CATJ

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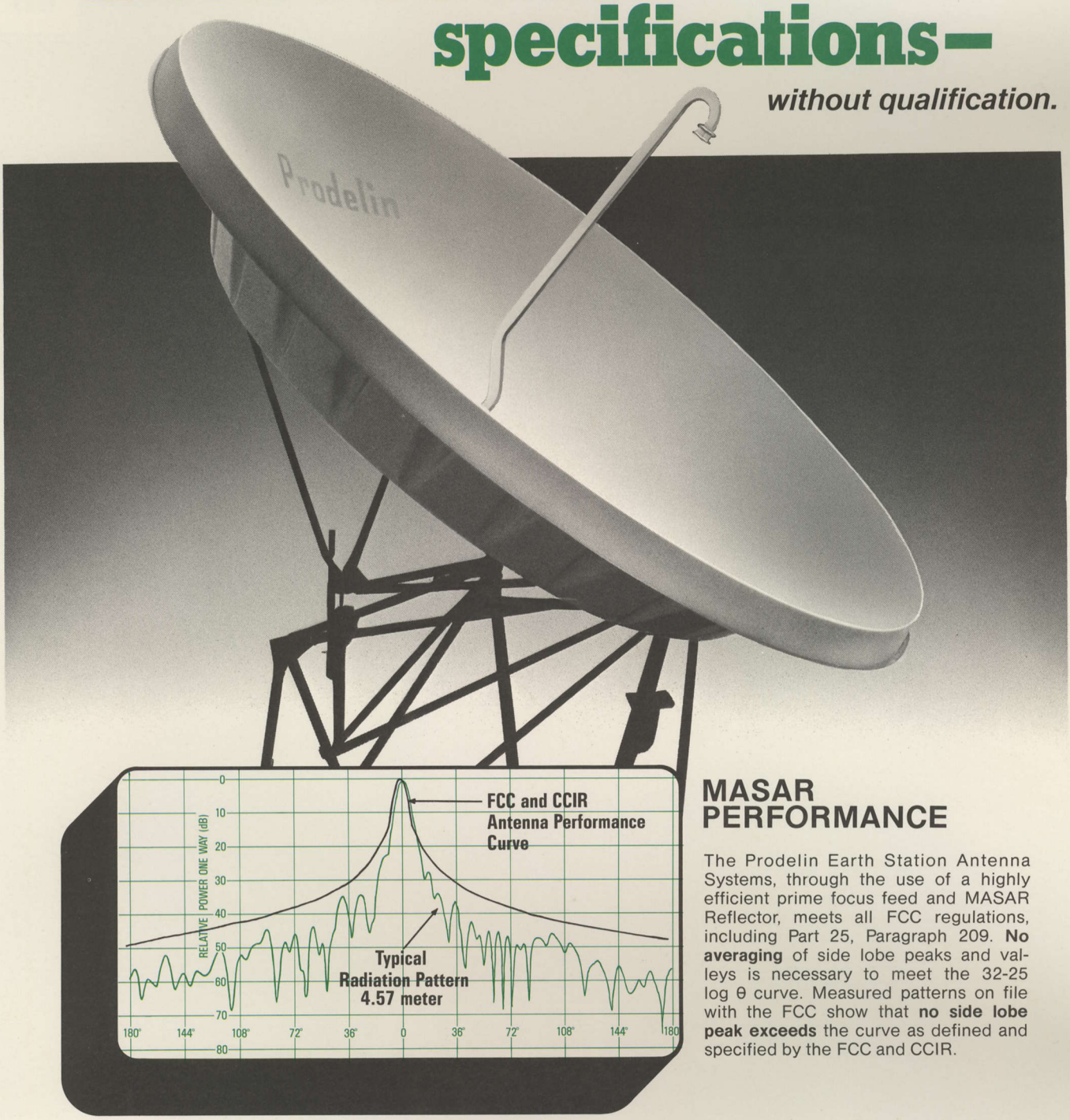
SPECIAL
SMALL EARTH TERMINAL
ISSUE

MASAR 4.57 meter earth station antenna system

meets FCC and CCIR specifications—

without qualification.



MASAR PERFORMANCE

The Prodelin Earth Station Antenna Systems, through the use of a highly efficient prime focus feed and MASAR Reflector, meets all FCC regulations, including Part 25, Paragraph 209. **No averaging** of side lobe peaks and valleys is necessary to meet the 32-25 log θ curve. Measured patterns on file with the FCC show that **no side lobe peak exceeds** the curve as defined and specified by the FCC and CCIR.

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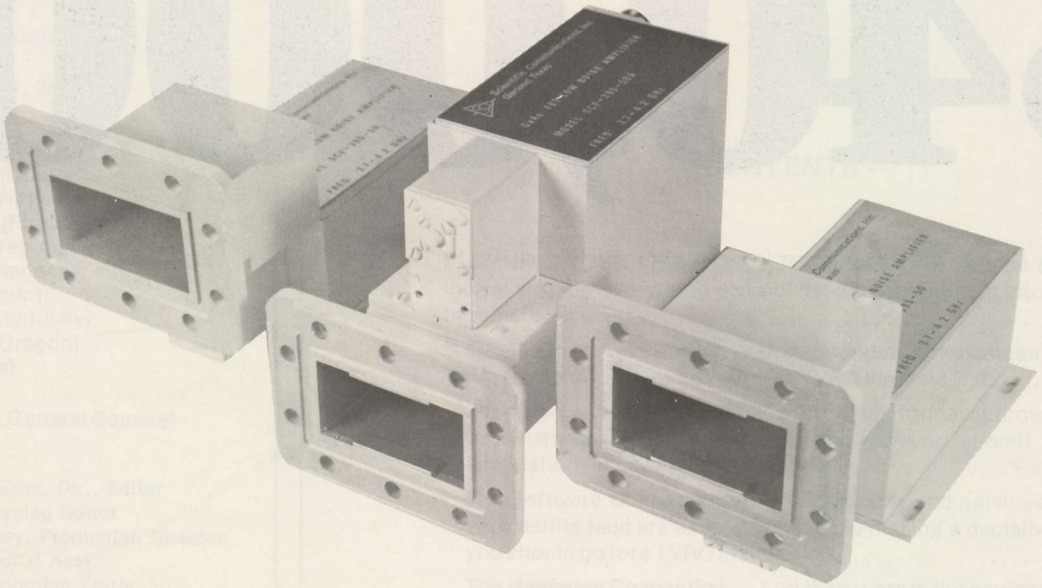

MODEL NO.	FREQUENCY RANGE	NOISE FIGURE	GAIN
SCF-395-505	3.7-4.2 GHz	1.5dB	50dB
SCF-395-50D	3.7-4.2 GHz	1.8dB	50dB
SCF-395-50A	3.7-4.2 GHz	2.0dB	50dB
SCF-395-50	3.7-4.2 GHz	2.6dB	50dB

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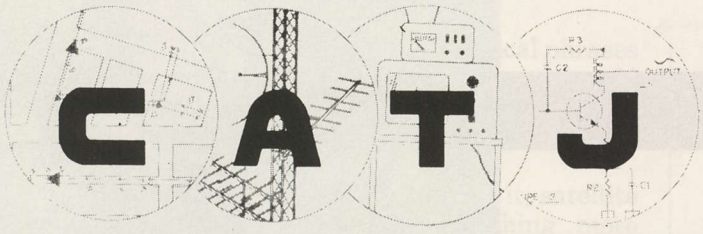

FEB
1977

VOLUME 4 – NUMBER 2

PUBLISHED MONTHLY, AS ITS OFFICIAL JOURNAL, BY THE COMMUNITY ANTENNA TELEVISION ASSOCIATION, INC. OKLAHOMA CITY, OKLAHOMA AS A SERVICE TO ITS MEMBERS AND OTHERS PROVIDING CATV/MATV SERVICE TO THE TELEVISION VIEWING PUBLIC LOCATED THROUGHOUT THE WORLD.

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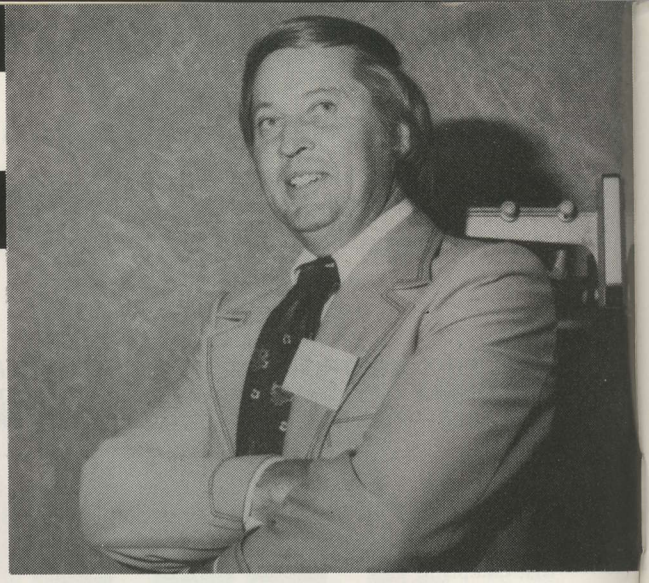
– CONTENTS –

OUR COVER

Come blow your horn. And we do. For a whole issue. All about small earth terminals. . .how they work, where they are, and how you get one for your own town. Photo of experimental feed on USTC 6 meter diameter TVRO located in Afton, Oklahoma.

CATA-torial



KYLE D. MOORE, President of CATA, Inc.

A New Era For CATV?

This month's special issue-long look at small earth terminals is intended to bring into focus most of the important considerations which you, as a new potential user of small earth television-receive-only terminals must contend with in making your own determination of satellite service for your town.

Is this another bit of blue sky? Are we about to be bit in the rear by the same wonderful people who brought us such innovations as "fully equipped local origination facilities" and "inter-active two-way communications". Perhaps, but the evidence suggests otherwise.

There are presently two exciting new technologies before us; TVRO's and fiber optics. TVRO's are here today. Fiber optics is not. We are spending our February issue looking at the "achieveable" with TVRO's. We'll come back along about April and do a similar practical study of fiber optics.

The approval of small earth terminals is, we believe, a very good thing for the cable industry. In its most simple context the small earth terminals are not really anything more complicated than a receive only microwave terminal. And a receive-only microwave terminal is not that much different than a receive-only off-air CATV headend. Only the frequency range differs from conventional CATV receiving antenna systems. Therefore, anyone who sets out to complicate TVRO facilities by trying to make them complicated, filled with black magic, and complex is setting out to deceive. **They are not complicated**, and there is nothing in them which the average system operator should back away from.

The antenna portion of the terminal is bigger than we are accustomed to using, but it mounts on the ground. I'd rather put a 15 foot parabolic at ground level than hang a quad of low band logs at 400 feet any day! The LNA is nothing more than the antenna mounting pre-amplifier we have all grown up with. The downline in TVRO service can be some of the larger 7/8th inch cable, but even if this is what you use, it is still smaller than the 1 inch cable some CATV systems use in trunks and only slightly bigger than the 3/4 inch stuff most of us use from time to time.

The TVRO receiver/demodulator is a cross between our familiar heterodyne processors and a television receiver. It is just like the CATV demodulators we now use to convert say channel 13 to video and audio (to drive a modulator) . . . except it starts out receiving a 4 GHz signal, not a 200 MHz signal. The only significant difference is a different set of local oscillators and mixers that get the 4 GHz imput signal down to the low i.f. range (typically 70 MHz in the TVRO receivers); and finally from i.f. to demodulated video and audio.

In short, there is nothing all that complicated about TVRO's. There are a few new "buzz words" like noise temperature and transponder and

phrases like G/T but they all have identical phrases in CATVwhich to the TVRO-only person would probably sound confusing. Anyone afraid of strange, new "buzz words" is in the wrong business.

So when you sit down to think about it, satellite delivery of WTCG (Atlanta) is nothing more complex than a one-hop microwave link, from Atlanta to you. And unless you are within 100-125 miles of Atlanta, this is something you could not otherwise do via terrestrial links. In short, there is much to be said for being only one-hop via microwave away from a first rate non-network signal such as WTCG. That is conventional CATV ... the business of providing **our viewers** with a diversified choice of programming. As additional broadcast and non-pay program choices become available via the "bird", our cable system values will grow. As an operator I happen to like the concept of being able to contract for microwave delivery common carrier service from WTCG for a flat rate of 10 cents per subscriber per month for full time service. In many of my small systems there is no way I can stand the normal multiple-hop microwave tarriffs of $300 to $600 per channel per month for one channel of independent programming. When you have only 500 subscribers to begin with, that works out either side of (but very close to) a dollar a subscriber per month. I would much rather consider the capital costs of a $25,000 earth terminal and ten cents a subscriber a month flat rate .... and then go to my city and show the new service(s) which I can offer if I can get a $1-$2 rate increase.

Where several systems can collectively share the cost of a TVRO terminal, and re-distribute the received signal(s) via CARS band, or conventional land-cable to the respective headends, the costs per system come way down in a hurry. And with each new transponder channel service added, the cost to my system per channel comes down rapidly.

So I don't see the new TVRO small terminals as being blue sky at all. They are a very practical way to get the most service to our customers for the lowest increment of cost. They are, I believe, going to prove to be more reliable methods of distributing non-network signals to CATV systems than land terrestrial microwave, and I suspect we will find that the signal quality we place on our cable systems is going to be far better than we often are stuck with now when we are at the end of a five or fifteen hop microwave network.

The only problem I have with the whole TVRO program is the FCC license required for my receive-only terminal. In their First Report and Order on domestic earth terminals, the FCC said:

"We think that receive only stations must be licensed by the Commission if they are to be protected from interference, and also to assure the quality of service intended for use by the public."

This sounds very similar to me to the FCC's rationale for their licensing of CATV systems. And Gridley not withstanding, the day must still come when a competent court of law outside of the Commission looks into this matter.

