET LNA's degrade. This is also a maintenance manageable item since user can replace or repair LNA if noise temperature degrades.

C/N_d (WC) = C/N_d - 1.71 = <u>11.26</u> dB

C/N_{eff} (WC) = C/N_d(WC) ⊞ C/N_u ⊞ C/I

= **11.26** ⊞ **29.48** ⊞ 19.17 = <u>10.55</u> dB

(which is <u>2.55</u> dB above receiver FM threshold)

Video SNR (Worst Cast) per para. h **<u>48.03</u>** dB

Audio SNR (Worst Case) per para. i **<u>48.40</u>** dB

(k) For the other transponders of interest, the following performance is presented for the indicated cases.

(i) Transponder No. 8,20,24 EIRP **35.0** dBw
EIRP difference from calculated transponder **+3.50** dB

Nominal Performance

C/N_{eff} **14.46** dB (which is **6.46** dB above receiver FM threshold)

S/N (video) **51.94** dB
S/N (audio) **52.32** dB

Worst case as per paragraph (j)

C/N_{eff} (WC) **13.31** dB (which is **5.31** dB above receiver FM threshold)

S/N (video) **50.79** dB
S/N (audio) **51.16** dB

MISCELLANEOUS LOSSES

Other losses or system degradations that must be considered are the effects of atmospheric absorptions, rain attenuation (up link and down link), earth station pointing error, spacecraft motion, and system degradation. The combined effects of these items, if all occur simultaneously, could contribute from 1-2 dB of degradation to the system C/N. Therefore, it is important to know the threshold characteristics of the video receiver used so that sufficient margins can be designed into the system to prevent operation at or below threshold in the worst case. The majority of video receivers have FM thresholds of 8 to 11 dB C/N.

LOW NOISE AMPLIFIER COMPARISON
Ref: 120°K GaAsFet

LNA Temp °K	G/T Improvement	$\frac{S_{p-p}}{N_{rms}}$ Improvement	Price Increase Over 120°K Unit
90°K GaAsFet, or			5- 6K
90°K Paramp	1 dB	1 dB	8-9K
80°K Paramp	**1.41 dB**	1.41 dB	10-11K
75°K Paramp	**1.63 dB**	1.63 dB	12-13K
60°K Paramp	2.36 dB	2.36 dB	14-15K
45°K Paramp	**3.25 dB**	3.25 dB	17-18K

Figure 12.

From our calculations, it is evident that there are several variables to be considered. One over which we have control is the selection of the LNA. Figure 12 shows the improvements available using different LNA's and approximate costs. Figure 13 shows the improvements available with different antenna and the approximate costs.

CONCLUSIONS

1. It is not difficult, nor is it a black art to design a satellite TV receive terminal, if the terms, technology and requirements are known.
2. The designer must make sure he understands the specifications and definitions he obtains from the hardware manufacturers.
3. Before he starts, he must determine from a frequency coordination study whether he can, in fact, install an earth station at his location, and if so, what his options are in antenna selection.
4. With his system design, he must ensure that he has sufficient margin so that he can meet his objectives (even under worst case conditions), and deliver a quality signal to his subscribers i.e. something better than the 36 dB minimum S/N specified by the FCC.
5. Because of the relative simplicity of an earth station, there is no reason that a system operator has to buy a turnkey system. He can shop around for best pieces for antenna, LNA and receivers and do his own system integration and instruction and save himself several thousand dollars.
6. System design calculations to be used as technical showings for FCC filing and selection of system hardware are available free of charge from several sources.

Figure 13.

Antenna Dia & Type	Gain Increase	$\frac{S_{p-p}}{N_{rms}}$ (Approximate) **	Cost Increase Over 4.5 Meter
4.3 Meter Conical Horn		1.5 dB *	4 -5K
6 Meter Parabola	2 dB	2 dB	2- 5K
8 Meter Parabola	4 dB	4 dB	15-20K
10 Meter Parabola	8 dB	8 dB	30-40K

ANTENNA COMPARISON
Ref: 4.5 Meter Parabola

* **This improvement** is a function of lower antenna noise temperature and superior side lobe performance resulting in a lower $C/N_{i\,(total)}$

** **This improvement** is approximate only as actual number is also a function of antenna noise temperature

DOLAN ON RADIATION

By Terrorizing The Anderson, Indiana System For A Couple Of Days We All Learned More About Signal Leakage

What To Do?

The FCC's rules on radiation appear clear enough; they have set out a set of numbers in section 76.605 and the numbers tell us how much radiated or leaked cable TV service signal we are permitted. But unfortunately the FCC's rules don't tell us how to go about measuring the "levels" present, which if you have never been through the experience. . .is. . .quite an experience.

Where exactly should the emphasis be? On measuring the levels found? Or locating the source of the radiation? Or fixing the radiation?

The FCC's rules say we measure (using a dipole et al) at ten feet separation from our lines. How important is a foot or two?

The FCC's rules say we are to use a resonant dipole antenna at the frequency we are monitoring. Is the dipole length critical? What happens if we are adjusted for say TV channel 10 with the dipole but measuring on channel 8, or 12?

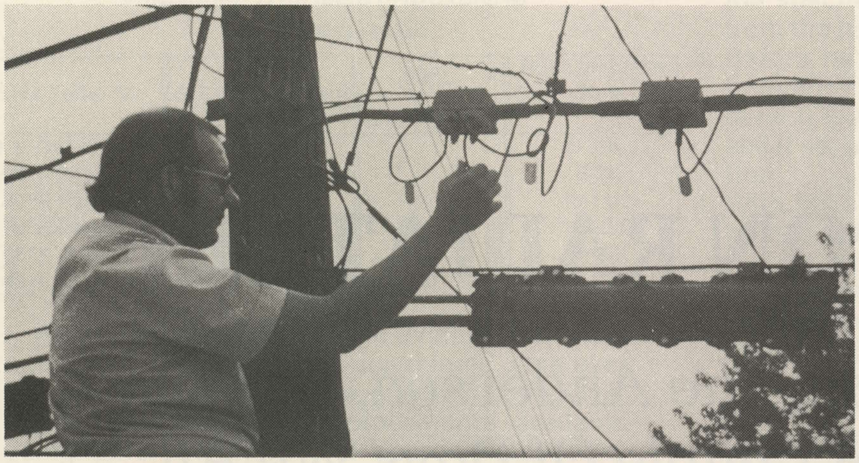
Suppose we are monitoring with an FM receiver, for an FM signal source. Is narrow-band (i.e. higher selectivity) FM receiving equipment better than. . . say. . .wideband? Does the narrower bandwidth affect the sensitivity of the monitoring system? If so, how much?

Suppose you elect to use a portable TV receiver and a dipole. How does this "system" compare with say a spectrum analyzer and dipole? Or with a tone modulated system such as the Cuckoo? Is a field strength meter plus a dipole a suitable monitoring package?

From the practical side of radiation testing, is a regular and routine maintenance program (such as patroling all of the cabled streets on a set schedule and pattern) worthwhile? Or is it simply a waste of valuable time?

And. . .how much difference does the selection of a measurement frequency make? To make any time at all in patrolling you obviously need to set your monitoring receiver system (whether TV receiver or FM receiver or SLM) up on some particular frequency. After you dis-card certain frequencies because of off-air signals around, are you better off selecting a (1) low band channel or frequency, (2) a mid-band channel or frequency, or (3) a high band channel or frequency? Does it make any difference, in monitoring-system sensitivity which you select? Are you more apt, for example, to catch leaks on high band than say at low band? Or is it the other way around?

Because of Mid State's involvement in the manufacture of a radiation detection system (which one we'll leave you to figure out on your own!) we regularly hear these and dozens of additional questions on a daily basis. Getting the answers seemed simple enough. . . pack up the gear and go out into a real-world cable system and check out the procedures most systems seem to be using. I elected to "visit" General Electric Cablevision in Anderson, Indiana primarily because it was a fairly short drive from Beech Grove and I'd had enough of long distance traveling for awhile. What we learned there is the "meat" of this report. Don't expect full answers to all questions; one of the things I learned was that many of the answers are not simple to find. But it is a start and through **CATJ** we can perhaps coax



JUST A LOOSE FITTING is often the cause of your problems. Radiation check reveals where fittings are loose (thereby causing radiation hot spot). Just tighten it up and be on your way!

(that's coax as in persuade not coax as in coax-ial cable!) others to share their experiences with the industry.

Now I get out into systems fairly often, to do system proofs, check out headends and to test our new production ideas. But you do forget that there is nothing simple about the CATV business when you spend too much time behind a desk. For example. . .the short trip turned into a long trip because (1) it rained the first day, and (2) the truck blew a radiator. OK. . . we're not sissies, we can walk around in the rain. Have you ever wandered up and down streets and alleyways in the middle of a lightning storm with a big aluminum dipole held above your head?

Better a live sissy than a dead dumby. . .we packed it up and waited a week to try again. This time we got fairly well into the project before the truck blew up again. (I'd like to say something nasty about GE's trucks but they are a customer of mine and it might be taken the wrong way!)

Doing It At Last

Enough of the fun and games; sooner or later we all have to buckle down and go to work. Now what is it we are supposed to measure? Well, the FCC sets it all out and if you are not much for math formulae just skip over the next paragraph re-joining us again down about 12 inches or so:

Point One: The radiation level limit is 20 microvolts per meter at a distance of 10 feet.

This does not mean microvolts as read on your meter. The meter here is the metric meter. First we have to construct or calculate a dipole antenna. To do this we start out with the formula for a dipole (half wavelength antenna) in free space:

$$\text{Length in feet} = \frac{492}{\text{frequency in MHz}}$$

Now unfortunately this formula ignores the diameter or size of the material out of which you construct the dipole. Since we are supposed to be making an exact or precision measurement, it pays to adapt this formula to the right correction factor which will allow for the diameter of the metallic portion of the dipole. And that is:

$$\text{Length in feet} = \frac{492 \times K}{\text{frequency in MHz}}$$

K is the correction factor, typically less than the whole number "1". In fact the smaller the diameter of the material the smaller K becomes. For a dipole such as the RD-1 the "K" factor" is .95. So therefore the equation becomes:

$$\text{Length in feet} = \frac{492 \times .95}{\text{frequency in MHz}}$$

Unless the multiplication and the division come out exactly on a whole number for an exact number of feet, we will end up with a fractional portion of feet. It is therefore easier to start off with a modification of this formula; one that gives us an answer in inches. That saves on wear and tear for the fraction conversion. And that is:

$$\text{Length in inches} = \frac{5904 \times .95}{\text{frequency in MHz}}$$

So let's compute for our lowest frequency CATV channel; two.

$$\frac{5904 \times .95}{55.25}$$

Which comes out to a dipole length of 101.53 inches. Remember this is the total length of the dipole, from tip through center to other tip. If you are measuring from the edge of the center transformer/fitting mounting box outward, the length is 50% (close enough for now) of 101.53 or 50.75 inches (rounded off) per side or whip-extension.