FROM MICRODYNE — the first name in satellite TV receiving equipment – a low cost, small aperture receive only terminal for the CATV industry

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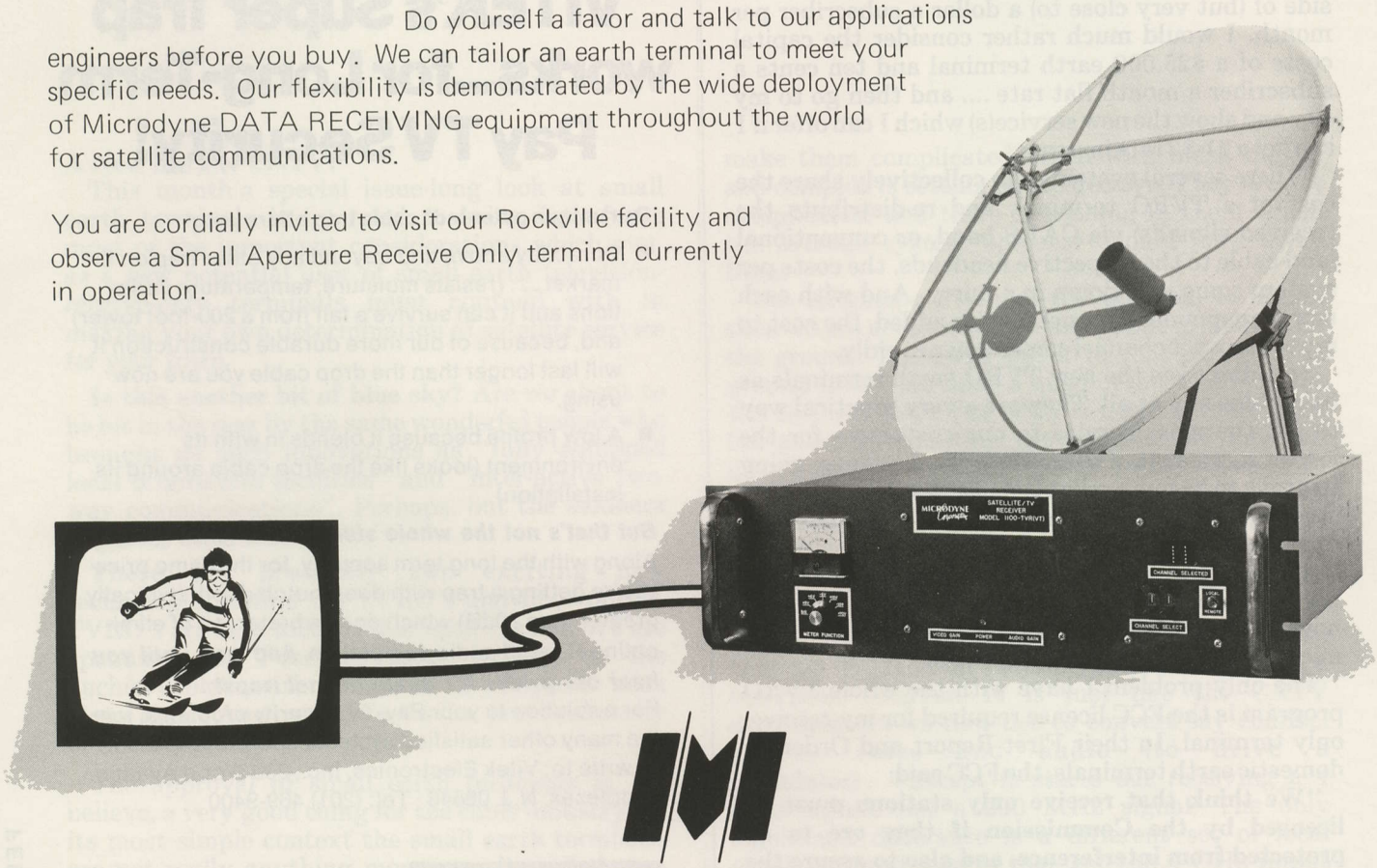
You are cordially invited to visit our Rockville facility and observe a Small Aperture Receive Only terminal currently in operation.



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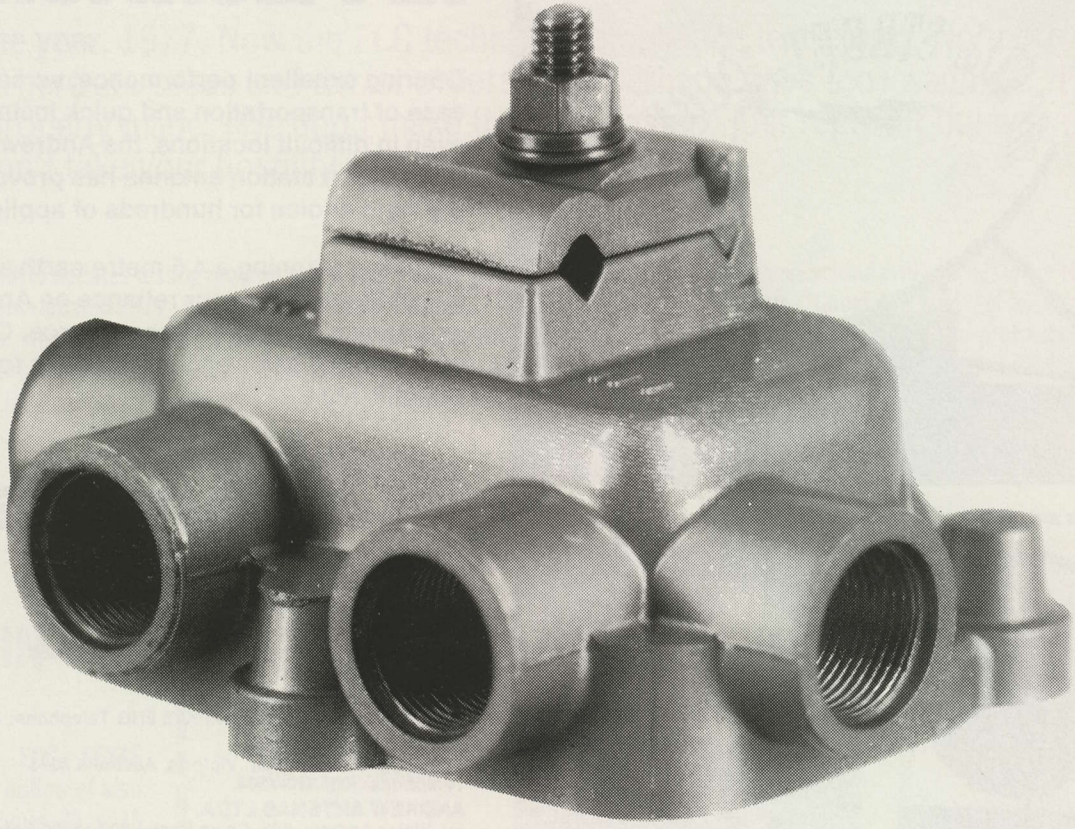

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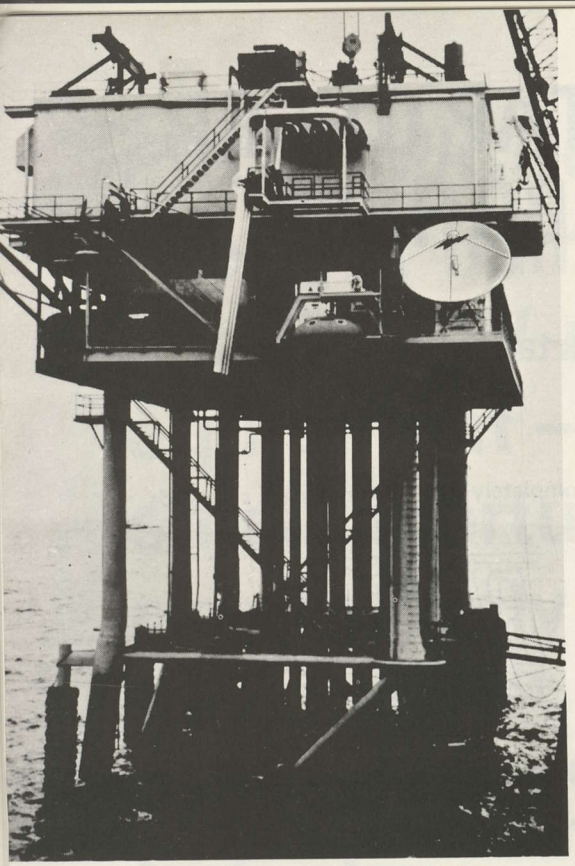

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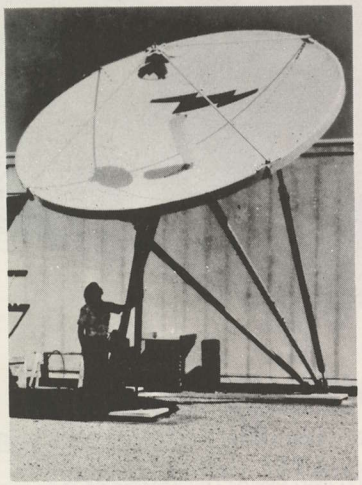
Remote Location in Alaska



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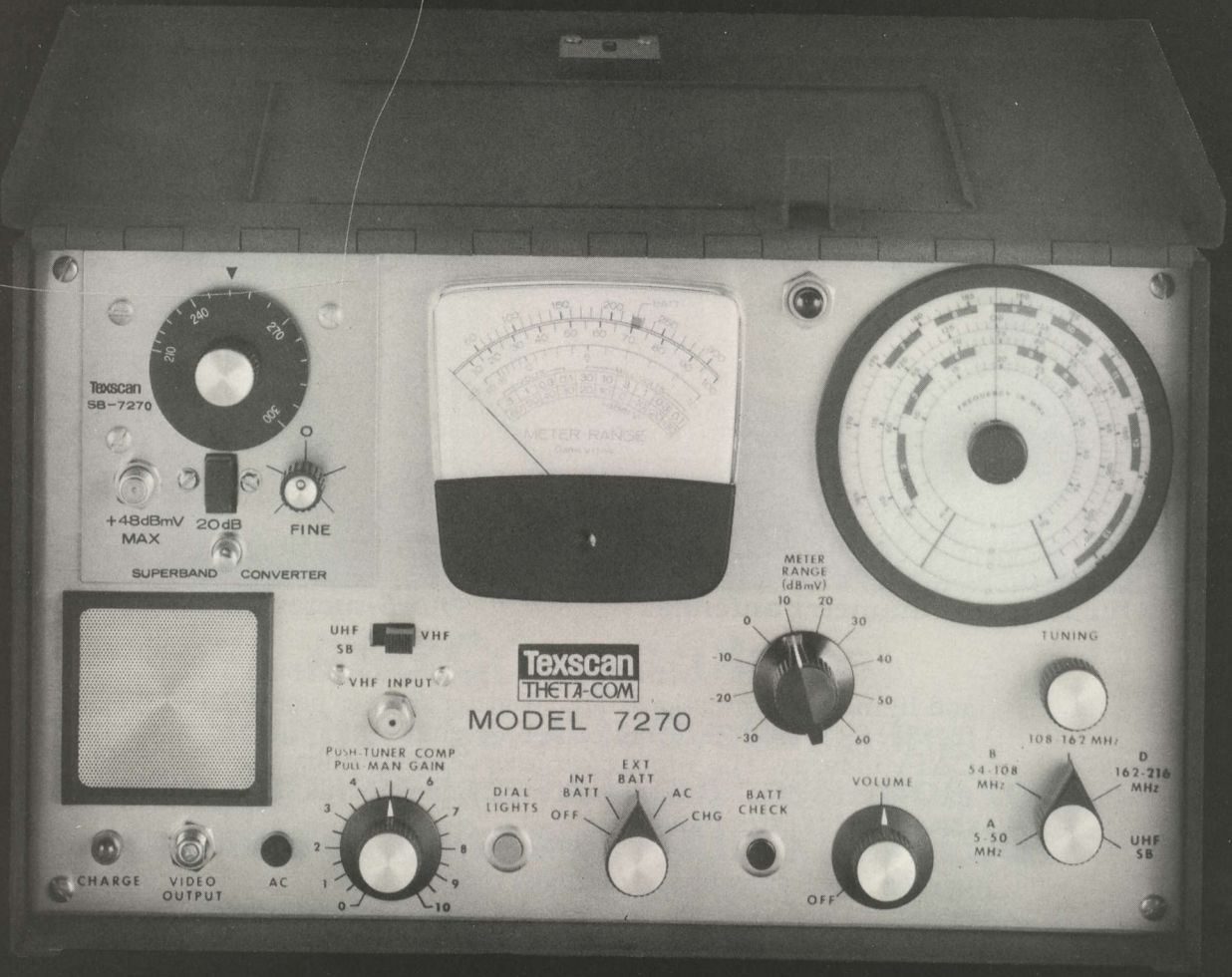
Trade Up...
To a New 'Old Friend'



Send us your worn out "old friend" (FSM 727) and receive $250.00 credit toward the purchase of a new "old friend", the 7270 signal level meter. This is a limited time introductory offer good until May 1, 1977. Texscan will accept your FSM 727 only in trade and any submitted for trade-in must be in reasonable mechanical condition.

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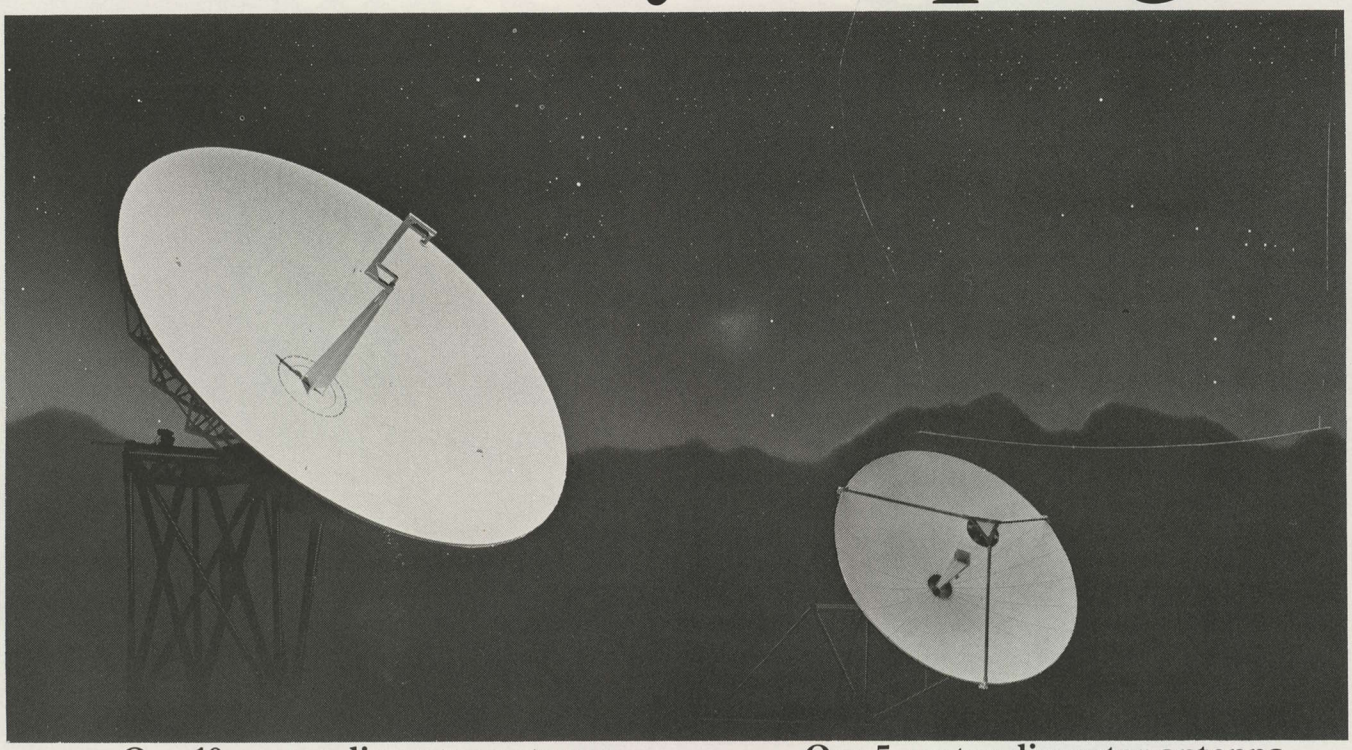
We can size you up right.



Our 10-meter diameter antenna. **Our 5-meter diameter antenna.**

At Scientific-Atlanta we are in production on both 5 and 10-meter earth stations. The 10-meter antenna pioneered the way for satellite distribution of programming for the CATV industry. The 5-meter has been designed utilizing the proven technology developed by supplying over 70% of the industry's earth stations.

Only an analysis of "quality-reception" and cost will tell you which antenna size to choose for your area.

To size you right, we'll put our 25 years of experience in telecommunications to work for you by preparing a complete analysis of expected system performance. Based on reception at your location, it will compare system noise temperature, G/T, S/N and C/N characteristics between a 5-meter system and 10-meter system. And the difference in costs can be compared as well, all to help you make an intelligent buying decision.

So before you buy anything, let us help you make the right decision. Our commitment to the Cable Industry includes a nationwide network of service locations where emergency help is available 24 hours a day.

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For more information and an in-depth analysis, please call Bob Mason or Pat Bohana at (404) 449-2000. Or write us.

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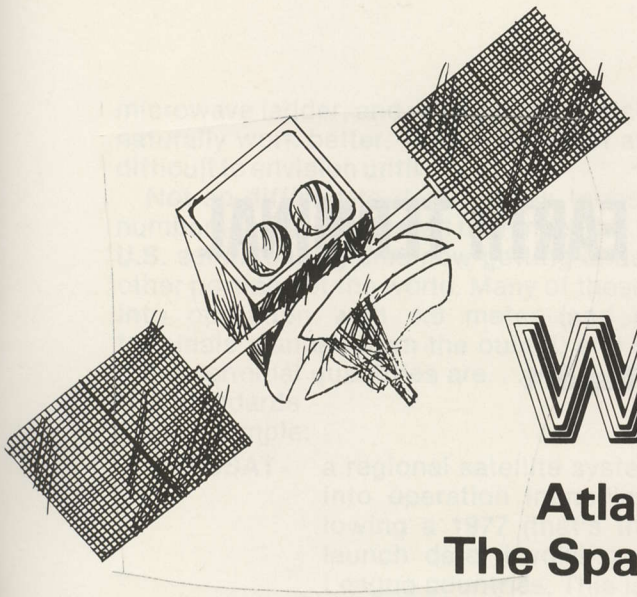

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Atlanta Channel 17
The Space-Age TV Station

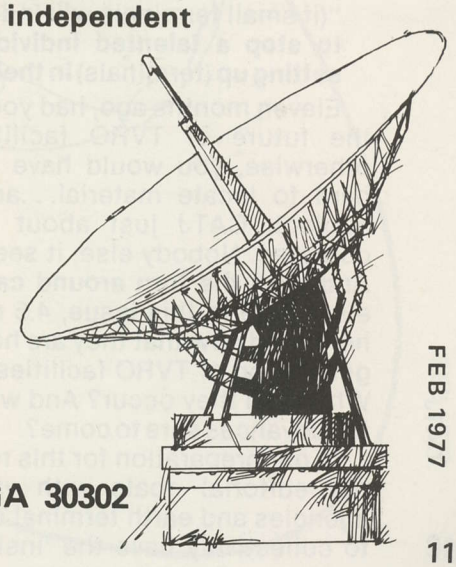
Proudly Announces
A Broadcast Industry 'First'

The first commercial television station to have its full daily broadcast schedule carried by satellite transmission to cable television systems.

And Congratulates

Southern Satellite Systems, Inc. on obtaining its FCC authorization to provide satellite distribution of WTCG.

Available NOW, via RCA Satcom II, WTCG will be reaching CATV systems presently beyond its reach from terrestrial microwave routes with its unique program schedule: Five movies a day, up to 40 movies a week...live telecasts of Atlanta Braves baseball, Atlanta Flames NHL hockey, Atlanta Hawks NBA basketball...college basketball...a full 24-hour-a-day schedule for family viewing from America's #1 independent television station.



WTCG Cable Relations, Box 4064, Atlanta, GA 30302

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PLANNING YOUR FIRST CATV EARTH TERMINAL

Special Issue—Long Report

The 11 Month Turn-Around

In the February 1976 CATJ, we reported (in **Earth Terminals-Phase II**) the state of the CATV industry at that point, with television receive-only (TVRO) facilities. We made the notation:

". . .The question is, will a 4.5 meter dish with the same electronics as the 10 meter dish deliver a signal? And, if it will, what kind of signal will it deliver?"

Back even further, in the October 1975 CATJ (see **Practical Satellite Earth Terminal Receiving Station Design Considerations For CATV**), we reported the comment of Scientific Atlanta's Henry Marron". . .**There are several 12-foot dishes around here which have minor imperfections. Dishes that cannot be sold to customers, but which with around $50 of materials and some of my own time, could be whipped into shape for installation in my own backyard. . .the pictures would not be nearly as good as the commercial 10 meter dish installations. . .but think of watching movies and sports in my own living room!"**

In our May 1976 CATJ (see **Satellite Terminal Antenna Size Arguments Heat Up - Phase III Report**) we noted:

"(if small terminals will indeed work). . .**what is to stop a talented individual or group from setting up** (terminals) **in their own backyards?"**

Eleven months ago, had you been interested in the future of TVRO facilities, for CATV or otherwise, you would have searched long and hard to locate material. . .any material on the subject. CATJ just about had the "market" cornered. Nobody else, it seems, saw it coming. **And then the turn around came.** As is reported elsewhere in this issue, 4.5 meter terminals are here. And now that they are here, what is the **next** generation of TVRO facilities likely to look like? When will they occur? And who will benefit from the advances sure to come?

In our preparation for this report, in discussing our editorial goals with various government agencies and earth terminal suppliers who seem to collectively have the 'inside track' on where earth terminals were headed, we discovered that several other well read publications were beating the same bushes. The reader who has access to the January 1977 issue of **Microwaves Magazine** (50 Essex Street, Rochelle Park, N. J. 07662) will do well to read the extremely well done and quite lengthy report appearing on pages 36-47 there.

Not All Alone

We tend to whallow around within our own relatively miniscule industry's boot prints. If it is not CATV related, **as a rule we ignore it.** That could well turn out to be a mistake in the TVRO business. You can be sure that suppliers of TVRO gear are not making that mistake; and since you are going to be dependent upon them for your equipment, and backup service, in the months and years ahead, it would be well to understand some of the technology problems ahead.

First of all, our CATV market for TVRO's is relatively speaking "miniscule". The key phrase is "**our** CATV market" with the emphasis on our. How many will be sold to U. S. CATV systems? And when?

Most people see between 150 and 200 small TVRO facilities undertaken in this year. Not all will get installed this year and the FCC may have a difficult time getting through the logistics of that many applications in the first year. In the coming **three year** period (i.e. 1977-8 and 9), a number like 800-1,000 CATV type TVRO facilities seems realizeable. (In the United States). If it should turn out that in Canada similar rules are adopted and similar systems are permitted, either using U. S. satellite signals or Canadian satellite signals, that number could increase by a couple of hundred. So when we are all done, going into 1980, it appears to CATJ that we are dealing in the 1,000 terminal range, with a plus or minus 20% accuracy. **That is for CATV alone.**

Now the FCC did not **really** address the **non-**CATV user of the present SATCOM I, WESTAR-II birds. Nor did it address the future users of new generation birds; which will be operating in frequency bands considerably higher up the

microwave ladder, and where smaller dishes just naturally work better. That is a market area very difficult to envision until it happens.

Not so difficult to deal with, in terms of real numbers for real-projected terminals, are the **non-U.S.** satellite programs now getting underway in other portions of the world. Many of these will go into operation with 4.5 meter **(and smaller)** terminals planned from the outset; and some of these terminal quantities are. . .well, very big, by U.S. standards.

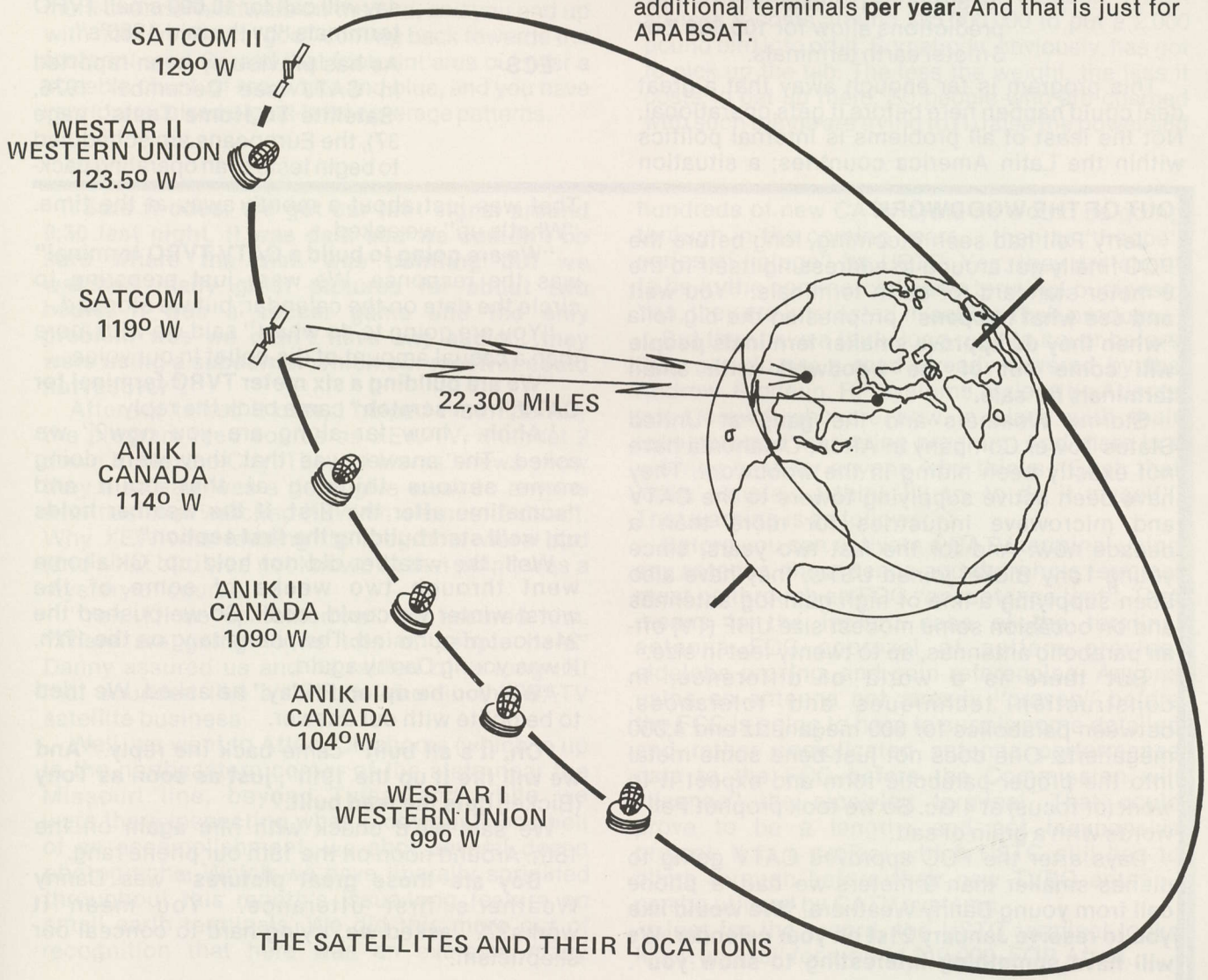
For example:

ARABSAT - a regional satellite system to go into operation immediately following a 1977 (that's this year) launch date, involving 19 Arab League countries. This is a twin-satellite program involving 2,000 voice channels per bird, four commercial-type TV grade channels per bird, plus, two "high power" television channels for "community antenna reception" services.

The four TV grade channels will be received on 8 meter antennas, which will be linked, not unlike the present northern Canada CBC VHF outlets, directly into "low power" VHF and UHF transmitters. In this way people living near these TVRO receive sites/VHF-UHF transmit sites will be able to have first-time television.

The two "high power" television channels "for community antenna reception" services will operate in the 2.5 GHz band (not unlike our ill-fated experiment here in the United States in the fall of 1974) and reception will be on **3 or 4 meter** dish antennas. There will be one antenna per community, town, oasis or village, and either at a community-receiver (meaning one large screen receiver) or via small, short-haul CATV type RF re-distribution systems, people will enjoy the programs fed downward via the "High Power" 2.5 GHz transponders.

The ARABSAT people are talking about approximately 30 terminals of the 8 meter size and a starting quantity of 100 of the smaller 3 or 4 meter terminals as this program begins late **this** year. But. . .and this is a significant number. . .the users are predicting or planning for as many as **40,000** of the **3 or 4 meter terminals by 1990.** That is but 13 years away, and what starts out as 100 will grow at a rate of approximately 3,000 new, additional terminals **per year.** And that is just for ARABSAT.



THE SATELLITES AND THEIR LOCATIONS

ANTENNA SURFACE ACCURACY—requires tolerances for 4 GHz down band on the nature of tiny fractions of an inch, over whole surface region, to realize full gain of the terminal.

SERLA - This is the "code word" for the Regional System of Telecommunications in Latin America. The program is very similar to ARABSAT except it is running 3 to 5 years behind ARABSAT's planned 1977 start-up date. The same approach to voice-plus high grade TV—plus "community TV receivers" is planned, and the 1990 predictions allow for **100,000** 2 or 3 meter earth terminals.

This program is far enough away that a great deal could happen here before it gets operational. Not the least of all problems is internal politics within the Latin America countries; a situation which changes quite often, and one where at some point one or more of the countries involved in the plan might well be expected to "pull out" and go it alone, in frustration of not being able to agree to an operational format for all of the projected involved countries.

The Mexican government is one country somewhat involved in the planning for the SERLA program which seems to be already tiring of the struggles within the group. There have been planning sessions by the Mexicans **alone** to launch **their own satellite** or to make use of a future U.S. launched bird for coverage of **their** country.

ASEAN - The Indonesian government is **already operational** with a satellite program not unlike the ARABSAT package; however, its growth potential and immediate needs for additional hardware is not generally known. The Indonesian program has however sparked an additional program; a group of nearby Southeast Asian nations are on the drawing boards with an ARABSAT type program that they say will call for **10,000** small TVRO terminals "by the mid-1980's".