For this exercise so much for the monitoring or test antenna; the basic 75 ohm balanced feed dipole. Except to note that if you are constructing your own test dipole (see **CATJ** for December 1976, page 40 for full do-it-yourself instructions) you will need a balanced (that's the dipole) to un-balanced (that's the 75 ohm downline) transformer.

What about this "microvolts-per-meter" business? Let's get around the problem with another formula; one that tells you how to convert "20 microvolts per meter" to microvolts on a CATV signal level meter.

Microvolts per meter = .021 x F x voltage

or, simply .021 F (V).

Therefore, to get the voltage we multiply .021 times the frequency (F), or 211.25; which is 4.436 and then divide that into 20 to get our answer (20 divided by 4.436 = 4.5 microvolts per meter).

Now let's have one last fling at math and convert the microvolts we have into dBmV since that is more convenient for the world we function in.

dBmV = 20 log (millivolts)

or,

for our channel 13 example

we have 4.5 microvolts which is the same as .0045 millivolts so
dBmV = 20 log (x) .0045, and
dBmV = −47 dBmV.

Now let's have one last fling at math and convert the microvolts we have laboriously constructed into dBmV since that is the more convenient world for us to function in:

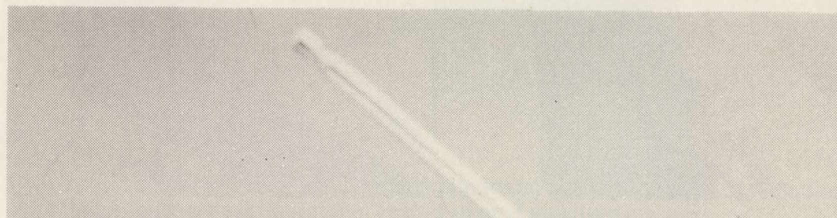
dBmV=20 log (millivolts)
or,
for our channel 13 example we have 4.436 microvolts which is the same as .004436 millivolts so
dBmV=20 log (x) .00444, and
dBmV=−47.060.

When you get all done with this nonsense you have a table; one that tells you how big a signal can be, at a specific frequency as received on a resonant (or cut to length) dipole antenna at a distance of ten feet from the cable equipment/line. . .and still be legal. That table (see page 40, **CATJ** for December 1976) runs the range from −37 dBmV at television channel 2 (55.25 MHz) to −47 dBmV at channel 13 (211.25 MHz). So much for the "permissible level(s)"; now which frequency do we select to monitor for radiation?

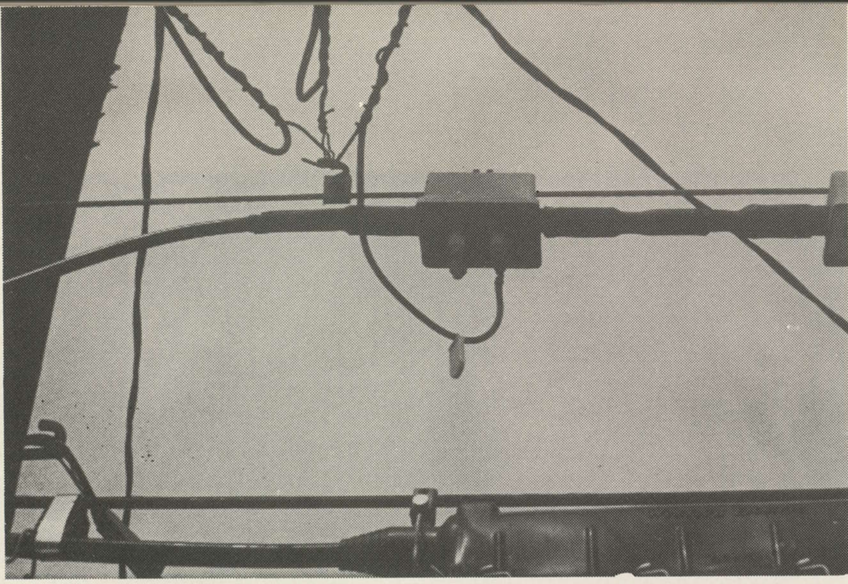
In Anderson, Indiana we have local orgination or microwave signals on channels 3, 10 and 13. That normally means we could find those channels more or less "clean" in the town. But scratch 13 because there is sufficient off-air in Anderson on 13 to make it not useable. After figuring all of the options here is what we picked to run comparative checks of the various "monitoring systems";

1) **Channel 10,** a microwave fed signal, which operates at 'system level';
2) **108.00 MHz,** a 'Cuckoo' signal deviated 5 kHz to be tested with a prototype crystal controlled narrow-band FM receiver;
3) **104.5 MHz,** another 'Cuckoo' signal deviated 150 kHz and used with a normal hand carried FM battery operated portable receiver;
4) **A 73.5 MHz pilot carrier,**

SEE GROUND WIRE coming down the pole? It confused the radiation level and source, acting as an 'unshielded transmission line' carrying the radiated signal down the pole (largely vertically polarized because of grounding wire polarization).



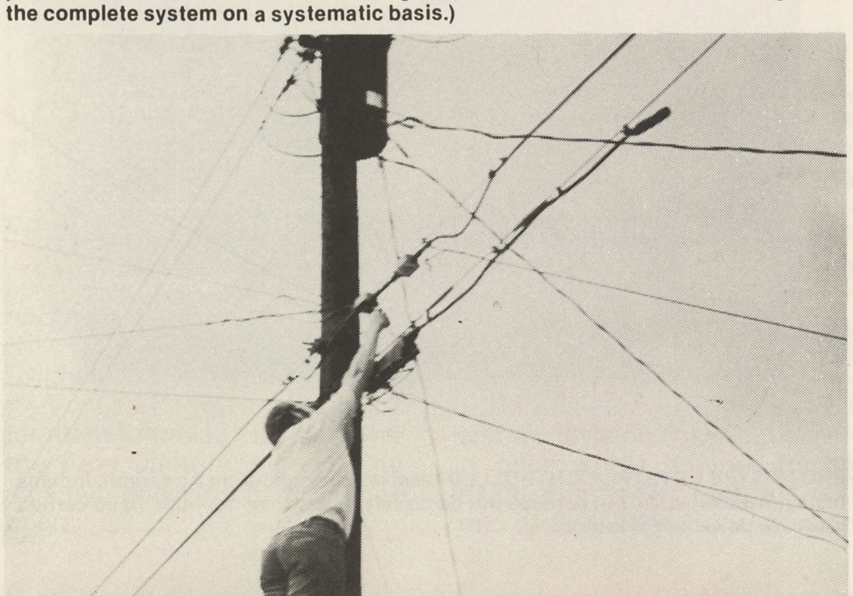
PROTO-TYPE CRYSTAL CONTROLLED receiver utilized during Anderson, Indiana tests proved effective but perhaps not decisively better than 'ho-hum' hand carried tuneable portable FM radio.



LOOK CLOSELY—that drop cable is hanging 'by a thread' from the DT. A bad TV receiver ground fed AC back to DT.

THE MORE WIRES AROUND the more confusing radiation sourcing becomes. When cable plant is not grounded at each pole (as virtually none are or really need to be) signal leak crawls along metallic surfaces nearby setting up secondary radiation sources and patterns. Telco drops, power messenger, guy wires and improperly anchored telco/power pole grounds all contribute radiation surfaces.

MOMENT OF TRIUMPH—cutting down an illegal drop found by radiation check! (People who run their own illegal drops often do such a sloppy job that their improvised installation radiates—another good reason to check radiation throughout the complete system on a systematic basis.)



running 6 dB down from the adjacent video carrier (channel 5 at 77.25 MHz).

A few random observations. Remember when you are measuring pilot carriers that are operating some number of dB below the adjacent video carriers that your "maximum" field radiation detection level (or the radiation threshold point) is that many dB lower also. If channel 5 is −39 dBmV to be "legal", your legal point for a 73.5 MHz pilot carrier run through the system '6 dB down' is 39 plus 6 or −45 dBmV.

Test Methods

Then we set up to measure each of the signals using a number of different measurment techniques.

1) **We measured or monitored** the 73.5 MHz signal with a tuned dipole feeding known-gain pre-amplifier feeding a signal level meter;
2) We measured channel 10 with:
   a) **tuned dipole,** pre-amp and signal level meter, and
   b) **portable TV receiver** with its built-in bunny ear antenna;
3) We monitored 104.5 MHz with the portable FM receiver using its own built-in whip antenna (gain unknown);
4) We monitored the 108 MHz signal with a crystal controlled narrow band receiver, using its battery supply and a built-in whip antenna of unkown reference gain;
5) We monitored 'broadband' the whole spectrum using a Tektronix 7L12 with a dipole adjusted for various spot frequencies (out of the above set) and a preamplifier between the resonant dipole and the 7L12.

Test Locations

We selected two of the Anderson FCC Proof test locations to 'double-check' with the entourage of equipment described and then went looking at random for other radiation locations. We found three, which gave us five locations at which we could then compare the effectiveness of the five test methods. **Table one** ('Anderson Test Locations') shows the results of the limited experiment. Each of the three non-FCC-proof locations were spotted by patroling with the 'Cuckoo' system, operating in the narrow band mode.

Test Location One

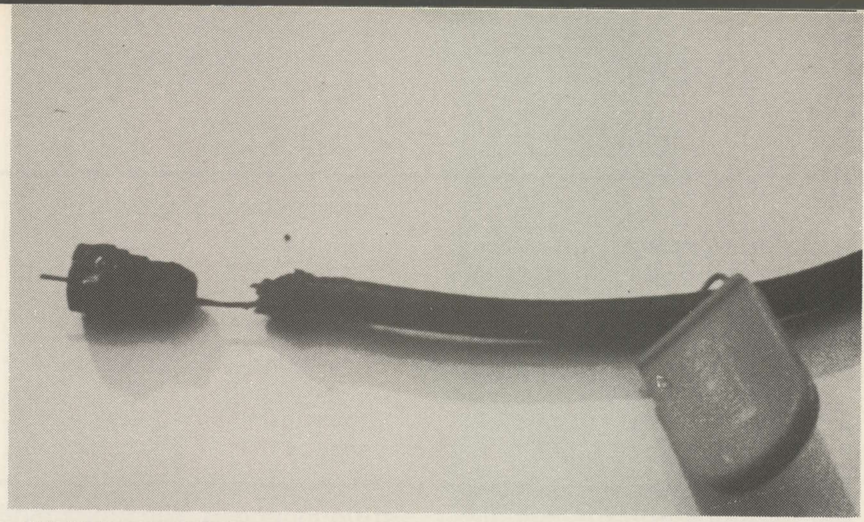
This point was spotted by detecting a barely audible (but there none the less) 'warble' from the crystal controlled receiver. When we broke out the dipole and SLM with pre-amplifier on channel 10 we found the radiated level was 2 dB out of spec. The 73.5 MHz signal was 6 dB out of spec (indicating that in this case the low band VHF range signal was leaking more than the high band signal). The TV set and the spectrum analyzer did not pick up the radiated signal. **Fault:** a loose "F" connector.