ECS - As has previously been reported in CATJ (see December 1976, **'Satellite To Home Tests'**, page 37), the Europeans are scheduled to begin tests of an operating pack-

OUT OF THE WOODWORK

Jerry Pell had seen it coming, long before the FCC finally got around to addressing itself to the 9 meter standard for earth terminals. **"You wait and see what happens"** prophesied the big fella **"when they do approve smaller terminals people will come out of the woodwork with small terminals for sale."**

Stormy Weathers and the gang at United States Tower Company in Afton, Oklahoma have not exactly been hiding in the woodwork. They have been active supplying towers to the CATV and microwave industries for more than a decade now. And for the last two years, since young Tony Bickel joined USTC, they have also been supplying a line of high gain log antennas and on occasion some modest size UHF (TV) off-air parabolic antennas, up to twenty feet in size.

But there is a world of difference, in construction techniques and tolerances, between parabolics for 600 megahertz and 4,000 megahertz. One does not just bend some metal into the proper parabolic form and expect it to work (or focus) at 4 Gc. So we took prophet Pell's words with a grain of salt.

Days after the FCC approved CATV going to dishes smaller than 9 meters we had a phone call from young Danny Weathers. **"We would like you to reserve January 21st on your calendar. We will have something interesting to show you".** That was just about a month away at the time. "What's up" we asked.

"We are going to build a CATV TVRO terminal" was the response. We were just preparing to circle the date on the calendar; but we stopped.

"You are going to do what!" said we with more than a casual amount of dis-belief in our voice.

"We are building a six meter TVRO terminal for CATV; from scratch" came back the reply.

"Ahhh. . .how far along are you now?" we asked. The answer was that they were doing some serious thinking at that point and **"sometime after the first, if the weather holds up, we'll start building the first section".**

Well, the weather did **not** hold up. Oklahoma went through two weeks of some of the worst winter we could recall. So we pushed the 21st out of our mind. The phone rang on the 17th. It was young Danny again.

"Will you be up on Friday" he asked. We tried to be polite with our answer.

"Oh, it's all built" came back the reply. **"And we will fire it up the 19th", just as soon as Tony** (Bickel) **gets the feed built."**

We said we'd check with him **again** on the 18th. Around noon on the 18th our phone rang.

"Boy are those great pictures" was Danny Weather's first utterance. "You mean it works???" asked we, trying hard to conceal our skepticism.

age in the 11 and 14 GHz bands shortly. One of the goals of this program is the utilization of antennas 31 to 47 **inches** in diameter.

There appears to be developing then a truly world wide market of rather large proportions. Still not heard from are such areas as Africa and the Red-Block nations which ultimately can be expected to get their own programs together and into operation. All of this interplays on our rather primitive start-up here in the United States of CATV related TVRO facilities; because of the volume expected and the technical advances projected.

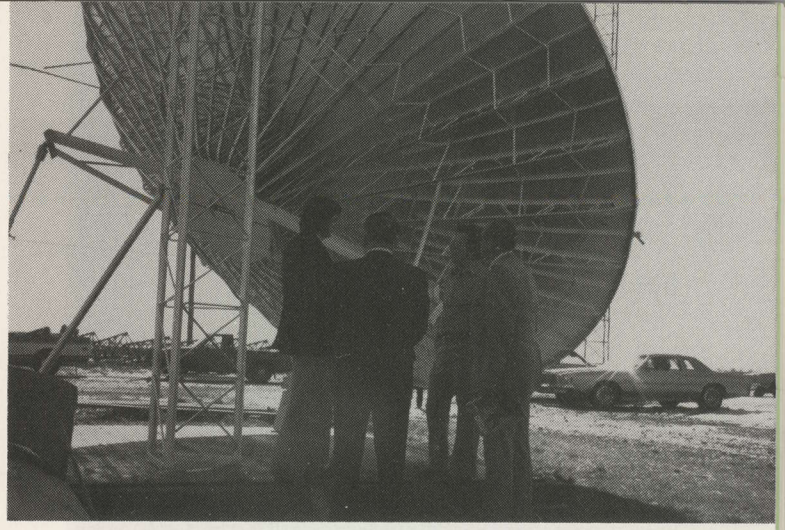
Lowering The Dish Size

There are only two ways to effectuate a smaller receiving antenna.

(1) **Improve the receiver system sensitivity,** by improving the characteristics of the low noise amplifier (LNA) and/or the demodulator, and,

(2) **Raise the power level** of the satellite transmitter.

Both are getting lots of attention. The present generation of SATCOM and WESTAR birds have a power output capacity of 4-5 watts per transpounder(!). Spread that amongst all of the multi-channel hardware on the bird, and you end up with not very much "goo" coming back towards the footprint area. Spread that footprint area out over a sizeable chunk of red, white and blue, and you have very low received-signal-level coverage patterns.



BACK CONSTRUCTION INSPECTION—almost as important as the front surface accuracy is the construction stability of the rear support trusses.

Generating power at 4 or 12 GHz requires two things: bulk and raw operating power to run the machine. Higher power means more weight. More weight for the transmitter and more weight in particular for the power collection and storage system that runs the equipment. The more weight in the "payload" (i.e. the raw weight of the transponder machine or bird), the more it costs to raise it into the "sky" and put it into the proper position. NASA advises it costs around $25,000,000 to put a 2,000 pound bird into orbit. Somebody, obviously, has got to pick up the tab. The less the weight, the less it costs to get up there. So people who are charged with such things are trying to (1) raise the power and

"Sure it does. We got our first signal around 9:30 last night. It was dark and we couldn't be sure where the dish was pointing but we watched really great pictures for about two hours. It was a soccer game and the only problem was we didn't have any audio. . .they were using a subcarrier which our receiver could not recover".

After we talked it over, I helped them identify the program feed source as XEW-TV, channel 2 down in Mexico City. The "24 Horas" news show they also saw was a dead give away to anyone who has ever watched XEW on channel 2 direct. Why XEW was feeding its programs via a bird (and **what** bird was not known at that point) was a mystery of course.

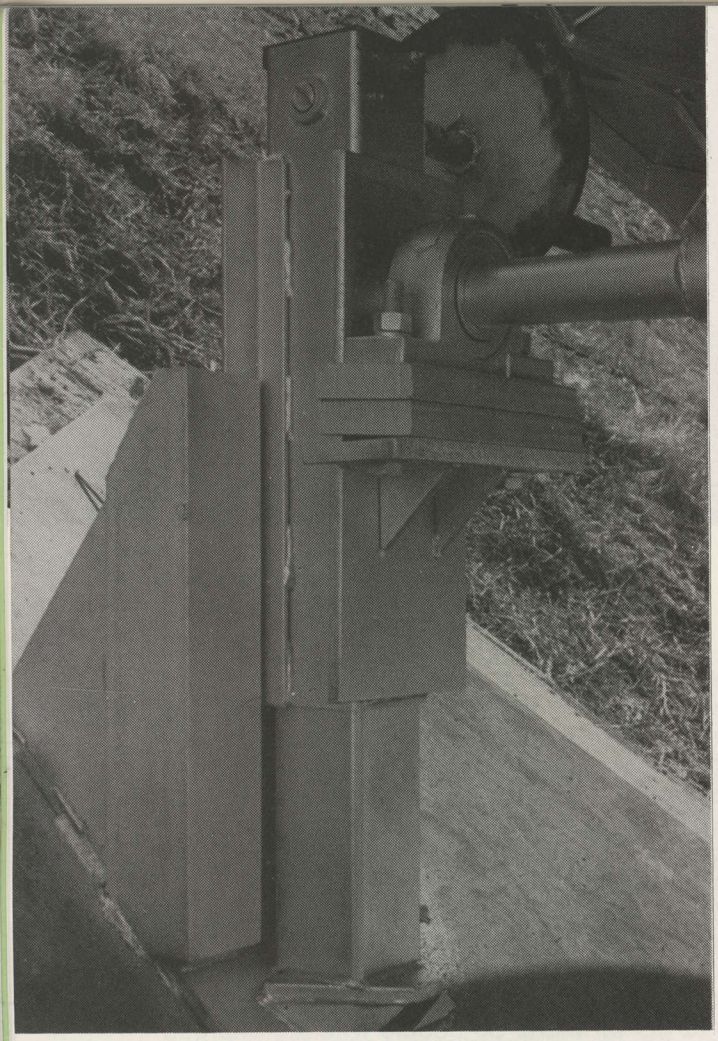
"Yeh, I'll be up tomorrow" we assured him. **"There are going to be lots of people here"** Danny assured us and he rattled off a long list that sounded like a 'Who's Who' in the CATV satellite business.

Well, we went to Afton, Oklahoma (which is up in the northeastern corner of the state near the Missouri line, beyond Tulsa) and while we were there inspecting what is obviously one hell of an accomplishment, we shot several dozen photographs. Which we have liberally sprinkled throughout this month's issue-long feature on small earth terminals. We did this more out of recognition that here was an exercise many hundreds of new CATV systems would be going through in the coming years. . .than as "freebe" series of "plugs" for USTC. Yes, they **are** about to be in the commercial earth terminal business. Yes, they **are** interested in **selling** their product.

But they have a fairly long road to cover before they can do so; **a road already covered** by the Andrew, Prodelin, RF Systems, Scientific Atlanta (etc.) crowd who are now in place with their terminals and marketing program. And there is a warning here for anyone who thinks "Gosh that looks simple. . .I think I'll try to do it myself". That warning is as follows:

Before you can activate a CATV terminal using **any** antenna, the antenna and the whole terminal must go through an FCC "acceptance test". That means in the instant case of the terminal antenna FCC approval of pattern proving, sidelobe proving, and gain referencing. Anyone using an antenna not already "proven" before the FCC is going to have to supply some detailed and rather complicated antenna performance data to the FCC **before** the Commission will "license" the receiving terminal. That could prove to be a lengthy and not inexpensive project. It is a project which USTC still has to climb through before **their** new TVRO antenna can be utilized by CATV systems.

Just for the record, the USTC terminal looks like it will sell for around $10,000. FOB Afton.



ELEVATION MOUNT—ala USTC. There is plenty of clever Stormy Weathers 'southern engineering' in this one but it is stable, solid, and relatively low cost to reproduce.

(2) bring down the weight. It is not an easy exchange. But there is relief coming. And it is called the Space Shuttle program. When the NASA people are into the Space Shuttle business (a few more years) they predict they will be able to bring the cost of putting a 2,000 pound box into synchronous orbit down to around $15,000,000.

Raising the power level of the transponder transmitter increases the EIRP, or the earth-surface power level **density** in the "footprint" of the bird's antenna. The United States and Canada already have a 12 GHz "CTS Satellite" in operation, for experiments, that has a 200 watt transmitter on board. That is a bunch of dB better than our present SATCOM/WESTAR (4)/5 watt transmitters and those dB come home to roost in our receiving systems. The U.S./Canadian CTS experiments are already demonstrating that transportable 3 meter antennas are capable of signal to noise ratios in the 50-plus region using the 12 GHz system with the 200 watt transmitter on board; and this is using much less effective receivers than we are now using in CATV.

In summary, there are several factors at work here; all of which inter-play with the drive for smaller earth receiving terminals:

(1) The cost of placing heavy transponders in orbit is going to come down, by at least 40%, when the Space Shuttle program gets underway;

(2) The weight of higher power transmitters (and their necessary power collecting [solar powered] package) is coming down as R and D facilities develop better microwave region power sources that weigh less;

(3) The effectiveness (or figure of merit) for low noise amplifiers (LNA's) is getting better all of the time, as we shall now see.

When the first CATV TVRO's facilities went into operation in the fall of 1975, it just about took a ten meter dish with **that era's** state-of-the-art GaAs-FET LNA's to do the job. Even then it turned out to be "marginal" in some areas like Florida. As the diagram here shows, there are three places where you can make up decibels in the receiving system. The antenna (bigger is better), the LNA (lower noise figure or degrees K is better) and the receiver (lower FM threshold is better). Making the antenna bigger was good for lots of bucks. And in the receiver area, once you had employed something called "threshold extension", you were pretty much down to the limit of physical laws. But the LNA could be improved. And improved it was. The world of TVRO LNA's is totally **unlike** the preamplifier world which CATV operators are accustomed to working with. In this world, **tenths of a dB improvement** in noise figure **are readily apparent.** And as the noise figure gets lower and lower, it becomes unwieldy to measure performance utilizing standard "noise figure" techniques.

Most of the early-day CATV TVRO facilities, utilizing 10 meter dishes, went into operation with 2.5 to 2.8 dB noise figure GaAs-Fet LNA's. To get the same (10 meter type) type of signal-to-noise performance **with a 4.5 meter dish** requires an LNA with a noise figure of around 1.3 dB. But, as the FCC has recently decided, not everybody needs the kind of 54/55 dB signal to noise ratios which 10 meter dishes are providing, and consequently there is an area here where a would-be-TVRO operator can make his own value judgement as to **how much lower-than** 54/55 dB a signal to noise ratio he and his customers will tolerate. This is one of the key, most important of all, CATV buyer decisions in the small TVRO package. Because here is where the bucks change fast.

For example, a 2.5-2.8 dB noise figure LNA is currently available in the $900.00 price range. On a 10 meter terminal, this will produce pictures with video signal to noise ratios in the 53 and up region, **in most** portions of the United States. And this is what is known as a GaAs-FET (Gallium Arsenide Field Effect Transistor) LNA. It is typically **similar in design-theory** to the FET VHF and UHF pre-amplifiers we use today; only, it has a **very** high grade and **selected** GaAs FET in it. One that costs lots of bucks to buy.

GaAs-FET technology is improving all of the time. When the 2.5-2.8 dB LNA's were bought for the first CATV TVRO's back in 1975, they cost from $2,500 to $4,000 **each**. And as noted, they are now down to under $1,000. The reason their price has come down is that now there are better grade GaAs-FET LNA's available, which means lower noise figures. And lower noise figures, remember, translates to better signal to noise ratios even with small(er) earth

terminals.

The **ideal** GaAs FET LNA **will have** a stable noise figure of around 1.3 dB and 40-60 dB of gain. And it will cost. . .well, about as much as the present day 2.5-2.8 dB noise figure units do. **That day is not here yet,** but it is coming. The best of the current art seems to be an NEC LA-0412 low noise amplifier, with a specified 1.55 dB noise figure (and 60 dB of gain). The price tag on this super-GaAs-FET LNA today is about where the 2.5-2.8 dB noise figure units were just 18 months ago; or $4,000.

Anyone going into a TVRO would be well advised to keep a close eye on the changing (and improving) state-of-the-art of GaAs FET devices. As the noise figure goes **down,** the signal to noise ratio goes **up.** This means better pictures with a fixed size dish (such as 4.5 meters). It also means that where today some portions of the United States (such as portions of New England, south Texas and Florida) may be marginal (if useable) with present day 4.5 meter terminals and present day GaAs-FET LNA's (with some transponders) the day **will come** quite soon where improvements in LNA's should make these smaller terminals useable **in even these** low EIRP regions.