Test Location Two

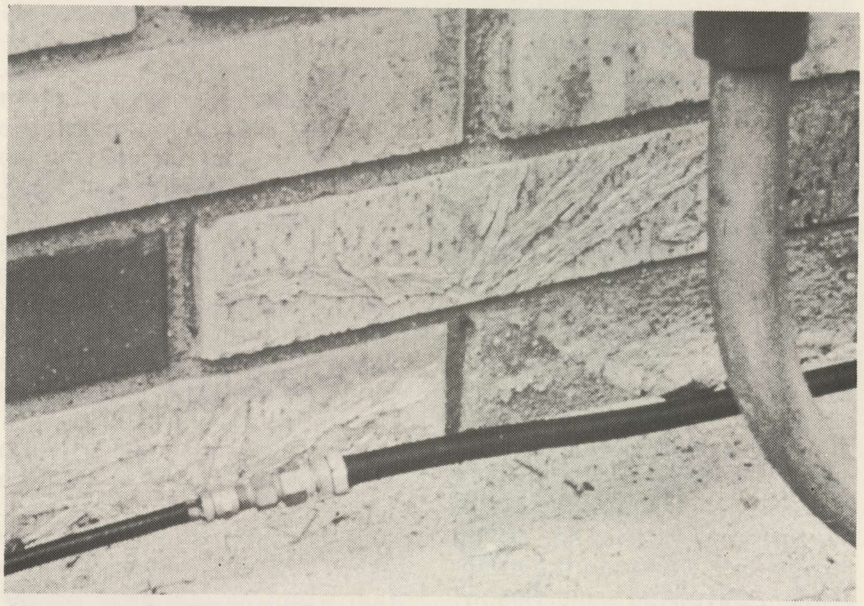
This point was spotted with both the 104.5 MHz and the 108 MHz 'Cuckoo' receivers picking up a warble from a distance 500 feet away. We kept on moving until we were under a pole where there was maximum 'Cuckoo' signal. Channel ten measured 37 dB (!) out of spec with the dipole/pre-amp/SLM while 73.5 MHz was 10 dB out of spec. The leak was so potent that the truck's position, parked nearby, made a difference in the levels we were reading on the SLM (the tall truck acted like an antenna or reflector, reradiating the signal in and out of phase to the test dipole; beware of tall trucks!). We did pick up radiated TV signal on channel 10 with the receiver and bunny ears, but the signals were more potent inside of the truck than outside. **Fault:** drop cable burned nearly in two by a 110 volt AC short inside of the TV receiver getting back up the drop.

Test Location Three

This point was an MATV system that had their own distribution system which was tied to the CATV system at a single feed point. We could not get

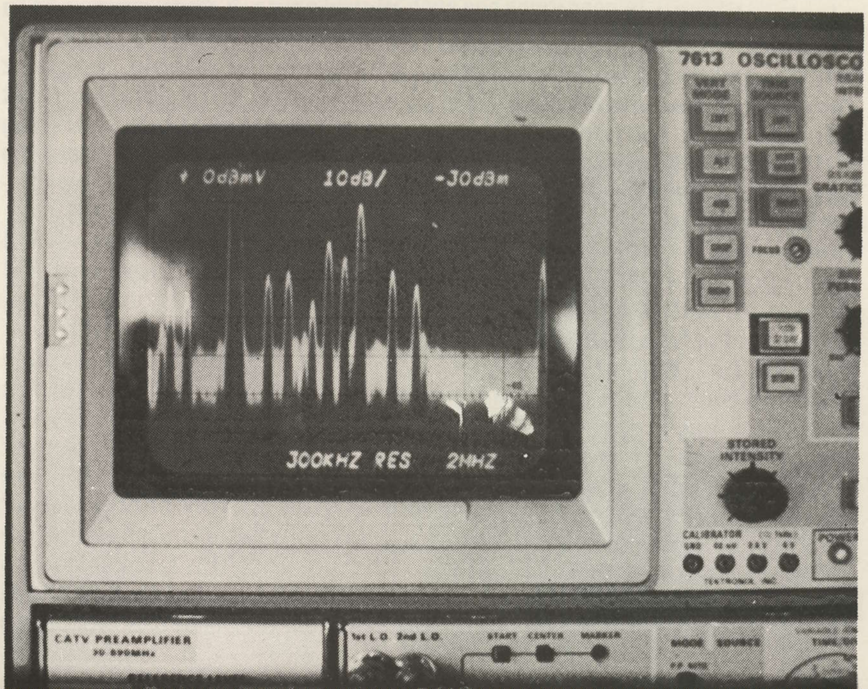


BURNED THROUGH DROP CABLE removed from DT fitting after leak source was spotted with radiation check. Boy, is grounding important!



INNOCENT BARREL SPLICE (we all have hundreds) is frequent point of radiation. And they should always be weather sealed against moisture ingress!

FIND THE RADIATION? It is buried under the off-air signals. Bottom line on hauling spectrum analyzer into field for radiation tests is that it is like chasing flies with a CRUISE missile; slightly overplaying your act.



ANDERSON TEST LOCATIONS					
Test Methods	**Location 1**	**Location 2**	**Location 3**	**Location 4**	**Location 5**
73.5 MHz pilot	**-15 dBmV**	-2 dBmV	not checked	**-13 dBmV**	no signal
Channel 10					
SLM	-28 dBmV	**+7 dBmV**	**-25 dBmV**	-23 dBmV	**-30 dBmV**
TV Rcvr	not checked	snowy pix	not checked	not checked	not checked
104.5 MHz	not checked	Yes	Yes	Yes	not checked
108.0 MHz	Yes	Yes	Yes	Yes	not checked
Analyzer	No	Yes	not checked	not checked	No

the tall truck into the complex so walked the area with the portable gear. Found several points of radiation, channel 10 was in worst case 5 dB out of spec. **Fault:** corroded F81.

Test Location Four

This was an FCC-proof-test-location. We were a whole block away when the 'Cuckoo' systems started howling. Measured channel ten 7 dB out of spec and 73.5 MHz 6 dB out of spec.

Test Location Five

This was the other FCC-proof-test-location. No sounds were heard from either receiver, with no other indications from the TV receiver or analyzer. We were able to measure the channel 10 signal right at spec; but when we turned off channel 10 on the system we found the meter reading stayed the same. **Result?** Background signal/noise/crud level is −30 dBmV at this location!

Observations

Anderson, Indiana (and I hardly think this is unique) has plenty of problems with man-made signal/noise sources which exceed the FCC's 20 microvolts per meter limit. If you happen to turn on a 27 MHz CB radion in Anderson you got several 'pounds' of hissing and crackling and just plain junk from power lines and things connected to power lines. Very careful checking, including turning off signals at the headend and verifying the off-air signals that **might** leak into town direct on channel indicated that in fact Anderson, Indiana does in many cases exceed the FCC spec (how do you go about getting the FCC to 'cite' a whole town!!!). This made the dipole and SLM tests and the TV receiver tests and the spectrum analyzer tests very difficult indeed. The broadband noise simply covered up the weaker radiation level signals.

It was some comfort to find that even with the noise problems the 'Cuckoo' system performed (that's a fact, not a plug).

What about the distance from the line? The distance and the position of the dipole, relative to the cable being patrolled, can make a substantial difference. A 2 foot change can make a 5 dB difference in the real level present. If you stay ten feet from the cable or plant but move underneath or to the side you can often find a 2 dB difference in measured level.

What about the precise length of the dipole? At channel 10 a two inch (overall) change (i.e. too long or too short) will cause about a 2 dB distortion of the real world signal level. An observed effect that is not totally explainable was that an incorrect dipole length desensitizes the distance error. With the dipole set to the proper length a change from 10 feet distance to 8 feet produces a 5 dB signal (error) change. By changing the dipole length 2 inches the error for incorrect length is present but changing the distance from ten feet to eight feet then made no difference (explain that one!).

What about narrowband FM deviation versus wideband FM deviation? One of the side reasons for this Anderson test was to determine whether there was a need (and therefore a market) for a special crystal controlled narrow band receiver for the 'Cuckoo' system. We found the narrow band receiver to be somewhat more sensitive (that is what the books say we should find as well) when there was high ambient (background) noise. When there was not high noise present the two systems seemed to have about the same sensitivity. The crystal controlled model did happen to have an 'Alert' position which squelched the receiver unless there was a 1050 Hz audio tone received. This turned out to be a plus we had not previously considered; after three hours or so of listening to hiss-hiss-hiss we were about to go buggy until somebody suggested we try the 'Alert' position.

And what about frequency sensitive leak sources? The microvolt per meter levels of leakage seemed to follow no particular format; perhaps a larger number of sampled radiation locations would develop a curve. At some locations the 73.5 MHz and 193.25 MHz (channel 10) carriers were 'flat' while leaking; at others the dB difference was substantial.

And the TV receiver, the analyzer and the SLM? The most difficult technique to follow of all tried was without question the analyzer. We even found it difficult to use the analyzer to locate signals which other test methods have already told us was present. There are simply too many signals in the air to allow you to use an analyzer effectively for this chore. The TV receiver falls in about the same categorey except that you have to be sitting on top of a **"plus"** type signal to see much with it. Normal ground wave off-air signals fading in and out don't help out much either. The signal level meter with the dipole and pre-amplifier is a pretty fair technique but primarily it becomes the **measurement system,** not the leakage-spotting-system. Between background noise and random off-air signals and harmonics I'd hate to have to patrol a whole town 'honestly' with an SLM/ dipole/pre-amplifier, and stop each time the needle moved upwards to verify what it is I was picking up and whether it was leakage or something else.

The Conclusion

Based upon this limited experiment in Anderson, Indiana it appears that **(1)** more people need to make qualitative type tests and report them to CATJ, **(2)** there is still plenty to be learned about the real-world of radiation patrolling and measurements.

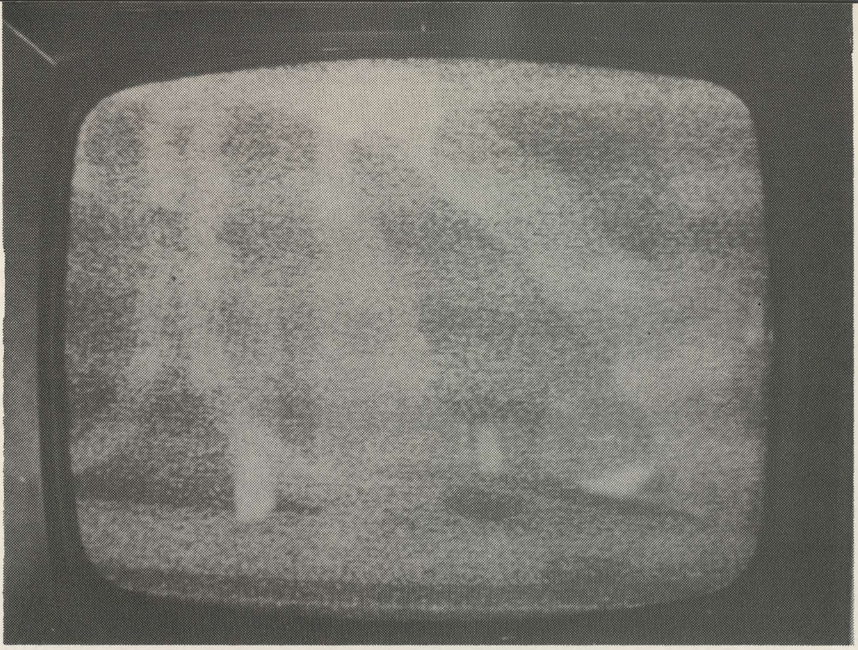
(1) **It appears** that the higher the leakage level the more unreliable the actual dBmV or microvolt per meter readings become. The presence of metallic objects along side of and a part of the utility plant system greatly confuse the real-world real-levels found;

(2) **Using a spectrum analyzer** for radiation patrols is a waste of an expensive piece of test equipment and the time of the often expensive person using it;

(3) **If you use** a dipole to search for levels (with an SLM, or whatever), don't waste valuable time stopping when a leak is found and trying to determine **the level** of the leak. If you have found it with this approach, better get busy fixing it because it is undoubtedly above the spec level anyhow.

(4) Because of interference-patterns set up by down guys, down ground lines, drops and what have you, the best you can expect is probably +/−3 dB accuracy with real-world measurements.

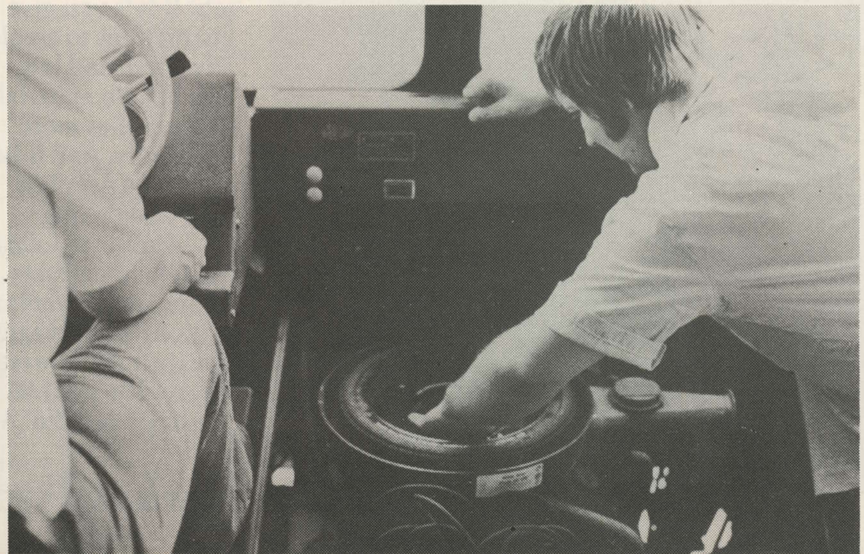
(5) **Which says simply that if you find radiation, fix it.** Don't worry about getting it within a fraction of a dB of being legal. It is far easier to fix the problem than to stand around moving dipoles and re-adjusting SLM's to

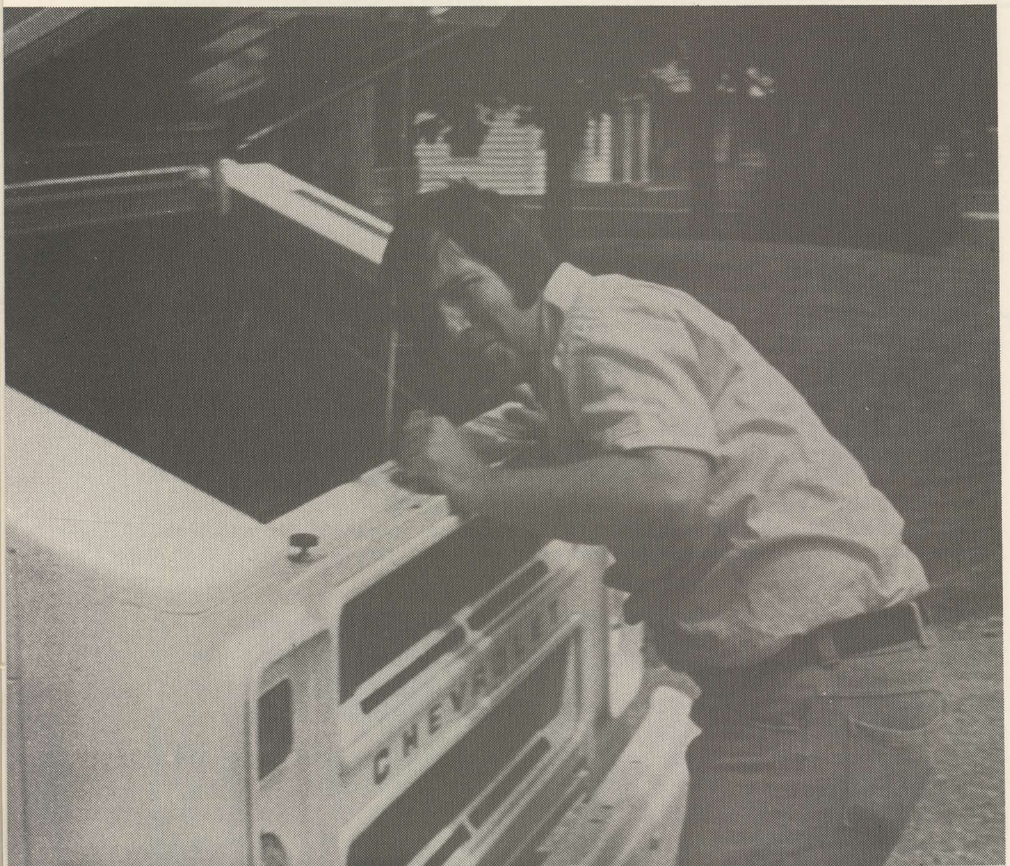


THE PORTABLE TV RECEIVER is still an 'over-played-hand' when it comes to catching radiation. In addition to off-air signal nuisance, 'threshold' of TV receiver is seldom low enough to spot any but overpowering leaks. This IS radiation.

WITH RADIATION TEST SET you can play 'detective' and actually spot unauthorized second outlets (when done poorly) by patroling the sidewalks and alleyways in an area. But watch out for dogs and angry people!

WITH A LITTLE MORE PLANNING this field exercise could have been a disaster. Plagued with erratic ground equipment we finally decided to see what the problem was.





YUP IT'S THE ENGINE ALL RIGHT—say, who let this character from Mid State into our town anyhow?

try to convince yourself you are REALLY **not** illegal and are **not** fudging on the test results.

(6) Riding along **and patrolling** for an audible tone is by far the quickest and easiest method of spotting radiation. Because the audible tone warbled signal is secure to the system you get no false indications; if you hear it, it is in truth yours and that means it is yours to fix.

Special thanks go to Don Coggins and Earl Tharp of General Electric Cablevision in Anderson, Indiana. Hopefully together we all learned something from the exercise. For one thing, I doubt I will again try to patrol in a lightning storm. For their part I doubt they will agree so readily to giving a 'peddler' the free run of their system in their truck again. And fellas, I'm sorry the truck broke down twice and it rained and rained and rained. Cable systems should really be built indoors

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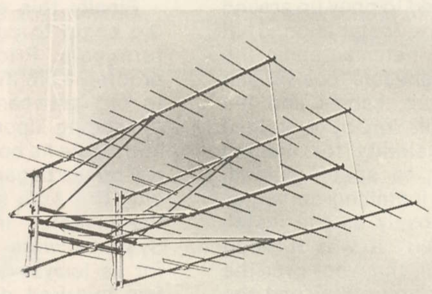

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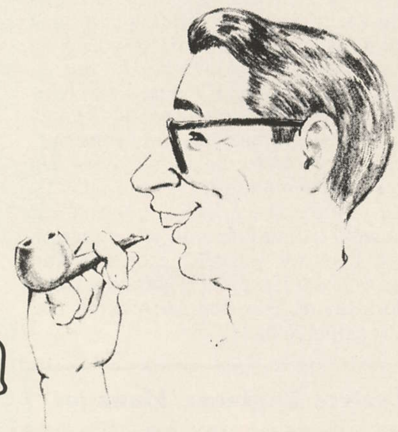

bob cooper editor in chief
CATJ

The Bottom Line

A curious thing is happening with pricing in the small earth terminal area and it deserves some comment.

Two years ago when the first ten meter TVRO installations went in a CATV system needed to pony up around $90-$100,000 for the installation. That bought you a ten meter antenna, the mount, an LNA, a tuneable receiver and associated hardware, cables and the professional installation by a trained crew. The responsibility for making the terminal play, to specifications, was borne by the installing company. If you watched closely as the installation was "proofed" it was difficult for the seller to pull the wool over the eyes of the buyer; you either had the proper carrier to noise and signal to noise ratios; or you did not.

One year ago the industry was moving hot on the trail of "small" TVRO's; the 4.5 meter revolution was underway and the FCC was getting serious about considering the CATA rule making proposal. At CCOS-76 we saw a pair of 4.5 meter terminals play and as an industry we were expectant that when the smaller terminals were OK'ed by the FCC the price tag for a TVRO would drop substantially. By the time we were at CCOS-76 and we were seeing pictures through the 4.5 meter terminals the price on installed, proofed, 10 meter terminals had dropped into the mid 60 K numbers. There were some slightly lower figures around for the ten meter jobs **if the buyer agreed** to be responsible for the proofing and installation. Most of us expected the initial 4.5 meter terminals to be around $25 to $30,000 each; but we were guessing.

When the FCC did approve the CATA petition last December and terminals as small as 4.5 meters were authorized the TVRO people reported a flurry of interest but few hard orders. Not everyone jumped in with a 4.5 meter antenna; in fact there ended up being more 5 or 6 meter antennas available than 4.5 meter antennas.