In the interim, for that great bulk of the nation where transponder EIRP's are high enough to allow 4.5 meter terminals to produce good signals, the consensus seems to be that if your LNA has a 1.8 to 2.1 dB noise figure (which is in the 150-180 degree Kelvin range if you calculate it that way), you are going to be in the 50 dB plus video signal to noise area with your terminal.

There are two final thoughts about GaAs-FET LNA's. Something the first-time buyer may not be aware of. The first is susceptibility to damage from the elements. Static electricity, or lightning damage, **can be** a big problem with a GaAs-FET LNA. Several big-name producers had to take their first shipment of units back when nearby lightning strikes knocked out the GaAs-FET devices. Because most of the GaAs-FET LNA's are mounted directly at the antenna feed, the power to run them comes their way via a separate (i.e. non-duplexed) power cable. This power source had been installed without the usual lightning protection safeguards in many of the first TVRO installations, and when lightning struck nearby the LNA quit working. The LNA manufacturing people are sort of at the mercy of the guy making the installation on this one since it appears most of the surges are coming **to** the LNA **via the power line** running the LNA. It pays to very carefully check out the LNA suppliers recommendations for installation of that power source line **before** you fire up your own LNA. Even at a "measly" $900 a whack, you don't want to lose one very often!

The second problem is still in the germination stage. That is RF power. The typical GaAs-FET seems to not like lots of RF floating around. The end result is about the same as lightning; the GaAs-FET fizzles and fries. Sources CATJ talked with reported that if there is an induced RF voltage of **10 milliwatts or more** with the terminal antenna, the GaAs-FET may suddenly quit working. There are some newly developed GaAs-FET devices coming on the market now which will stand the comparitively high RF induced levels of 100 milliwatts before problems start, but they will be late 1977 before they get into the field. In the interim, if there is lots of gigahertz RF (from nearby microwave, etc. transmitters) floating around **your** projected TVRO site, it is best you talk it over with your LNA sales engineer before jumping in.

TRAILER HITCHES? Look closely friends, there are two well placed trailer hitches in this photo and they ain't holding no trailers! Preparing to make a change in the dish setting for a look at a different bird.

Feeds And Stuff

The casual observer of TVRO antenna designs has probably noticed that there are two general families of "feed antennas" in use. (The feed antenna is the small antenna out at the focal point of the dish where it picks up the energy that is directed towards it by the reflector surface). One type looks like a miniature dish, **facing backwards into the bigger dish.** This is called a **"Cassegrain feed"** system. Andrew and some of the Scientific Atlanta antennas employ this approach.

The other feed type antenna is a miniature "horn" antenna that typically bolts onto the LNA waveguide flange (in some installations). This is called (in the trade) a **"prime focus feed"** (antenna). Prodelin, and some Scientific-Atlanta antenas (as well as others) employ this approach.

The engineers responsible for each design make strong claims for **their** approach. The facts **seem** to

DID IT GO UP? Terminal designer Bickel found his eyes crossing after staring at the TerraCom receiver signal level meter for minutes on end.

boil down to this:

(1) **Cassegrain Feed**—A well designed Cassegrain has approximately one dB **more** antenna-system gain than a prime focus feed, but in the process of getting more gain, the terminal antenna picks up some **side lobes** (i.e. antenna gain in directions other than straight ahead). This means the Cassegrain is a higher efficiency feed (by approximately 1 dB), but it may well turn out to be more susceptible to interference from other signal sources, such as terrestrial microwave transmitters operating in the same signal range.

(2) **Prime Focus Feed**—Gives up that approximately 1 dB of system gain that the Cassegrain feed has, but also **better controls the side lobe pattern** of the total antenna system.

That "1 dB of added antenna system gain" might well turn out to be an important 1 dB in low EIRP areas where **every** dB of fade margin is very important; but in areas of moderate to good EIRP, the decision factor could just as easily turn out to be the better rejection of potential interference sources from terrestrial signal sources.

Antenna Size

There is probably nothing magic about 4.5 meters; excepting of course it is one-half of 9 meters (which was the old FCC standard until this past December). When the FCC addressed the earth terminal antenna standards issue in December, it said it was relaxing the present "9 meter standard" to a new **non-standard** of 4.5 meters. In other words, while the letters and numbers "4.5 meters" appear frequently in the new FCC mandate, **there is no out and out prohibition** against utilizing other size (read smaller) terminal antennas. What there is in place is the FCC decision that **if** you wish to use **any** antenna smaller than their previous 9 meter standard, you will have to show them (that's the FCC) in your application for a construction permit that you have very carefully studied all of the trade offs between antenna size, LNA noise temperature (i.e. noise figure), receiver threshold and so on for your particular location and your particular equipment configuration. **If,** they say, **you can show** that you can arrive in the "ballpark" of their recommended parameters for signal to noise, carrier to interference and carrier to noise, you can put in virtually any installation you wish. After they give you your CP.

There are now on the market antennas of larger-than-4.5 meter size but smaller-than 9 meter size. There is a 5 meter antenna from Scientific Atlanta, a 6 meter terminal from RF Systems and others. What is that all about?

Obviously, the bigger the antenna terminal (all other things being equal), the higher the gain of the receiving-antenna-system. And since gain translates to received signal voltage from the transponder, the more signal you have going into the LNA, **the better the quality you will have coming out on your CATV channel from your modulator.** This says that there may well be something to looking at the in-between sizes, say 5 or 6 meter size antennas, because perhaps in your own situation you might be better off with a slightly-larger-than-4.5 meter antenna.

There are several reasons why this might be so:

(1) If you are located within the United States in an area where the EIRP (that's the RF power density on the ground from the satellite transponder) is low (see map here. . .say Florida or far south Texas), you may have a serious problem getting the FCC recommended ratios with a 4.5 meter terminal, unless (and here is the trade) you are willing to invest in a 1.55 dB noise figure LNA. A bigger antenna (i.e. slightly bigger such as a 5 or 6 meter) **might be** the answer.

(2) Your own CATV system may have such a long trunk/feeder cascade that you need a better signal to noise ratio going in than the typical guy does (remember that no matter **what** your start-off-point signal to noise ratio is, everytime it goes through a bunch of CATV plant amplifiers, it degrades some). Again, you **may need** the ultimate (in today's world) NEC type $4,000 LNA, or, you may figure a slightly bigger dish is the way to get more signal.

Multiple Outputs

Let's assume you have a single antenna, fixed on sat SATCOM-I, and you want to carry transponder six (WTCG). That means you need a single channel receiver tuned to transponder six. Now let's say you want to be able to switch between transponder six and transponder 24 (or some other number). You can buy a receiver that continuous **tunes** through the channel range (there are 12 channel and 24 channel receivers) or you can buy a receiver that is fixed tuned (not unlike a modern 'CB' set) on two or more pre-determined channels. You change channels by pushing a button or turning a switch.

Now take this to the next plateau of operation. You want to carry not one **but two** separate transponders, at the same time. **That takes two separate receivers.** But only one antenna, one LNA and one feedline (provided the two transponders are coming from the same bird and are of the same polarization). How do you do it? By installing what we call in CATV a "splitter" at the base of the downline, and dividing the available

received signal voltage into (in this case) two equal parts. Off one side of the "splitter" (or power divider as they like to term it in this region) you drive one receiver, and off the other side the second receiver. It is just about that complex to add a second (or third or fourth) receiver.

There are some other considerations of course. Like signal voltage. The gain of the LNA needs to be high enough (that's gain, not noise temperature) so that the signal voltage at the bottom end of the feedline can stand being halved or quartered and still be stout enough to drive the respective receivers to "full quieting". So when you are thinking ahead, it is wise to think about **how many receivers** you might eventually stack up on the end of the downline, and order your LNA for-gain accordingly.

Crossed Polarizations

One of the ways the satellite people get so many channels out of so little spectrum space (24 channels out of spectrum space for only twelve 40 MHz wide channels) is to use alternately vertical and horizontal polarization in "half channel" steps. For example, channel 1 has a center frequency of 3720 MHz (vertically polarized) while channel 2 has a center frequency of 3740 MHz (horizontally polarized). Channel 1 extends from 3700 to 3740 (vertical) while channel 2 extends from 3720 to 3760 (horizontal). This frequency offset (20 MHz from channel/energy centers) is not unlike our own TV broadcast stations offsetting 10 or 20 kHz; except everyone hopes it works out a whole lot better than our TV offsets do! SATCOM I (the RCA bird) has 24 channel capacity while WESTAR II has 12 channel capacity. That means that the **presently-in-use** SATCOM channels **are horizontally polarized** (all of the **even** number channels such as 2, 4, 6, etc. **are horizontal** and all of the **odd** numbered are **vertical**) while the WESTAR II channels are vertical. ANIK is also horizontal.

This has some bearing on the feed polarization of your dish. You cannot switch from a horizontally polarized SATCOM channel to a vertically polarized WESTAR channel, for example, **without** "rotating the feed polarization" **as well as** swinging the dish. It's not a big deal, but it is something to keep in mind as you begin to make antenna and signal use decisions.

NOBODY'S TOO OLD FOR THE FLINTSTONES—part of WTCG's approach to syndicated programming is to carry 'old favorites' to avoid syndicated exclusivity problems in many markets. Reiser of Microdyne tunes in on WTCG's signal via transponder six.

The Approval

On December 15, 1976 the Federal Communications Commission acted favorably on a "Petition for rule making or for declaratory ruling of receive-only small earth station antennas" filed on June 24, 1976 by the Community Antenna Television Association. The full text of the December 15th decision was finally released by the FCC on January 7, 1977.

The Commissions's December 1976 action was actually in response to a **pair** of "petitions" before the Commission; the afore mentioned CATA petition and a **dis-similar** petition filed on October 20, 1975 by the American Broadcasting Companies, Inc. (ABC network and 0/0 stations). In the December 15th decision, the Commission approval of the CATA petition resulted in a simultaneous rejection of the ABC October 20, 1975 petition. Here is what it was all about.

Both petitions to the FCC questioned the "adequacy and appropriateness" of the FCC's technical licensing standards for domestic satellite (receive) facilities. The first-filed ABC petition believed the 1975 era technical requirements for licensing of earth terminals "insufficient to insure the availability to future users of domestic satellite capacity in the 4 and 6 GHz bands". In a nutshell, ABC did not like the idea that CATV systems were getting into satellite program delivery (then using 9 meter and larger terminals) and ABC wanted the Commission to make the rules tougher; **to preclude CATV use of TVRO facilities.** The CATA petition, on the other hand, believed the 1975/6 era technical standards "unduly restrict(ed) the availability of satellite communications to many users who have immediate requirements for such services which (could) be met by economical earth station facilities. . .".

CATA won and ABC lost. The cable television industry gained a victory and the television broadcast networks fumbled a loss.

ABC felt the 4/6 GHz region (4 GHz is the **down**link from the transponder to your receiving terminal; 6 GHz is the **up**link from the program source to the transponder in orbit) was a bad frequency location for CATV and other 'non-essential' satellite service users. ABC claimed that at some "future time" the desireable 4/6 GHz region would or **might** be needed "by the nation's great free-broadcast service industry" and they feared that if CATV use of the 4/6 GHz region proliferated (i.e. grew rapidly) there would be a shortage of transponder frequencies for the broadcast users at some future, undefined date.

DAVID G. REISER—Senior Applications Engineer for Microdyne Corporation does a preliminary check of the carrier to noise ratio for the USTC terminal in Oklahoma.

ABC wanted the Commission to "freeze" any additional approval for use of the 4/6 GHz region by CATV terminals, and move the CATV terminal users to the 12/14 GHz bands. There were a **few** flaws in the ABC argument. First of all, there are **no presently operating** 12/14 GHz birds. With that as the first flaw. . .you don't really need a second one.

We'll treat the ABC petition lightly here; it is instructive only because it was in opposition to the CATA filing and while normally a petition from a network gets lots of attention at the Commission, this one did not. It should be noted however that the ABC petition did draw some comments, and to some surprise there was favorable support for the ABC petition from. . .of all places, some CATV interested parties. Eastern Microwave, for example, felt ". . .no earth stations with antennas smaller than 10 meters in diameter . . .should be allowed."

CATA's petition went the opposite direction from ABC. It asked the Commission to ". . .amend its application standards for satellite earth station receive-only antennas to permit the construction of 'small earth stations' less than nine meters in diameter". CATA further stated "(FCC rules which) require receive-only antennas (to be) more than 9 meters in diameter results in the denial of satellite service to many small and medium sized communities". CATA also noted that the (then) 9 meter standard resulted in the denial of satellite service to small and medium sized communities and "the 9 meter standard does not benefit the public and appears to be for administrative convenience only". CATA went on to point out that the allowance of smaller terminals would have a healthy effect on the creation of cable services in many communities currently prevented from enjoying such services because of the impact of FCC rules on signal carriage, and, the economics of bringing to these communities permissible signals for carriage on new systems yet unbuilt.

The CATA petition drew reams of response; some favorable and some not so favorable. Those opposed to "relaxed standards" included ABC (no surprise here), GTSE (General Telephone and Electroncis Service Corporation), NAB, AT&T. Those favoring the relaxed standard included HBO, NCTA, AFC (Antennas For Communications), Hughes, Microdyne and Prodelin. There were also comments filed by a collection of CATV system operators, favoring the CATA petition.

Discussion And Policies

Way back in 1970 the FCC, in its "First Report and Order" dealing with domestic satellite facilities, stated that:

> **"Rather than attempting to prescribe arrangements for the initial** (satellite systems) **we believe it would be preferable to permit potential applicants to take the initiative in submitting concrete proposals for the Commission's consideration".**

In other words, in 1970, the going-in policy regarding domestic satellite terminals was at best "loose". In establishing "guidelines" for applicants proposing satellite systems (and this meant the whole system including not only the receive terminals but the satellite itself and the uplink transmitter), the Commission in 1970 stated:

> **"Applicant shall consider and submit details regarding the selection of the orbital longitude(s) for its proposed system. . .and shall discuss the probability of interference between its proposed satellite system and other satellite systems. . .Broad guidelines such as a 5 degree minimum separation between satellites and excursions in both longitude and latitude of ±0.5 degrees should be observed until more definitive standards can be determined. . .**
>
> **"The** [earth station] **receiving antenna directivity in the plane of the geostationary orbit shall, as a minimum, be comparable to that of a parabolic antenna with a diameter of 9 meters operating at 4 GHz, and have a side lobe suppression of at least 25 dB, unless a waiver has been granted. . .".**

Of course, in the processing of CATV TVRO facility applications, waiver requests for antennas smaller than 9 meters and also for antennas not of

a parabolic configuration never got to first base. There were some that did, in other fields of endeavor. The Alaskan earth terminal program utilized approximately 100 of the less-than-9-meter terminals and at least one off-shore oil drilling rig in the Gulf of Mexico had gained approval for a small terminal antenna prior to the filing of the formal CATA petition. In the first 9 months of CATV activity in the TVRO arena, there were 104 earth (station) terminal applications. Of these, 102 applications were for terminals 9 meters or larger in size. As the FCC says in its January 7th release "two earth station applications (for terminals smaller than 9 meters in size). . .were not prosecuted". That means **the Commission declined** to process the applications.