Finally this past spring the orders did begin to come in for the smaller terminals. Prices for installed and proofed 4.5/6 meter terminals seemed to run between $26,000 and $32,000 depending upon who the buyer was and where he bought. Then around May the prices began to erode a bit; for not only the 4.5/5 meter size TVRO's but the 6 meter 'intermediates' as well. Systems were buying the terminals for as low as $21,500 (give or take a few hundred dollars); **if the system assumed** the responsibility for installation and proofing. Prices stayed in that ball park (although many systems **were still** ordering at the $26,000 to $32,000 figures as well) into summer. Orders were substantial, but not brisk. **Interest** was very high and it appeared the dam was about to burst (i.e. orders were about to start flowing in big quanities) very soon.

Through this we found a very substantial number of operators waiting however; waiting for the price to drop still further. **"I'll buy a TVRO as soon as the price gets down to $15,000"** was an oft heard comment. At least several people on the selling end were trying diligently to put together $15,000 terminals. One knowledgeable individual spent a good part of the summer negotiating with a 4.5 meter antenna supplier, an LNA supplier and a receiver supplier. He found that the mount normally supplied with that particular 4.5 meter antenna was too expensive and perhaps overly complicated. By purchasing the dish plus feed **(less mount)** from the antenna supplier, and having the mount constructed by a job shop to his specifications he hoped to shave a $1,000 or so off of the total package cost. From the LNA supplier he sought a volume price for bulk orders. He asked the same from a receiver supplier. He did his homework and was ready to freelance a package for around $16,000; semi-installed. (The buyer would make ready the concrete pad and assemble the antenna on the site; the seller would drop in for a day at the right time and assist in getting the package flying right and the proof run.)

Close but not quite $15,000.

While all of this was happening some companies selling in the field were taking a fresh look at where the TVRO pricing was headed. At least one (very) major supplier in the earth terminal receiver field quietly dropped out of the CATV business this summer after deducing that the profit was gone.

Then came CCOS-77 and the on-floor appearance of a quiet man from El Paso, Texas. His name was Pete Warren and his credentials were substantial. He was a 'faith-broadcaster' with close ties to CBN. His El Paso operation had constructed and overseen the installation of more than 100 Caribbean area TVRO installations which are today providing 90 minutes a day of 'beamed' Christian programming to remote Caribbean islands via the 860 MHz service of the ATS-6 satellite. Warren knew what TVRO's were all about. His quiet approach at CCOS-77 made a substantial dent in a hurry.

"Through our El Paso operation we build our own 860 MHz receivers for the ATS-6 project. That makes us an 'Original Equipment Manufacturer' (OEM). **And between suppliers there is a trade discount known as an 'OEM Discount';** sometimes amounting to 15% or so off of other discounts. **We would like to pass those discounts along to cable** operators **if** they will cooperate with our CBN project via SATCOM II."

Warren had talked with virtually all of the TVRO equipment line suppliers who would talk with him. In the antenna field he had talked with Prodelin, and USTC. In the LNA field he had talked with Scientific Communications. In the receiver field he had talked with Microdyne and Microwave Associates. We don't know that he did or **did not** talk with others in the industry; but those are the ones who agreed to grant his El Paso operation a volume/OEM discount **if** he ordered large quanities of equipment.

"By not marking up the prices we have obtained from the manufacturers, by passing these prices on to the cable system operator, we can bring the price of a TVRO set of hardware down to under $12,000."

That seemed close enough to the $15,000 "I'll buy. . ." mark to get the attention of most of the operators who had been waiting.

Tremors went through the TVRO supplier industry. **"The market is ruined. . .it may never recover"** one told us. **"Boy is this a buyer-beware**

deal!" warned another. We'll see why shortly.

Warren's requirements are simple enough. **"In order to buy at these volume/ OEM prices the cable system operator needs to agree to carry either CBN or the PTL channel** (due on the air in October/November) **full time.** We can justify this project only if we increase the coverage of the Christian word" notes Warren. People of the good faith have a difficult time faulting Warren's objectives; God is a powerful ally to have in your corner.

"We will even help the cable operator find local financial support for some of the cost of the terminal" Warren goes on. A West Virgina operator took Pete at his word and in short order found he had the pledged support of a local church group for at least $5,000 of the installation cost. **"That means I can invest around $12,000 of my own money and end up with a TVRO installation that has two receivers; one for CBN or PTL and another for WTCG/17"** notes the smiling operator. Another operator found his local ministerial alliance so excited about the concept that they pledged $20,000 for the project; enough to buy the dish, the LNA **and** three receivers. They want CBN **and** PTL and the operator could use the third receiver for WTCG/17. **"Then I got to thinking about whether I wanted someone. . .anyone. . .owning a part of my hardware, and finally I decided I'd figure a way to finance it on my own"** reports this operator. He may have been wise in the long run; one operator told us that after his local church association agreed to pay for $5,000 of the cost they then wanted the right to censor those religious programs which they might not agree with. **"They are a conservative group and they fear some of the religious programs might** offend **their church members"** notes the operator. There's a new can of worms invented everyday.

Through all of this the word spread like wildfire that if a man took **full** responsibility for surveying, licensing, installing and proofing his terminal he could buy all three of the major pieces of hardware for under $12,000. The people offering terminals for $21,500-up lost a bunch of sleep. Some of them still are.

The under $12,000 number bears some study. When first offered it amounted to a 4.5 meter name brand antenna with a mount that could not be adjusted through the azimuth (i.e. left and right along the equatoral belt). The FCC has a little requirement built into their licensing procedure wherein they require that any TVRO installation have the ability to change (at will) from one satellite to another; and to receive adequate signals from all in orbit. That means you don't install the antenna so that it has a blocked view from any portion of the orbit belt and it also means that you have a mechanical way to go out and re-direct the azimuth pointing direction if you are required or commanded to do so. A non-azimuth mount doesn't qualify. . .**unless you go to the FCC** and ask for a **waiver.** Such waivers have been granted, and undoubtedly will be again. But they take extra time and some extra money in the licensing procedure. This first-offered 4.5 meter antenna was fixed in azimuth, for around $6,800 (give or take a couple of hundred bucks) in the Warren package.

Then along came a 6 meter antenna supplier with an "aluminum-skin" dish that was (and is) innovative in design and construction. It is also less expensive than any previous six meter dish, and for about the same $6,800 price tag the supplier offers this one to the "Warren program" **complete with** an azimuth adjustable mount. Now the operator interested in the Warren package had two antennas to choose from.

In the LNA department the novice buyer is faced with four choices; a series of LNA's which run the gamut from around $1,300 to around $2,400. You select the noise figure/noise temperature you want (lower noise figure is still more money) and the bandwidth you want (broadband, covering all 24 transponder channels is also more money).

Finally in the receiver department we have a pair of offerings in the Warren package; both new, largely still untried but each comes from a well known, established supplier of quality microwave apparatus. Each is single channel. To change the channel you change out a crystal inside of the radio, and make a few field-do-able adjustments. The price on each is in the $3800 to $3950 range via the Warren package. If you add up the low-ball numbers all across the board you have $6800 plus $1300 plus $3800 **or $11,900.**

To this you must add:

a) A site survey via Compucon/Safe or someone else who is in the business to tell you and the FCC what you need to know **before** you file for a CP to construct a TVRO. **That will cost you right at $1200.**

b) Some 7/8th's inch downline, and figure at least $2.00 a foot for the stuff (to run from your LNA to your receiver);

c) A two or four way power divider (splitter) to allow the single antenna to drive multiple receivers. **Figure $165/$225 for this item.**

d) The concrete pad plus any excavation, land preparation work you may require (figure 6-10 yards of concrete plus some steel rebar work).

e) A way to get power from the head-end building out to the LNA (they run on either 110 VAC or a DC voltage).

f) The license application to the FCC. **Figure $350 to $1,000 for this.**

g) Around 7 man-days of time to do all of the work from a bare piece of ground to an operating terminal.

Now let's suppose you do all of this, turn the TVRO on and it doesn't play. Either at all or not good enough. **Now what?**

There are three possibilities:

1) **Somewhere in the planning** a major problem was overlooked; such as

inadequate signal from the bird, an interference source from a terrestrial transmitter on the channel you wish to receive, and so on.

2) **You installed the terminal improperly,** and you now find that you are pointing into the wrong part of the sky.

3) A piece of **equipment is defective.**

Under a turn-key installation the seller would have been responsible for the final operation of the system and while you might have been delayed in your turn on date, ultimately the project would deliver adequate pictures (or you and the supplier would end up in court). But if **you** take the 'full responsibility' on your own, then what?

"We will have an engineer available for a nominal fee, perhaps $250 per day, if a system needs help" suggests Warren. That sounds good, but I believe you can count on substantial delays in getting operational **if** you have problems; and are waiting for a free-lance engineer to turn up in your town. It may not turn out that way, but at least you won't be disappointed if it does. . . if you plan on a delay going in.

There is another possibility of course. You could become proficient on your own with the installation. It is not, honestly, a difficult installation. It turns out that it is easier to "tune up" a TVRO than perhaps a 12 GHz microwave path. **But it also turns out that the system is not very forgiving of mistakes.** Remember that most TVRO signals off of 4.5 antennas are only a few dB "out of the noise"; in the carrier-to-noise (C/N) department. A small pointing error, a sloppy coax fitting, an incorrectly adjusted feed antenna can take you down into the noise ("sparklies") in a big hurry. A 6 meter antenna is a couple of dB better in the best case. We've attempted through **CATJ** to pass along tips for installation and we are stepping up this coverage this fall. But when all is said and done getting proficient in the TVRO installation business will require some study and mental effort on the part of any operator who decides to go it on his own.

Which brings us to the bottom line in the TVRO pricing world. What happens when the bottom drops out of the pricing schedule and necessary profits for the suppliers disappear or shrink below tolerable limits?

One possibility is that some suppliers may decide to give up the CATV business. There are coming on line any number of new satellite system user types and in a couple of years the CATV users will be but a minor, insignificant part of the TVRO business field. We may be 'king' today, but our days of "glory" are limited.

Any product offered has four basic cost ingredients built into the selling price. They include (1) **the cost of the materials** in the product, (2) **the direct costs** of the labor to assemble, test and complete the product for shipment, (3) **the indirect costs** of design, manufacture, sales and production (often called G and A) and finally (4) **profit.** It **may** be true that there is less than $1000 in direct parts and direct labor costs in even the most sophisticated TVRO tuneable receiver on the market today. But it cannot be sold for that dollar if the company selling it is going to stay in business. A new field such as TVRO's always requires a substantial learning-curve period during which reasonably well paid sales people and field engineering people must be ready, willing and financially able to drop everything and hop on an airplane at the drop of a C/N ratio to help out a customer/user who is experiencing problems. A $300 airplane ticket plus two days of a trained engineer's time has to be paid for by someone. It is built **into the price of the receiver** as part of the G and A. Those data sheets you call and ask for and the secretary that you talked with about sending out a receiver or LNA manual "gratis" cost money too. These costs are built into the cost of the receiver. The engineer who labored for six months to design the receiver and the three breadboard/proto-type receivers he built **before** he had a production-ready 'model' to copy also cost some bucks. These costs too are built into the receiver you purchase. The manufacturer's warranty program, which you hope you never need, is not a gift. It's cost has been carefully estimated and a pro-rata share of the warranty program also appears in the price you pay for the receiver.

The truth is that the $4,000 receiver is not all that profitable. Which is our fourth categorey of basic "costing ingredients". **The profit** after all costs have been subtracted away may go into (1) company development of new products, (2) dividends for the stock holders who bank rolled the operation in its early days, or (3) a new Mercedes Benz for the boss every year. When they dry up, the company faces dark days ahead with no new products, a stock holder's revolt and an irate boss who has to ride around for two years running in the same Benz.

We can squeeze as an industry just so far. We spent 1974,5 and 6 squeezing the suppliers of CATV trunk and distribution line equipment to the point of no profits. **We perhaps did not do it on purpose,** but we are now paying the price. When was the last time this industry saw an innovative new design in a trunk or extender amplifier? When profits dried up new R and D stopped.

A similar fate may await us if we push too hard for 'the best possible deal' on TVRO systems. We might end up being in the same boat as the mouse that chased and chased an elephant until he had it cornered. **"After you catch the elephant, what do you do with it?"** If you can't afford to keep it alive by feeding it, it will eventually die trapped in your corner. **Then how do you dispose of an elephant carcass?**

Is the $12,000 price the bottom line? Probably not. If we all get together and squeeze real hard we might get it down to around $11,000 by next spring. But in doing so we are likely to drive the best qualified companies in the business out of the CATV TVRO field. And create a huge nationwide resting place for decaying elephant flesh in the process. It is something we all need to keep in mind; is that extra thousand or two really that important to our ability to make a TVRO pay for itself? If it is, we are too close to our own margins for comfort and the risk we run of finding ourselves with $12,000 or so in hardware but no place to get it serviced and no way to get replacement parts is very real indeed.

Think about it.

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Think about it.

TECHNICAL TOPICS

The Full Bird Syndrone

"Aw. . .they've got channels they haven't even thought of using, that's a bunch of hot air" is one line of comments one hears about the **capacity** of SATCOM II; or, "The bird is (almost) full and there **are** going to have to be some tough decisions made about where the future service channels go pretty quick".

The truth probably lies someplace in between the two fields of thought. The SATCOM II bird of RCA, now almost 18 months old and largely supported by the cable television industry, **is in fact** pushing the limits of 'channels available'. There **may be** some serious changes coming.

The cable industry has been good for RCA Americom; the operators of the SATCOM series of satellites. It is the bread and butter of the RCA transponder business, and RCA is not about to put themselves in dutch with the mushrooming cable television industry useage of its "repeater in the sky" system.

SATCOM II carries our signals. There are 24 transponders on SATCOM II; let's see how they are used and how that relates to CATV.

There are odd numbered channels (1, 3, 5 and so on) which are vertically polarized. There is nothing sacred with these channels, but RCA has chosen to keep video **off** of these channels (using them for audio, data and other non-video transponder customers) primarily because they fear that their **might be** some problems with "cross talk" or interference between adjacent channels (such as even numbered 6 and odd numbered 7) **if** there was video on **both** at the **same** time. So for CATV purposes, for now, we can forget about the "odds".

Which leaves the "evens", or channels 2, 4, 6 and so on. They are horizontally polarized and that is what we are now using; horizontal polarized even numbered channels.

Now channels 1 through 5 (or 1, 3 and 5 in the vertical mode and 2 and 4 in the horizontal mode) are sort of "reserved" or "set aside" by RCA for data, message traffic and other **non-video** and **non-cable** TV users. So that means we can forget, for now, about channels 2 and 4. Which leaves us with horizontally polarized channels 6 through 24; or 10 channels in all. That seems like that ought to be enough for cable TV. But is it?

For example:

Transponder Channel	Used By
6	SSS/relaying **WTCG** Atlanta
8	CBN/relaying **WYAH** Norfolk
10	used by non-full time, or occassional users video relay
12	still open **(1)**
14	still open **(2)**
16	**PTL**/scheduled for October/November start
18	used by non-full time, or occasional users of video relay
20	**HBO**
22	**HBO** (reserved)
24	**HBO**

Now, with United Video, Inc. having announced that they will offer Chicago independent WGN (channel 9) "in the spring of 1978" and Southern Satellite Service having announced they will offer San Francisco independent KTVU (channel 2) "before August 1, 1978", we have **two** virtually-for-sure **additional** transponder **users**. Just for drill, assign WGN to transponder 12 and KTVU to transponder 14. That takes care of **(1)** and **(2)** above. And that leaves RCA with channels 10 and 18; channels which RCA really does **not** want to give up, because **if** they are filled up with 24 hour per day (or close to it) CATV signals them RCA looses the ability to sell the higher tariff 'occasional-use-time' by which they stand to make bunches of money (more than users pay for so-called full time or bulk-use transponders).

Add to this pot the "promises" of **Network One** and others who are saying they will "be on early in 1978" with CATV type programming, and you begin to see the nature of the problem.

What are the options available? Some transponder users could move **off** of SATCOM II to another bird. Spanish International Network, through Hughes/Paramount did that recently. The SIN programming is now on Westar (RCA is protesting this move); where SIN reportedly "got a better financial deal than they had from RCA. . ." That's fine except that to have WESTAR **and** SATCOM II in your headend, you will need **two separate** TVRO antennas; one full time dedicated to each bird. Only Owensboro, Kentucky has that kind of capacity now and with the costs of terminals being what they are, it is unlikely that too many other systems will jump into two TVRO installations per system very fast. Most of us are still trying to get over the hurdle of the first TVRO!

So splitting up the CATV signals amongst two (or more) satellites does not seem like the practical thing to do. We'll all **hope** that that doesn't happen. Other options include:

(1) **RCA re-evaluating** the "sacred nature" of channels **10** and **18** (i.e. changing their 'occasional useage' designation to full time CATV use) and, or. . .

(2) **re-evaluating** the sacred nature of channels 2 and 4 (maybe moving the occasional video users here and thereby opening up 10 and 18 for CATV full time use), and, or. . .

(3) **Having all** of the CATV users move to vertically polarized transponders on SATCOM II (giving us really no measureable new channels **unless** 1, 3 and 5 were added to the 'CATV pot'), and, or. . .

(4) Having **all** of the CATV users pick up and move (boy what a moving that that would be!) to SATCOM I (the other RCA bird). . . which would require whomever it is on SATCOM I now to move to II).

Not to panic however. There are other options. Such as RCA simply saying 'sorry Charlies, but there is no more room available'. Or maybe (just maybe) you don't need **all** of these great (new) signals anyhow. . .and you would be perfectly happy to have just a half dozen or fewer signals anyhow.

Who would have forecast just two years ago this month, when the first faltering TVRO signals ended up on 10 meter antennas in Florida and Mississippi that the day would come less than two years later when we would be worrying about such nonsense. **Pogo would be right at home in the cable industry!**

PBS Via Satellite?

"Congratulations to all who made the convention at Fountainhead another tremendous CATA success. The cable owners owe you all a debt of gratitude. Now to something else. As a result of all of the effort by CATA, the small earth satellite receiving station has become a reality, making the reception an economic possibility for small systems. Now it would appear that since Public Broadcasting Service is planning to put its signal on a satellite, these fine programs would be available to many of the small communities that would never have had the service. But, no, PBS puts its signal on Western Union Satellite so it is not available with CBN and HBO and Channel 17, necessitating another dish to receive the signal. But that's not insurmountable—we could break our necks and over a period of time put in a second receiving dish.

Now the crowning blow—apparently the PBS does not have any plans to make the signal available to cable systems.

We are in a very remote area of Texas and an area that the F.C.C. has constantly indicated it hoped to see adequately served. Wouldn't it appear to any reasonable thinking person that a wedding of PBC and Cable is the only way for PBS to get the kind of coverage that was originally intended?

Neil Hickey in his article in the current TV Guide titled "It All Comes Down to Money" talks to this problem.

"One example of where such study is clearly needed is CPB's satellite plan. By January 1979, at a cost of $40 million, CPB expects to have in operation a full satellite distribution system for PBS programs (replacing the current terrestrial one), giving each station the capability of receiving three or more program signals simultaneously instead of only one. It'll make PBS 'one of the most efficient and sophisticated' agencies in all of broadcasting, says the Corporation, since it will be better able to serve the regional and special-interest audiences, and enhance the program options of every station.

It may also simply add to the chaos, making a coherent national program schedule even more difficult to achieve than it is now. Stations will be receiving up to four programs simultaneously (depending on equipment), but they'll be able to broadcast only one at a time—until cable (or optical fiber) TV provides public broadcasting with multiple outlets into American TV homes. When that happens, a well-funded and enlightened PTV system could truly offer rich and varied TV fare: a children's channel, an instructional channel, a drama and music channel, a sports channel and so forth. That co-joining of satellite and cable technology is one of the most promising and tantalizing prospects for PTV's future."

This tells better than I can what CPB-PBS with cable can do for rural areas and, for that matter, many areas of the country.

If others in the industry feel that these thoughts have merit, perhaps we can get something going. I'll help in any way.

Bill Sohl
Alpine TV Cable Co.
Alpine, Texas

Bill—

Because many states, such as Texas, lack a comprehensive state-wide coverage ETV service plan (and the funding that goes along with the plan), **there are large gapping holes in the PBS coverage nationwide. True, few people may live in these** 'holes' **but those that do pay at least their pro-rate share of taxes to keep the PBS system operating. What you suggest is that PBS needs to be more responsive to a 'helping hand'; a hand which a cable operator such as yourself would be willing to lend to PBS if only they would show some interest. How about it PBS? Is there not some way that you can revise your present program to include direct satellite feeds to rural America, where direct off-air PBS service is now lacking? Here is a man in the outback of Texas that says his area needs your service. And we are betting that others are in a similar boat.** How about it industry? **Are you too suffering from poor or inadequate PBS coverage?**

CCOS COMMENTS

"I would like to offer the following comments on CCOS-77 with accompanying suggestions. First, let me say that the program was well organized and I found it both interesting and informative. The only negative point I would make would be from my viewpoint as a CATA Associate Member; the time alloted for exhibitors to display their products was minimal and I recommend that it be substantially increased for your next meeting.