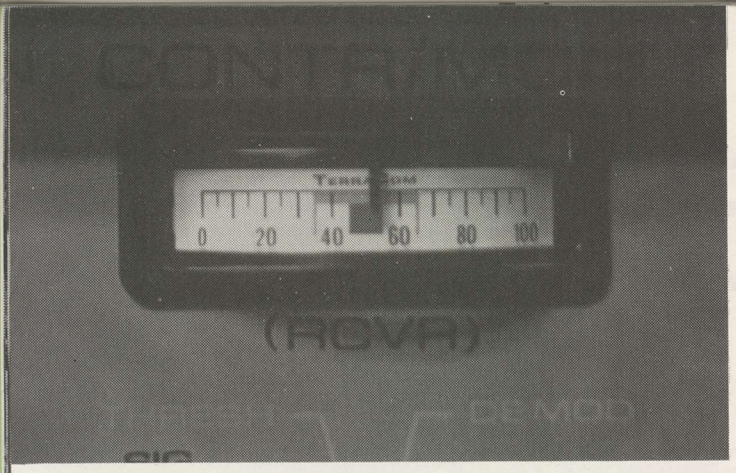
Subsequent to the First Report and Order, a second run-by for the domestic satellite questions came along and it was called (again, not surprisingly) the **Second Report and Order.** This was along in 1974, and in that process the proposal that satellite to satellite spacings, in orbit, be reduced to 3 degrees came along (recall five degrees was first proposed in the First Report and Order). In the end, the matter was resolved with 4 degree spacings and that is pretty much where we are today. The three degree spacing was desirable, in the Second Report and Order, because (simply stated) the closer you place the satellites together, in the geostationary orbit "belt", the more satellites you can put into service. Of course there are trade offs there, the primary one being the type of earth or ground receiving terminal antennas that must be employed to keep the same-channel signals in one transponder from interfering with the signals on the same channel from another transponder. The closer together the birds are in orbit, the larger (i.e. the more directive) the receive terminal antennas must be, as a means of narrowing up the receive-antenna system "beam width".

The problem is enhanced somewhat by the appearance in the orbit belt of the Canadian ANIK series of birds. The ANIK birds are stationed at **three** locations, and because of the particular Canadian operating objectives, it is necessary for any U.S. domestic birds to be spaced 5 degrees away from the adjacent ANIK birds; although the U.S. birds can be only 4 degrees from one another. This results in the orbital spacing shown here in diagram form. It is not a precise 5/5 degree spacing format, but its ultimate shape will be largely guided by those two criteria.

The Commission stated in addressing the CATA petition:

> **"Our domestic policies do not preclude and have never precluded the authorization** (of facilities of less than 9 meters) **provided certain showings can be made.** (In issuing) **this decision we are only clarifying the nature of the showings and information which we would consider to be an acceptable demonstration that proposed small earth terminals would satisfy the technical objectives we have**

BUILT LIKE A TOWER? Actually, people who build good towers should build good earth terminal antennas. There is nearly 2,500 pounds of metal in this six meter terminal although Weathers expect to drop it by 300 or so pounds in the production model.



NEAREST THING TO AN FSM—front panel meter on TerraCom receiver has 0-100 scale, with area between 45 and 55 dark green. This indicates received signal level from the bird; when you are in the "green" the signal is out of the noise and Cliff Schrock's "sparklies".

previously set forth for domestic satellite communications."

The Commission also laid the ground work for the 'new procedures' which (as we shall see shortly) the applicant for a smaller-than-9-meter terminal must follow in submitting his application to the Commission:

". . .it must be emphasized that the desire of a potential user to utilize an earth station antenna less than 9 meters in diameter is not the sole criterion on whether such a facility is acceptable for licensing in the 4 and 6 GHz bands. It is incumbent on (the applicant) **to demonstrate, on the basis of sound engineering analyses, that the proposed facilities will satisfy the required performance objectives of the user and would not impose additional restraints on the flexibility of the satellite operators to satisfy the domestic satellite communications needs of customers using 9 meter or larger antennas. . .".**

In other words, when you make application for a (small) TVRO facility, you will set out in some form acceptable to the Commission the complete details of your proposed installation. We'll see what that entails shortly. Then, if the Commission's engineers find your analysis of your system operation is proper:

". . .(we) **see no public interest to be generally served . . .by requiring further showings regarding the comparative quality or quanity of service obtained from such** (small) **facilities relative to the** (quality) **obtainable from 9 meter or larger antennas. . .".**

You will determine what signal to noise, carrier to noise and carrier to interference ratios or numbers you and your system are willing to accept. Can you go in with an application which specifies such low efficiency antenna and LNA and receiver combination that you obviously will have cruddy looking pictures? Would such an application be approved by the FCC?

Probably not.

HBO, in particular, has been pushing the Commission to establish some type of "hard numbers" for the pass or no pass condition for the application when it lands at the Commission.

Remember that HBO, unlike say WTCG or CBN or others that may come down the pike later on, **is your 'partner'.** For every dollar you collect from a cable subscriber for HBO 'premium' service, HBO collects (typically) 50 cents. They therefore have a real (and understandable) stake in the **quality of signal** you deliver to your subscribers. Because your subscribers are HBO's subscribers as well.

HBO is hard at work with people at the Commission and through various engineering companies that specialize in the preparation of the paperwork that must precede or accompany an application, **trying to enforce** signal to noise (and carrier to interference) numbers which are. . .well, pretty stiff. About this problem (i.e. do you make hard and fast numbers or merely establish guidelines?) the FCC said in their December decision:

". . .our (guidelines) **assume nominal performance and interference objectives which HBO and others suggest would provide acceptable signal quality for cable television systems. Specifically, we consider the feasibility of employing 4.5 meter antennas to achieve a 14 dB carrier to noise ratio, which provides a 3 dB margin over the 11 dB FM threshold of conventional receivers, and an 18 dB carrier-to-interference ratio with 4 degree satallite separations." Of significance is this follow-up FCC statement:**

"It is not our intent, however, **that these particular values be established as** concrete standards **that** must be met **by each individual earth station. Rather, these values are used in our analyses as being representative of the type of good engineering practices on which our general evaluation of such proposals must be based."**

Of all of the words you will have read in this issue of CATJ, the last two FCC quotations should be underlined or emphasized in your own mind. Here is what it all means. Let's take the 14 dB carrier to noise ratio. If the receiver/-demodulator you wish to employ has an 11 dB FM threshold number, a 14 dB carrier to noise means you have 3 dB more signal than you need to be at the precise point of FM threshold. FM threshold can be explained in laborious textbooks with complicated mathematical analyses but it boils down to this. At what input signal level to the receiver, reference the receiver noise level or temperature, does all visible signs of noise (i.e. sparklies or degradation) disappear to the eye? The point where the noise disappears is right at or just a tad above the so-called (individual) receiver FM threshold. So if the noise disappears at 11 dB FM threshold, why do you need a 14 dB carrier to noise (that's 3 dB better than the threshold point)?

Margin. Fade margin, for those days when your antenna buffets in the wind, or there is heavy cloud layering between you and the sky (clouds cause loss, especially when they are 'wet' clouds) and so on. But do you need **3 dB** of 'margin'?

HBO apparently believes you do.

OK. . .suppose you are designing a terminal that does **not** plan to use HBO. Say one that will carry WTCG. Do you need to stick to the FCC 'guidelines' of 14 dB carrier-to-noise? The FCC says **"It is not our intent that** (this) **particular value be established as** (a) **concrete standard that must be met by each individual earth station".** Therefore, apparently if there is going to be any type of hangup while your application is being prepared for FCC submission by the engineering groups, it will largely be the result of HBO standards.

In most areas of the country, the 14 dB carrier to noise is **not** impossible even with a 4.5 meter dish. **Only expensive.** All it takes is a first class LNA, either one of the state-of-the-art NEC jobs (perhaps hand selected) or one of the more exotic parametric LNA devices.

Just for the record, a 14 dB carrier to noise will usually translate to a 52 dB signal to noise. The FCC had more to say about signal to noise in their December 15th decision. It is interesting to review what they said because here for the first time CATV **system** technical standards (section 76.605) were married in FCC text to **earth terminal** technical standards. Regarding TVRO receivers which employ FM threshold extension, the Commission said:

> **". . .In some cases, receivers with FM thresholds extended down to 8.5 dB carrier to noise ratio might be used, although the resulting signal-to-weighted noise ratio will be less than achieved by receivers with 11 dB FM thresholds. The carrier-to-noise ratio should exceed the FM threshold of the earth station receiver by at least 1 to 2 dB,** and simultaneously **furnish a minimum 36 dB S/N ratio at the subscriber terminals as specified in Section 76.605 (a) (9) of the rules and regulations. . .".**

Humm.

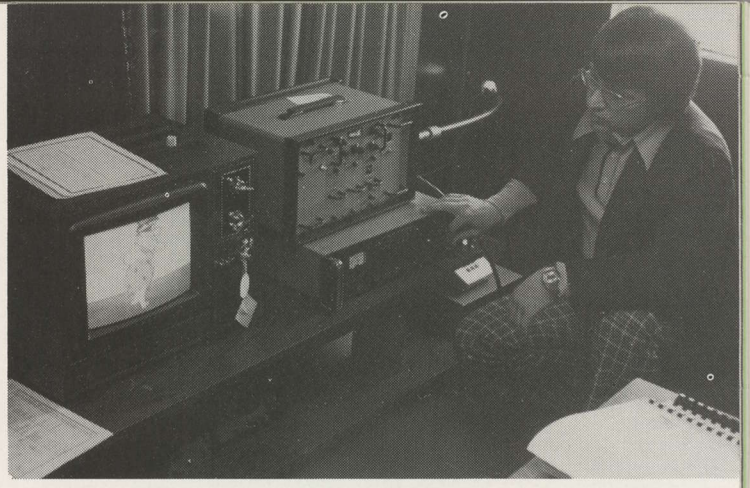
Somehow the earth station delivered signal just got brought into the technical standards of Part 76, although the technical standards very clearly spell out that they shall apply **only to** Class I or broadcast-originated signals, which in this case are first taken "off the air" **within** the Grade B region of the television station. As a practical matter, we have three separate sets of numbers now in the discussion.

Carrier To Noise—A measurement of the level of the transponder signal and the receiver noise, expressed as a ratio established between the two;

Signal to Noise (video)—A measurement of the video signal voltage and the background noise level, as measured at video as the video signal comes out of the TVRO receiver/demodulator;

Signal to Noise (RF)—A measurement of the cable plant signal to noise, as typically checked at subscriber locations, using techniques we all understand and practice.

In its closing comments for establishing "guidelines" for CATV TVRO applicants, the FCC has merged them all together into a single pot. This may not be a time to be picky, but some discussion is obviously in order.



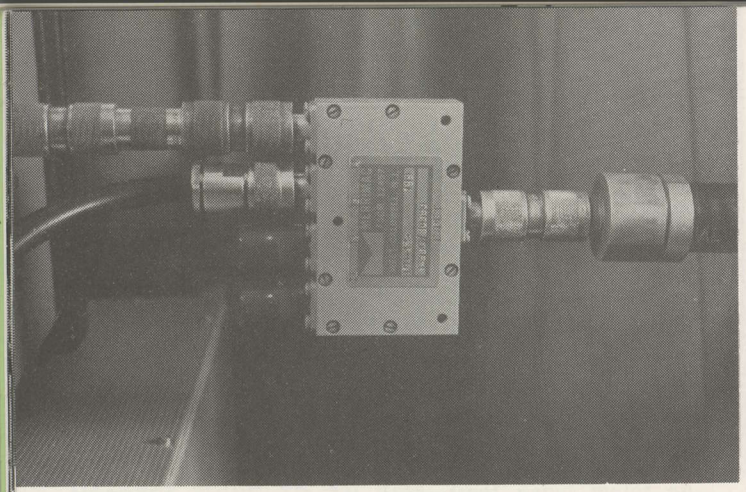
DIAL-A-CHANNEL—Microdyne's Reiser runs his receiver through the channels looking for 'new' signals.

First of all, if the **final** measurement to be made is at the subscriber's home, of RF signal to noise ratio on the cable TV channel, then the 36 dB signal-to-noise ratio can only be made to apply to Class I broadcast signals, first picked up off the air within the Grade B contour of the television station. WTCG (for the record) fits this situation, because Southern Satellite takes the signal off the air at a point only 8 miles from Ted Turner's 1042 foot tower. So when you deliver WTCG to customers on channel 7 or G or whatever, it needs to be **at least** 36 dB out of the noise at RF at the subscriber's home.

What type of video signal to noise do you need coming out of your demodulator/TVRO receiver to achieve a 36 dB RF signal to noise ratio at the subscriber home? It depends, of course, on the CATV plant and its length. As a rule of thumb, if your **present** worst-case on-cable channel is 36 dB signal to noise or better at RF at the subscriber's home, you could go **back to your headend** and measure/calculate the RF signal to noise of that same channel at that point. Let's say you do this and find out that your 36 dB signal to noise real world cable signal you are now delivering to a subscriber starts off with (say) a 48 dB RF signal to noise at the headend. How does this relate to the type of video signal to noise coming out of your TVRO demodulator/receiver which you will need to insure that WTCG ends up no worse than the 'reference' channel on your plant?

Simply be sure that when your channel 17 via satellite signal is modulated to RF at your headend that it will be no worse at the headend than your present 'worst case' passing signal.

Now what about the **non**-Class I channels, those which Part 76 rules do **not** establish signal to noise (or other) numbers for? Well, if it is HBO we are talking about, that will be between you and HBO (your 'partner' in premium programming cable). If it is CBN or Federal, that will probably be between you and them **or up to you alone.** But as for the FCC or anyone else "insisting" that these **non**-Class-I channels have specific signal to noise (or other) numbers. . .well, we feel certain the FCC



FOUR WAY SPLITTER—microwave style. Output of six meter dish was split at end of transmission line to drive two receivers on hand (TerraCom and Microdyne); other two inputs were terminated. This cost at least 6 dB signal voltage to the receivers.

did **not** mean that when they released their TVRO document on January 7th **(even if that is the way it could be read!).**

The Specific Application

Each application is prepared following established procedures for the domestic satellite service. The license application is for a receive-only terminal, and it will be handled by the FCC's Common Carrier Bureau. The Commission says:

"(as a minimum) **each applicant will have to include certain supplemental information in its application to demonstrate that acceptable performance objectives can in fact be achieved by** (proposed) **facilities under the particular circumstances** (of each location). . .".