"Secondly, the attendees were national in scope but the majority seemed to come from the mid-western region. Thus to make CCOS more meaningful to your CATA membership I think you should consider varying the regional location each year. This would benefit both the CATA membership by making it easier to attend a national convention and the CATA Associates by allowing them exposure to those smaller systems in various parts of the country that do not undertake the expense of attending conventions that are distant geographically.

We appreciated the opportunity to participate in CCOS-77 and thank the CATA staff for the help and courtesy extended to us during our stay."

Jack C. Hooper
Sales
Oak Industries, Inc.
Crystal Lake, Illinois
60014

Jack—

Expanded exposure time for CCOS-78 Associates is promised; although the best way to do this is yet to be decided. The location problem is considerable. CATA membership is nationwide, but the largest concentration of members is in a 'belt' stretching from Canada to Mexico, the Rockies east to the Appalachian area. One way to look at the site selection process is to create a "route-miles-traveled' **model, by which the distance from** each member **to various proposed sites for CCOS is analyzed, and averaged. If you do this (we are doing it for CCOS-79) you come to the conclusion that between the 'membership belt' and the bigness of America, the average member travels** the least distance **when you are located some-place** south **of the geometric center of that belt. In other words, this becomes the shortest average distance to travel for the average member. But because it is an average equation, that means that some members (such as in Maine or Oregon) end up traveling a considerable distance. Perhaps there is no** perfect answer. . .**only one or two that "are better than" the other choices possible.**

Mid State Seminars

John Weeks & Associates in co-operation with Larry Dolan of Mid State Communications is sponsoring a series of seminars for CATV personnel covering the following topics:

1) Radiation detection and measurements
2) System sweeping as a prevenative maintenance technique
3) FCC tests and measurements; and calibration techniques

Sessions are to start at 9 AM and will be completed by 4 PM on the following dates and in the following locations:

September 19th—Hi-Q Motor Inn, Orlando, Fl.
September 20th—Holiday Inn NE, Atlanta, Ga.
September 22nd—Sun 'N Sand Motor Hotel, Jackson, Ms.

There is no charge for the session; you may contact John Weeks at (404) 963-7870 for further information.

Texscan Road Shows

The fall seminar series for Texscan's Raleigh B. Stelle and his magic lantern program is as follows:

October 10-14/**Austin, Texas**
October 24-28/**Albany, New York**
November 14-18/**Orlando, Florida**

Full information on the Texscan sessions, covering test equipment applications for CATV, is available from Texscan at 2446 N. Shadeland Avenue, Indianapolis, Indiana 46219 (317/357-8781).

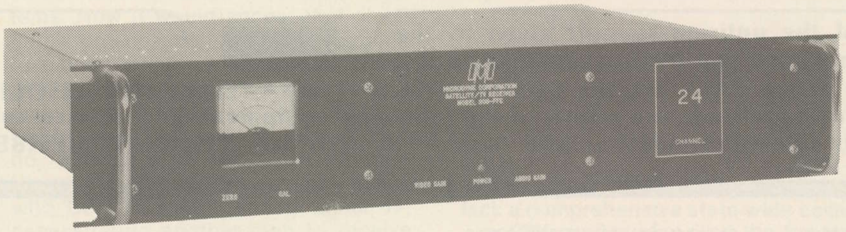
CATA ASSOCIATES

In recognition of the untiring support given to the nation's CATV operators, and their never-ending quest for advancement of the CATV art, the COMMUNITY ANTENNA TELEVISION ASSOCIATION recognizes with gratitude the efforts of the following equipment and service suppliers to the cable television industry, who have been accorded ASSOCIATE MEMBER STATUS in CATA, INC.

AEL, INC., CATV COMMUNICATIONS DIV., P.O. Box 552, Lansdale, PA 19446, **(M1, S2)** 215-822-2929
Andrew Corp., 10500 W. 153rd St., Orland Park, IL. 60462 **(M2, M3, M9** Satellite Terminals) 312–349-3300
Anixter-Pruzan, Inc., 1963 First Ave. S., Seattle, WA. 98134 **(D1)** 206–624-0505
Avantek, Inc., 3175 Bowers Avenue, Santa Clara, CA. 95051 **(M8)** 408–249-0700
Belden Corp., Electronic Division, Box 1327, Richmond, IN. 47374 **(M3)** 317–966-6661
BESTON ELECTRONICS, INC. 903 South Kansas Ave., Olathe, KS. 66061 **(M9)** Character Generators-913-764-1900
BLONDER-TONGUE LABORATORIES, One Jake Brown Rd., Old Bridge, N.J. 08857 **(M1, M2, M4, M5, M6, M7)** 201–679-4000
BROADBAND ENGINEERING, INC., 535 E. Indiantown Rd., Jupiter, FL. 33458 **(D9, replacement parts)** 305-747-5000
CALIFORNIA MICROWAVE, INC., 455 West Maude Ave., Sunnyvale, CA. 94086 **(M9 Satellite Terminals)** 408–732-4000
CATEL, 1400-D Stierlin Rd., Mt. View, CA 95043, **(M4, M9)** 415-969-9400
CCS HATFIELD/CATV DIV. 5707 W. Buckeye Rd., Phoenix, AZ. 85063 **(M3)** 201–272-3850
C-COR ELECTRONICS, Inc., 60 Decibel Rd., State College, PA. 16801 **(M1, M4, M5, S1, S2, S8)** 814–238-2461
COLLINS COMMERCIAL TELECOMMUNICATIONS, MP-402-101, Dallas, TX 75207, **(M9, Microwave)** 214-690-5954
COMMUNICATIONS EQUITY ASSOCIATES, 651 Lincoln Center, 5401 W. Kennedy Blvd., Tampa, FL 33609 **(S3)** 813-877-8844
COMM/SCOPE COMPANY, Rt. 1 Box 199A, Catawba, NC 28609, **(M3)** 704-241-3142
ComSonics, Inc., P.O. Box 1106, Harrisonburg, VA. 22801 **(M8, M9, S8, S9)** 703–434-5965
C R C ELECTRONICS, INC., P.O. Box 855, Waianae, HI 96792, **(M9** Videotape Automation Equipment) 808-668-1227
DAVCO, INC., P.O. Box 861, Batesville, AR. 72501 **(D1, S1, S2, S8)** 501–793-3816
EAGLE COM-TRONICS, INC., 8016 Chatham Dr., Manlius, N.Y. 13104 **(M9 Pay TV Delivery systems & products)** 315–682-2650
EALES COMM, & ANTENNA SERV., 2904 N.W. 23rd, Oklahoma City, OK 73107, **(D1,2,3,4,5,6,7, S1,2, S7,8)** 405-946-3788
FARINON ELECTRIC, 1691 Bayport, San Carlos, CA. 94070 **(M9, S9)** 415–592-4120
FEDERAL BROADCASTING CO. 600 Fire Rd. Box 679 Pleasantville, N.J. 08232 **(D9, S9)**
FERGUSON COMMUNICATIONS CORP., P.O. Drawer 871, Henderson, TX. 75652 **(S1, S2, S7, S8, S9)** 214–854-2405
FRANK L. CROSS & ASSOCIATES, INC., 5134 Melbourne Dr., Cypress, CA 90630, **(M9)** 714-827-0868
GILBERT ENGINEERING CO., P.O. Box 14149, Phoenix, AZ. 85063 **(M7)** 602–272-6871
G T E SYLVANIA, 3046 Covington Rd., Marietta, GA 30062, **(M1,D1)** 404-003-1510
HUGHES MICROWAVE COMMUNICATIONS PRODUCTS, 3060 W. Lomita Blvd., Torrance, CA. 90505, **(M9)** 213-534-2146
HOME BOX OFFICE, INC., 7839 Churchill Way–Suite 133, Box 63, Dallas, TX 75251 **(S4)** 214–387-8557
ITT SPACE COMMUNICATIONS, INC., 69 Spring St., Ramsey, N.J. 07446 **(M9)** 201–825-1600
JERROLD Electronics Corp., P.O. BOX 487, Byberry Rd. & PA. Turnpike, Hatboro, PA 19040, **(M1, M2, M4, M5, M6, M7, D3, D8, S1, S2, S3, S8)** 215-674-4800
JERRY CONN ASSOCIATES, INC., P. O. Box 444, Chambersburg, PA 17201 **(D3, D4, D5, D6, D7, D8)** 717-263-8258
LARSON ELECTRONICS, 311 S. Locust St., Denton, TX. 76201 **(M9 Standby Power)** 817–387-0002
LRC Electronics, Inc., 901 South Ave., Horseheads, N.Y. 14845 **(M7)** 607–739-3844
Magnavox CATV Division, 133 West Seneca St., Manlius, N.Y. 13104 **(M1)** 315–682-9105
MICROWAVE ASSOCIATES, INC. 10920 Ambassador Drive-Suite 119 Kansas City, MO. 64153 **(M9)** Microwave Radio Systems-816-891-8895
Microwave Filter Co., 6743 Kinne St., Box 103, E. Syracuse, N.Y. 13057 **(M5, bandpass filters)** 315–437-4529
MID STATE Communication, Inc. P.O. Box 203, Beech Grove, IN. 46107 **(M8)** 317-787-9426
MSI TELEVISION, 4788 South State St., Salt Lake City, UT 84107 **(M9 Digital Video Equip.)** 801–262-8475
NORTHERN CATV DISTRIBUTORS, INC., 8016 Chatham Dr., Manlius, N.Y. 13104 **(D1)** 315–682-2670
OAK INDUSTRIES INC./CATV DIV., Crystal Lake, IL. 60014 **(M1, M9 Converters, S3)** 815–459-5000
PRODELIN, INC., 1350 Duane Avenue, Santa Clara, CA. 95050 **(M2, M3, M7, S2)** 408–244-4720
Q-BIT Corporation, P.O. Box 2208, Melbourne, FL. 32901 **(M4)** 305–727-1838
RADIO MECHANICAL STRUCTURES, INC., P.O. Box 1277, Kilgore, TX 75662 **(M2, M9, S2)** 214-984-0555
R F SYSTEMS, INC., P.O. Box 428, St. Cloud, FL 32769, **(M2, M6)**, 305-892-6111
RICHEY DEVELOPMENT CORP., 1436 S.W. 44th, Oklahoma City, OK. 73119 **(M1, M4, M8, S8)** 405–681-5343
RMS CATV Division, 50 Antin Place, Bronx, N.Y. 10462 **(M5, M7)** 212–892-1000
Sadelco, Inc., 299 Park Avenue, Weehawken, N.J. 07087 **(M8)** 201–866-0912
Scientific Atlanta Inc., 3845 Pleasantdale Rd., Atlanta, GA. 30340 **(M1, M2, M4, M8, S1, S2, S3, S8)** 404–449-2000
SCIENTIFIC COMMUNICATIONS, INC., 3425 Kingsley Rd., Garland, TX 75041, **(M4 Low Noise & Parametric)** 214-271-3685
SITCO Antennas, P.O. Box 20456, Portland, OR. 97220 **(D2, D3, D4, D5, D6, D7, D9, M2, M4, M5, M6, M9)** 503–253-2000
Systems Wire and Cable, Inc., P.O. Box 21007, Phoenix, AZ. 85036 **(M3)** 602–268-8744
TERRACOM, 9020 Balboa Ave., San Diego, CA 92123, **(M9 Microwave Earth Stations)** 714-278-4100
TEXSCAN Corp., 2446 N. Shadeland Ave., Indianapolis, IN. 46219 **(M8, bandpass filters)** 317– 357-8781
Theta-Com, P.O. Box 9728, Phoenix, AZ. 85068 **(M1, M4, M5, M7, M8, S1, S2, S3, S8, AML MICROWAVE)** 602–944-4411
TIMES WIRE & CABLE CO., 358 Hall Avenue, Wallingford, CT. 06492 **(M3)** 203–265-2361
Titsch Publishing, Inc., P.O. Box 4305, Denver, CO. 80204 **(S6)** 303--573-1433
Tocom, Inc., P.O. Box 47066, Dallas, TX. 75247 **(M1, M4, M5, Converters)** 214–438-7691
TOMCO COMMUNICATIONS, INC., 1077 Independence Ave., Mtn. View, CA 94043 **(M4, M5, M9)** 415-969-3042
Toner Cable Equipment, Inc., 418 Caredean Drive, Horsham, PA. 19044 **(D2, D3, D4, D5, D6, D7)** 215–675-2053
Triple Crown Electronics Inc., 42 Racine Rd., Rexdale, Ontario, Canada M9W2Z3 **(M4,M8)** 416 743-1481
UNITED PRESS INTERNATIONAL, 220 East 42nd St., New York, N.Y. 10017, **(S9)** (Automated News Svc.) 212-682-0400
UNITED STATES TOWER & FAB. CO. P.O. Drawer "S", Afton, OK 74331 **(M2,M9)** 918-257-4257
Van Ladder, Inc., P.O. Box 709, Spencer, Iowa 51301 **(M9, automated ladder equipment)** 712–262-5810
VIDEO DATA SYSTEMS, 40 Oser Avenue, Hauppauge, N.Y. 11787 **(M9)** 516-231-4400
VITEK ELECTRONICS, INC., 200 Wood Ave., Middlesex, N.J. 201–469-9400
WAVETEK Indiana, 66 N. First Ave., Beech Grove, IN. 46107 **(M8)** 317–783-3221
WEATHERSCAN, Loop 132 - Throckmorton Hwy., Olney, TX. 76374 **(D9, Sony Equip. Dist., M9 Weather Channel Displays)** 817–564-5688
Western Communication Service, Box 347, San Angelo, TX. 76901 **(M2, Towers)** 915–655-6262/653-3363

NOTE: Associates listed in bold face are Charter Members

SHOWCASE



New Microdyne TVRO Receiver

Microdyne Corporation (P.O. Box 1527, Rockville, Maryland 20850) has formally announced a new single channel satellite TV receiver at $3,990 per unit; as originally reported in the August issue of CATJ.

Model 1100-FFC is a single frequency, stand alone receiver that rack mounts (3.5 inches tall), which is fully EIA and CCIR compatible. the receiver has the Microdyne 8.0 dB C/N threshold extension package. Full details are available from the Microdyne address given above.

Jerrold Moves

Corporate headquarters for the **Jerrold Electronics Corporation** has moved from Horsham, Pennsylvania to Hatboro, Pa. All management, marketing, sales support and engineering activities are now located at P.O. Box 487 (Byberry Road and Pennsylvania Turnpike), Hatboro (zip 19040). The telephone number remains 215-674-4800.

C-COR Building

C-Cor Electronics, Inc. of State College, Pennsylvania has announced they are supplying equipment for system expansion and rebuilding as follows:

Crowley, Louisiana where C-COR amplifiers and mainline passives are replacing old tube style SKL equipment;

Coshocton, Ohio where C-COR T-440 series trunks are being dropped into existing amplifier locations and expanding system capability from 12 to 30 channels.

Lafayette, Louisiana where C-COR amplifiers and mainline passives are being installed to rebuild segments of the older system as well as expand the system into Scott, Broussard and Breaux Bridge.

TVRO Progress Reported

Texas Community Antenna, Inc. President Robert M. Rogers has announced the purchase of five of the **Scientific-Atlanta** 5 meter terminals to be installed in TCA systems in Arkansas, Louisiana and Texas. The new terminals will bring channel 17 Atlanta to the TCA systems.

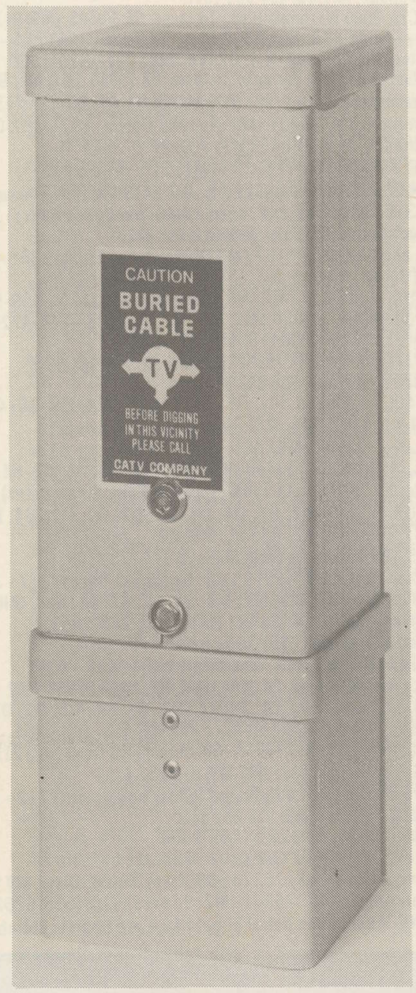
RF Systems, Inc. has announced they are constructing a new 60,000 square foot production facility for TVRO and other antenna systems on a new ten acre site near St. Cloud, Florida. RF will continue to operate its Orlando, Florida facility and the home office in Cohasset, Massachusetts.

Communications Systems, Inc. with headquarters in Irving, Texas was awarded a contract for a 4.5 meter TVRO terminal to **Hughes Aircraft Company's Microwave Communications Products Division** for the Dickinson, North Dakota system. The system will add channel 17 Atlanta.

Three five meter terminals have been purchased from **Scientific Atlanta** by Liberty Communications, Inc. for installation at undisclosed CATV systems. Liberty presently has one of the S/A ten meter terminals at their Birmingham, Alabama CATV system.

Tough Pedestals

Toner Cable Equipment (969 Horsham Road, Horsham, Pa. 19044) has announced a new pedestal manufactured by a new process that utilizes a fiberglass material which Toner characterizes as "virtually impossible to break". An



optional vending machine type lock is available. The fiberglass construction means the enclosure will not need painting, will not rust or corrode and should have virtually no maintenance problems.

Full information is available from Bob Toner at the company address.

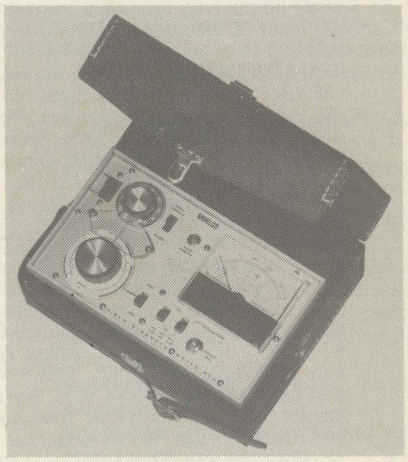
AML Brochure Available

A new brochure describing AML multi-channel microwave systems for CATV applications is now available from **Hughes Aircraft Company's Microwave Communication Products Division** (3060 West Lomita Blvd., Torrance, Ca. 90509).

The brochure describes AML systems, samples operational packaging, and includes data sheets on various receiver and transmitter models. The brochure is available free for the asking at the address given.

Economy CATV SLM

Sadelco has announced an 'economy price tag' on their dual-range CATV VHF (plus super band) signal level meter; the FS-733B. The unit covers 54-216 MHz and 216-300 MHz with two separate built-in tuners. The meter has a metal hang-up loop for attaching over the cable or strand, a built-in speaker and is touted as an installer's meter.



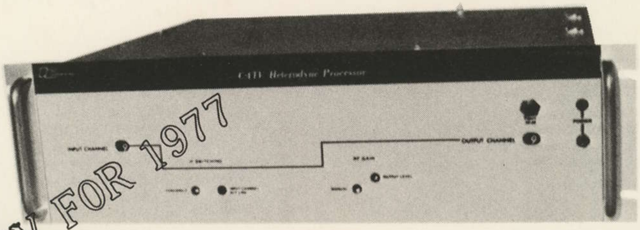
Full information on the unit is available from Sadelco at 299 Park Avenue, Weehawken, N.J. 08087.

Another MFC Filter (FM)

Microwave Filter Company (6743 Kinne Street, East Syracuse, New York 13057) has another new filter for those people who have difficulty keeping signals apart.

Model 3303-FM is available to pass either 92 to 108 MHz or 88 to 108 MHz, with channel six audio (87.75 MHz) notched down by 30 dB. Both models have FM passband losses of less than 1 dB. Price per unit is $195, and delivery is two weeks.

CATV HETERODYNE PROCESSOR FROM Q-BIT CORPORATION



Model QB-650 processor adds to Q-bit Corporation headend capabilities, and offers both flexibility and performance. Main frame concept with modular internal construction; 75 ohm connectors, and interface cabling between modules allows the system designer to configure a processor to his particular needs and provides for simple servicing.

FEATURE HIGHLIGHTS

- Design emphasis on reliability and serviceability without sacrificing performance.
- Separate sound and video AGC - noise immune true keyed AGC system with > 60 dB dynamic range.
- Up to +60 dBmV output with -20dBm in.
- Delay distortion <±25 nSec, video response flat from -.75 MHz to +4.2 MHz.
- IF output, substitute IF input and IF switching controls standard equipment.
- Automatic 24 Vdc standby power switching standard equipment.
- Many options and accessories:
  — high-level or looping output amplifiers
  — adjacent channel IF filter
  — phase lock output
  — standby-power battery charger

Write or call Hansel Mead for information on QB-650 and other CATV products.

Q-bit

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- ni-cad battery/AC
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  5-54MHz with optional adaptor

Sadelco
DIGIT LEVEL-100

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DL-100VS
DL-100VU

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