The **minimum** information required shall include:

1) Make, model number and noise temperature and FM threshold of the TVRO receiver (demodulator) to be employed;
2) An identification by make, model number and noise temperature of LNA to be employed;
3) An identification of the antenna type, model and by reference its on-file-with-the-FCC gain and pattern parameters;
4) A detailed calculation of the overall receiving **system** noise temperature (that's antenna, LNA, receiver/demodulator with all connecting downlines and cables), identifying all relevant noise contributors;
5) A detailed link calculation of video and audio signal to noise ratios to be achieved for each satellite (that's satellite, not transponder) to be used by your earth terminal, assuming appropriate values of miscellaneous losses in addition to free space propagation loss;

Note: Those 'miscellaneous losses' are where you are to set forth your fade or signal reduction losses due to rain, antenna movement and so on.

6) A statement of your desired carrier to interference ratio objectives for terrestrial and inter-satellite interference.

Note: Your objective must be at least 18 dB since that is the 'guideline' number the FCC will be working with. In your application you will need to show all of the terrestrial sources in your area that might now or one day in the future (i.e. CP status microwave links) cause you some interference. One way to avoid this whole calculation is to rely on the antenna manufacturer's on-file data for the inter-satellite interference numbers and then put the small terminal 'in a hole in the ground' so that there is 'earth shielding' from any terrestrial circuits in the area.

This would be a good point to point out that while the discussions have been primarily concerned with 4.5 meter (and up) parabolic antennas, the Commission, in footnote 33 of their January 7th release on this subject allowed:

"With respect to horn antennas, such types of antennas with apertures as small as 14 feet will be considered to fall within this (4.5 meter parabolic) **range for routine processing."**

Additional Guidelines

In its 39 page appendix to its January 7th release, the Commission spends a great deal of time (space, paper and energy) setting out the nitty-gritty of the form and content which applications 'should' take. Reproduction here would be educational but largely wasted and boring for the person who will leave the actual preparation of his application up to a professional application-preparing individual or firm.

There are a few caveats however. First of all, preparing early applications (i.e. those early birds first in the door) will be tedious and frustrating, even if you think you know what you are doing. There is no readily available FCC form to fill out; rather you are sort of on your own following their 39 page Appendix guidelines to format the application yourself. It will take individuals well versed in space technology lingo, mathematics and systems engineering to do it correctly. This **may be** a **legal filing** with the Commission, but the meat of the filing is the supplemental data the Commission requests. People with**out** the necessary credentials (engineering with emphasis on space technology) are already 'coming out of the woodwork' offering to prepare these applications 'for a fee'. The caveat (warning) is that an improperly prepared application, done at a bargain-basement rate, may turn out to be no bargain at all. Later on down the road, **after** 50 or 100 such applications have gone through the Commission, it **may** be possible by following the steps others have taken before to simply copy other's work and do it yourself. But we doubt that is going to be the case for at least the first six months of 1977.

The Commission wants you to **try** to attain what they call "good quality television". To them, that means a "minimum of 1 dB carrier to noise ratio **above** the receiver FM threshold", and, a minimum of 36 dB signal to noise ratio at the subscriber's home. That also means a minimum carrier to interference ratio of 18 dB (C to I). Where this whole matter gets confusing is when the Commission slips into something they call

"objectives". Their objectives and their "good quality television goals" are not always the same, and it will be up to the Commission engineers wrestling with the first load of applications to sort the two out.

Where they want you to try to attain a minimum carrier to noise ratio of 1 dB **in excess of** the FM threshold, they are at the same time citing objectives of a carrier-to-thermal noise ratio of 14 dB and a 52 dB (video) signal to noise ratio. It will be interesting to see where all of this leads, and how long the Commission is able to stick to HBO type numbers (52 dB) for non broadcast (i.e. not Class I) signals.

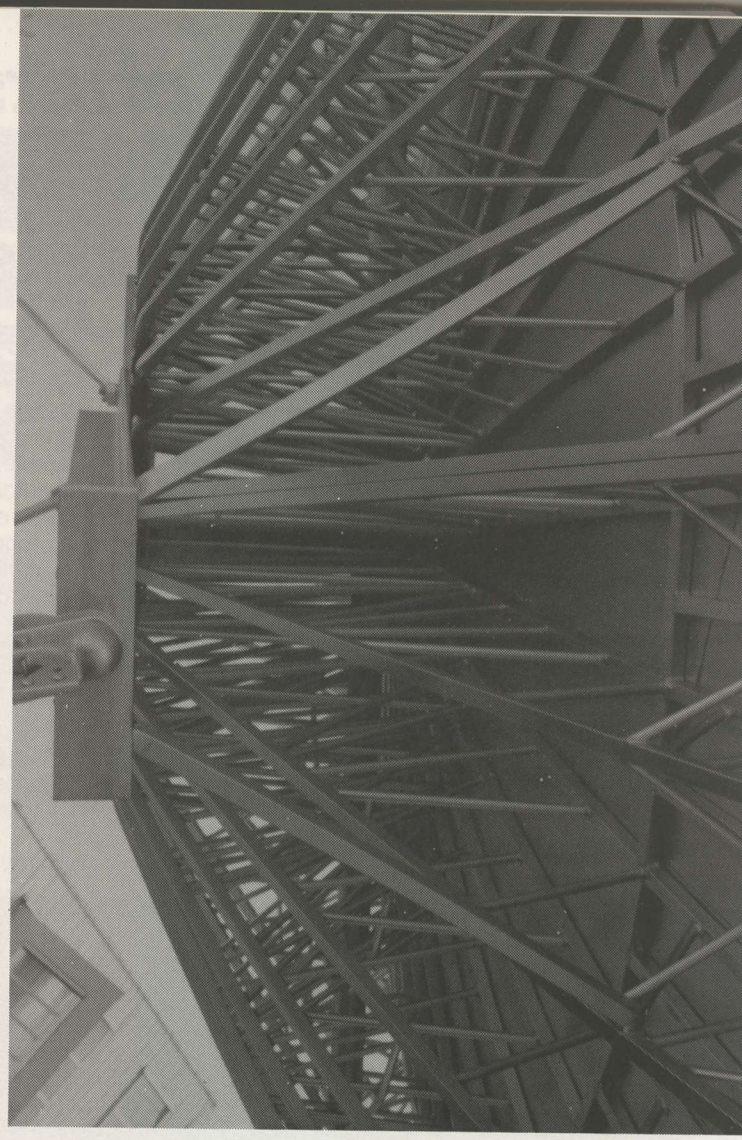
The Commission wants you to consider 'miscellaneous losses' when you calculate your margin, but then in their Appendix they state that **"rain losses need only be considered for those systems that have an overall noise temperature of less than 80 degrees Kelvin".** Such a system is well beyond the system noise temperatures one can expect to attain with today's state of the art GaAs FET LNA units, so it appears that rain losses are not a factor afterall.

Confusing Facts

Between the 34 page decision and the 39 page Appendix, there are any number of argueable facts and approaches to "facts". There is every opportunity here for a gung-ho FCC application-processing type person to put any individual application into a 'frozen in-pile' basket from which it could conceiveably never escape. At least one FCC Commissioner saw this possibility and he took the time in voting his own approval on this docket to issue a 'separate statement' concerning the Commission's action.

Commissioner Abbott Washburn, an early proponent of smaller terminals for CATV, had this to say in his remarks:

> "...**I have been assured categorically by the staff** (of the FCC and in particular of the Common Carrier Bureau) **that the supplemental information required for such** (small earth terminal) **applications will not constitute a burden on individual applicants**...".



HEAVY BRIDGE WORK—is part of the requirement for any TVRO antenna system since the antenna must retain pointing-accuracy even under heavy wind and icing conditions.

So if you feel, in the course of pursuing your own less-than-9-meter application through the Commission you are getting 'waltzed around' by a 'burdensome series of requests for supplemental data', CATJ suggests that you pick up the telephone and put in a call to FCC Commissioner Abbott Washburn. His telephone number is (202) 632-7117.

The Software Connection

At the moment, there are two cable-viable full-time services available via the bird. Both are located on RCA's SATCOM-I generation machine, which makes it slightly easier for the cable operator who might wish to avail himself of both or alternately either of the services.

SATCOM-I is located at 119 degrees west and utilizes 24 transponder channels which are alternately vertically and horizontally polarized. A listing of standard transponder channels appears separately here.

Transponder six operating on the down-link frequency of 3,820 megahertz (3.82 GHz) carries the WTCG full time programming. This is horizontally polarized. HBO (west) operates on transponder channel 20, which is 4,100 megahertz (4.1 GHz) and HBO (east) operates on transponder 24 or 4,180 megahertz (4.18 GHz). Both are also horizontally polarized.

There are, for all practical purposes, two CATV-of-interest birds currently in fixed orbit. The SATCOM-I bird of RCA and the WESTAR II bird of Western Union, which sits at 123.5 degrees west. There is, as one might suspect, something of a "bidding war" now going on between WU and RCA over the new, **additional services** which require delivery via satellite transponders. RCA seems to have the lead at the

Continued Page 30

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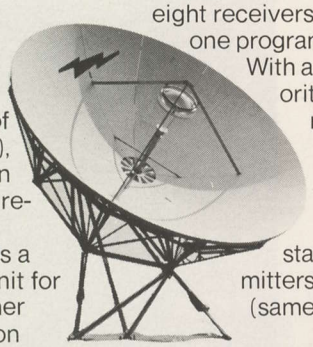

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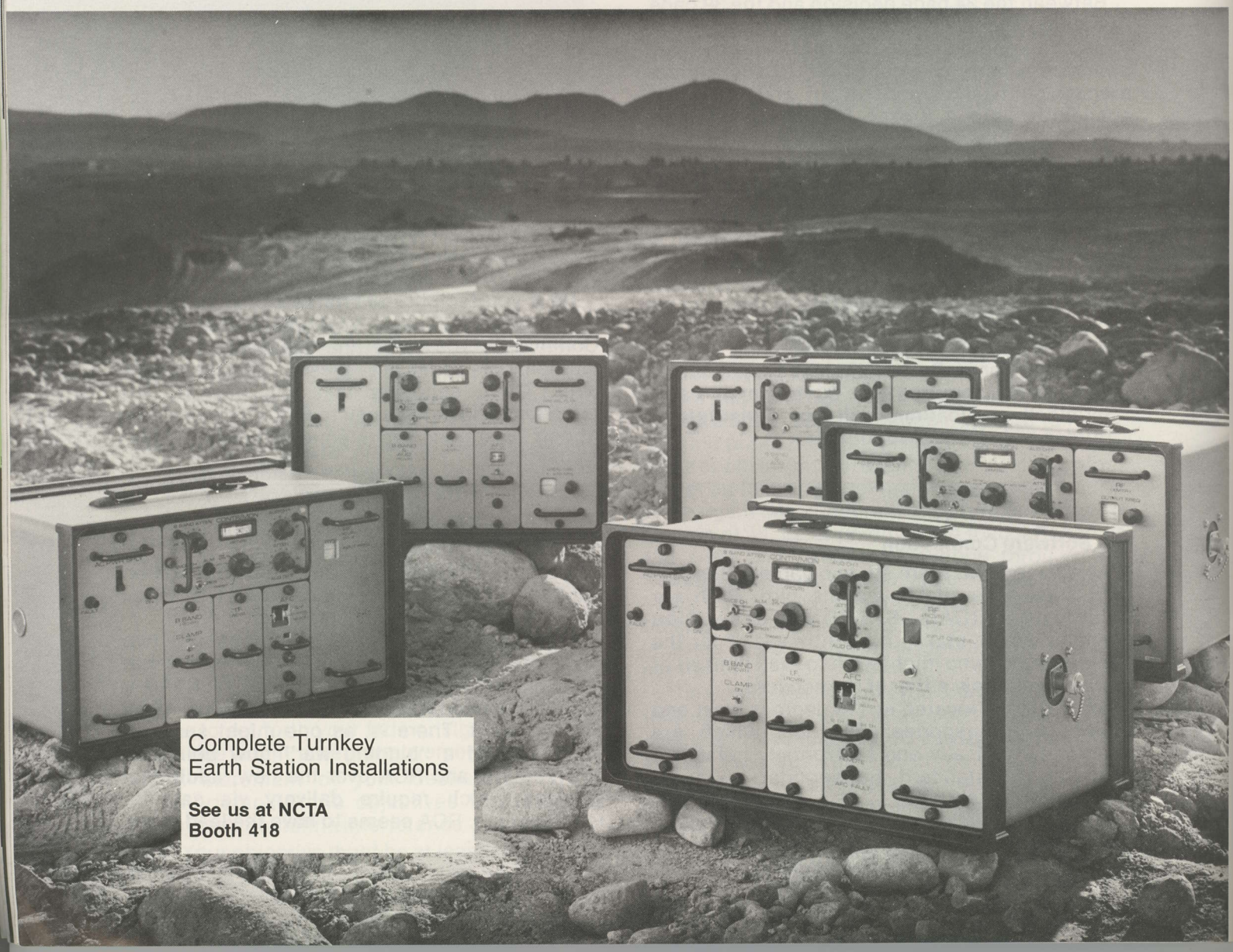
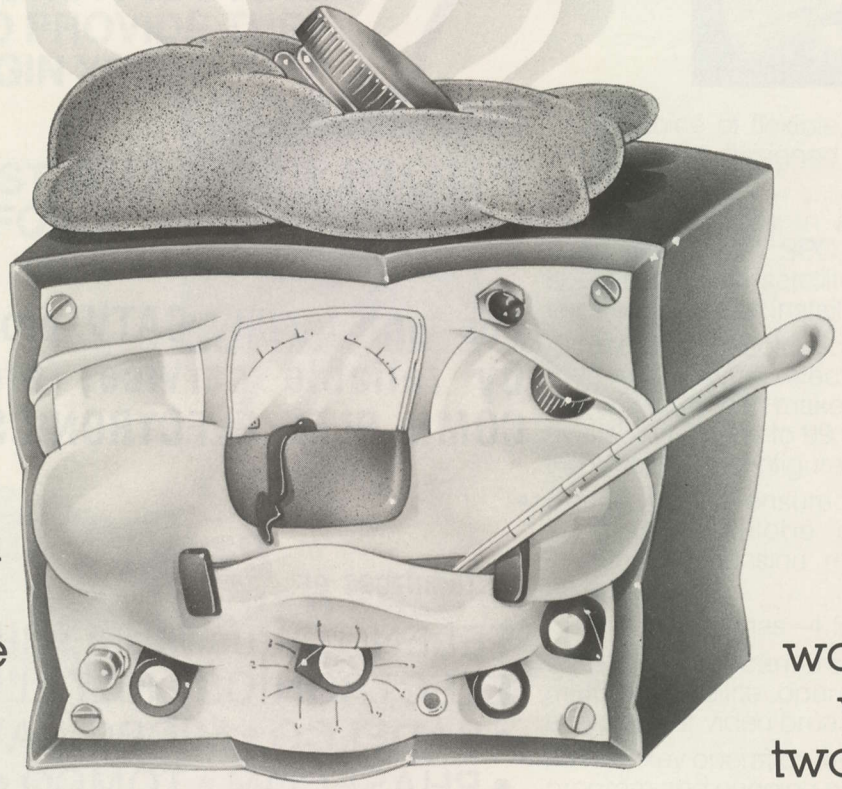


WHERE DOES IT HURT?



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ANTENNA ELEVATION—explained by USTC's Bickel (left) to Southern Satellite System's Ed Taylor (center).

present time, and WU can be expected to employ some heavy marketing and pressures to get back into the CATV ball game. The cable operator is caught in the middle.

You have two choices; if all CATV related signals come from the **same** bird, then your CATV earth terminal antenna can be fixed on that bird and you merely dial up the channels of interest with one or more receivers. However, if some program services are located on one bird and other program services are located on a separate bird, you have a problem; either you arrange to move your TVRO antenna from 119 degrees west to 123.5 degrees west when you want or need to switch program sources, or, **you put in two separate terminals**. . .which includes two separate antennas. Moving the antenna around may be alright for the occasional program that comes from a different bird, but it does not make much sense for day to day operations. Even if the azimuth system was remotely controlled by radio or telephone command, having to drop one or more services from one bird while picking up a service from another bird is at best going to be a problem for system managers and customers. Dropping an HBO program in the middle of a movie to pick up a special event such as a championship fight is sure to rattle the cage of viewers engrossed in the movie.**Seemingly this approach is not very sound.**

RCA is pushing 'this argument' to those new people who have begun to make noises about getting onto a transponder. Let's see who these people are, what they might have to offer, and when they are likely to take place.

Another Indie?

As soon as WTCG was approved for satellite signal delivery, there were a rash of rumors throughout the broadcast industry that "two or more other indies are sure to follow". In the ensuing weeks the rumors died off, but the prospect is still there.

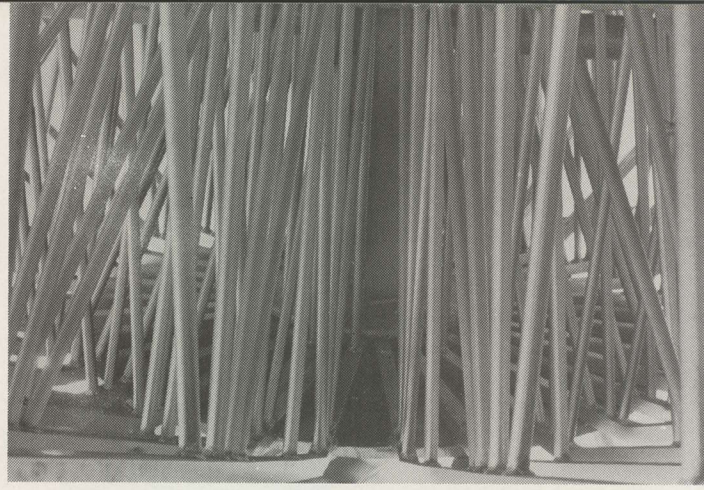
First of all, analyze what it is about the WTCG program offerings which sets **it apart** from say an independent station in New York or Chicago. WTCG has put together a very successful program schedule that blends live Atlanta-based-team professional sports with movies and a

sprinkling of proven, almost ageless off-network syndicated programs. There is a general shortage on the WTCG program schedule of **recent** off-network programs. There is also a shortage of the current first-run syndicated fare such as Mary Hartman/Mary Hartman. **This is on purpose**. Station owner Ted Turner has been dreaming about a national satellite connection for several years. He has been carefully guiding his program schedule so that when that magic day finally arrived he would not be landing in places like Tulsa (which has both cable and satellite terminal capabilities) with a schedule that would be largely carved up into 30 and 60 minute blank carrier periods by the confusing and complicated FCC "syndicated exclusivity" rules. Turner, wisely we believe, said to himself "Why load the schedule with programs which because of their presence on the schedule will prevent me from being carried in many markets?"

By opting **not to carry** a heavy first run or recent off-network-run syndicated program schedule, Turner has been forced to be very creative with his programming department. He has been forced to judge every program offering against not only what will attract audience in Atlanta and Georgia, but also what programs 'will play' live via the satellite in Kansas , Texas and Florida. This has put Turner into the rather unique position of creating much of his own programming. Which is part of his heavy exposure of sports. Turner has an inside track on sports in Atlanta, which is not necessarily true with other independent station owners; he owns the local professional baseball and basketball teams.

So Turner has been planning for years for his entry into the satellite delivery arena. He has constructed a programming schedule that largely avoids the pitfalls of the FCC rules, which means he has created a very clever **alternate programming choice** for viewers. Furthermore, there is every indication that he is thinking in terms of **southeastern USA regionalism**; not of himself and his station as an 'Atlanta' UHF independent. This suggests that as the WTCG program carriage grows, via direct reception, via microwave feed (more than 100 cable systems providing an additional 450,000 potential homes), and via the satellite, the final molding of the WTCG program schedule will take shape. Turner, we suspect, is **not** out to create a fourth **nationwide** network; but he could well become something never experienced previously in television broadcasting; a strong (very strong) regional network. And that, as we shall see, has its own pluses.

Having established that the programming content is an important ingredient in determining **where** a cable system can show (via satellite) various existing non-network (independent) stations, the question comes back full circle to the rumors that plagued the broadcast industry in late December.



FRENCH TORTURE CHAMBER? Shades of the revolution ("I'll talk. . .I'll talk!). **Actually, this is a thru-the-mount view of the complex steel fabrication rib structure that holds the USTC six meter terminal together. Stormy Weathers—"I'm worried whether it is strong enough. I know you could drive one tank over it. But would it take two tanks at the same time?" We bet it would.**

Who will be next?

The question cannot be answered at this time; for certain sure. But one can engage in a type of educated guessing, based upon such known factors as follows:

(A) **Programming content of existing indies** (with a careful study of the syndicated versus non-syndicated programming offered);

(B) **Time Zone** (WTCG is in the eastern time zone. . .there is some logic for the next station being in a somewhat removed time zone);

(C) **Regional appeal of the station** (WTCG's approach to regionalism is not unique, as we shall see);

(D) **Existing cable system carriage or coverage** (stations already carried by a high percentage of their available cable audiences would not be as prime as indies which have by their location large zones of of influence yet to reach, with substantial portions of that zone still unreached by terrestial microwave services).

There are other factors. . .but these will do for now.

The independent stations tend to bunch up; that is, as **CATJ** for April 1975 discussed at length (pages 44-49) there are "influence centers" for independent stations and once you move west of the Mississippi, with the exception of the Los Angeles and San Francisco markets, a large portion of the country is largely unserved by off-air or even terrestial microwave fed independent signals.

In the December rumors, stations such as WGN (Chicago) and WPIX (New York) were often mentioned. Logic suggests such stations would **not** be likely candidates for satellite delivery. For example, WPIX is already carried on CATV systems from Massachusetts to Ohio, and reaches an additional 1,650,000 homes. WGN is less extensively carried (largely due to the lack of terrestial facilities perhaps), but is still before 300,000 or so CATV homes. The name of the game is, always has been, and always will be

PROUD DUO—and the next generation of USTC management are probably in place to see the growing terminal business explosion through until the 21st century (Danny Weathers, left and Tony Bickel right).

"numbers". Home numbers.

Here are some numbers to ponder:

WTCG (Atlanta)
Net Weekly Circulation 516,300
Average Daily Circulation 268,100
WSB (Atlanta)
Net Weekly Circulation 855,900
Average Daily Circulation 567,600

WSB, NBC for the Atlanta market, has a larger **daily** circulation in the Atlanta market than WTCG has for **weekly** circulation. A combination of factors are at work here. . .but a major one is the programming difference. Ted Turner's WTCG, inspite of his innovative programming, has a difficult time getting tune-ins when he is opposite Sanford and Son. So Turner is going to have to **increase his coverage of potential homes** to bring his average daily circulation up to say WSB's.

The potential audience for the two is only slightly unbalanced in favor of WSB's channel 2 facility:

Potential TV Households

WTCG 1,217,800
WSB 1,274,000

Of all potential homes covered, WSB reaches 44.55% of the homes on a daily basis. Over at WTCG, the number is 22.02%. That makes Turner about 50% as good as WSB. Where it counts. **With homes reached daily.**

That says Turner's WTCG has got to reach **twice as many potential homes** as say WSB before Turner has the **same homes delivered daily** as WSB. Turner then must reach 2 x 1,217,800 or 2,435,600 homes. That's where the satellite comes in. We'll come back to all of this shortly.

Other indies have the same problem, to a larger or lesser extent. A VHF indie, well established as most are, is naturally going to be a couple-up on WTCG's channel 17 frequency. Let's take a not-randomly-chosen station such as KTVU in San Francisco and do a similar comparison.

KTVU (Oakland/San Francisco)
Net Weekly Circulation 1,436,400
Average Daily Circulation 627,200
KPIX (San Francisco)
Net Weekly Circulation 1,566,700
Average Daily Circulation 929,300

KPIX, CBS for the Bay Area market, has a daily circulation **48.17% larger** than independent KTVU. For KTVU to draw up to the KPIX daily circulation number simply means they have to **increase their homes reached** by some number that adds the 302,100 daily-homes-tuned-in difference to their statistics.

Advertising Bucks

Homes are dollars. To date the people who spend money for advertising have shown moderate reluctance **to allow themselves to pay** for homes **not** reached direct; or homes not within the respective Grade B contours of the stations involved. There are changes coming however, and stations like WTCG and KTVU are "leading the attack".

Local advertising, that is advertising from local companies which service only the TV station coverage area or a portion thereof, could care less about coverage half way across the country. They will never pay more money to be seen in Great Bend, and that is logical. But national advertisers who use spot advertising buys have a different problem **discounting** the added-cable-coverage homes. They buy numbers **and homes reached are numbers.** Ford, General Motors, Coca-Cola and the hundreds of other "spot buyers" who augment their network fare with advertising schedules placed directly with the stations (as opposed to advertising placed through the network) are fair game for WTCG's number game. They may fight it at first, but sooner or later they will come around to accepting that Ted Turner's 567,000 total homes (via direct reception, terrestial microwave to cable and satellite microwave to cable) have got to count the same as WSB's direct (plus cable) 567,000 homes. When that day finally arrives, Ted Turner will be in a position to deliver as many (if not more) "homes" to such national (or regional) spot buyers as the network stations do now.

The network affiliates strength is their programming appeal. Around the high appeal network shows they have a seller's field day filling up their schedule with high dollar (and high audience reach) spot announcements. The people doing the spot buying are buying **homes reached**; nothing more. Turner knows that, and where his programming may only have **half the appeal** he will come back with **twice as many potential homes delivered.** Which will make him even-up with the network affiliate numbers.

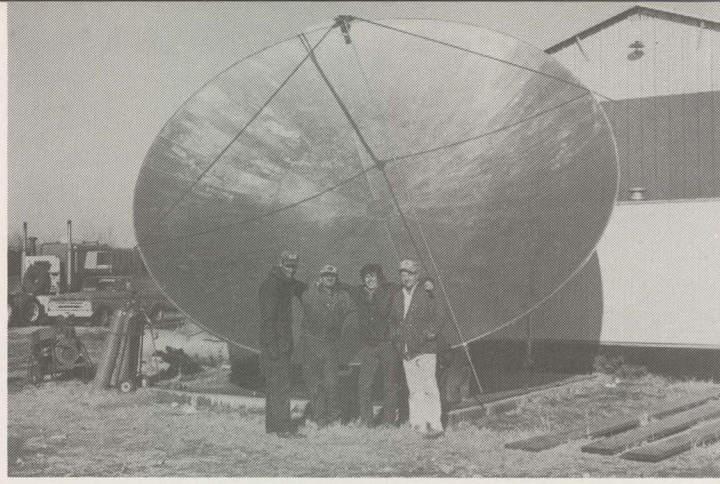
There are alot of independent television people wearing out alot of yellow legal pads over this particular numbers game. One estimate suggests that if Turner can up his potential homes by 1,000,000 (which translates to another 220,200 daily tune-ins based upon our previous analysis), he will be rewarded with an additional $12-$14,000,000 advertising revenue at WTCG for

the year. That is a bunch of bucks. If he adds another million potential homes **beyond** that first 1,000,000 new homes he may then expect $2-3,000,000 additional advertising revenue at WTCG annually. It works that way **now** because he is getting the "left over spot buy budgets" **after** the agencies have saturated the three Atlanta network affiliates. Getting **on a par with** the three Atlanta network affiliates is an important and dollar-rewarding **first step**.

The same thing could be said for the likes of KTVU in San Francisco. It may not realize quite as dramatic a percentage increase when it pulls equal with KPIX, but it will be big bucks none the less.

Of course KTVU is **an** example, there are numerous other stations that might have a run at the satellite delivery business. Let's go back now and look at how stations in various parts of the country **might find** satellite delivery appealing.

Initially, the FCC wanted cable systems to only carry the independent station signals which were closest to them. This rule was modified in 1975 when the so-called leap-frogging provision was voided. However, as long as there was no **economical means** of delivering New York's WPIX to San Diego, it didn't make too much sense to worry about the **long-distance implications** of the rule change. WGN out of Chicago, for example, and its estimated 300,000 potential homes reached by cable, fits the "regional pattern" very nicely. By serving cable



THE PROUD BUILDERS—the gang who did most of the welding and fabricating work on the USTC six meter terminal have every reason to be proud of their product.

outlets in the Dakotas, Wisconsin, Minnesota, Iowa, Illinois and in portions of Michigan and Indiana, WGN just about fills out its own "region" with terrestrial service.

The extensive terrestrial microwave in the northeast, largely dominated by the programming of New york City independents, **is also regional in nature.** Given another year or two, there will be few cable locations in the northeast that cannot be reached via terrestrial links.

The same can hardly be said in the southwest, the Rocky Mountain States, or the northwest. While there are **some** microwave trunk routes that extend California independent station programs ease into the Colorado area, or the New Mexico/west Texas area, the regions

GO BACK AGAIN!—six meter terminal designer Tony Bickel of USTC spent a lot of time shouting out to the crew moving the dish through its azimuth and elevation settings to "coordinate" his 'eye-balling' of the signal level meter on the TerraCom receiver with the AZ-EL adjustments.

unserved by such service are far larger than the regions served.

All of this begins to point towards **a San Francisco Station** as the next most likely candidate for transponder time. All of the ingredients are in place, although perhaps not as set in place as Ted Turner's foresight has created for WTCG. The Bay Area has plenty of big time, professional sports. The market is plenty large enough to on its own justify purchase-for-airing of virtually any special or high dollar cost program to come down the pike. The time-zone-differential fits. And the 'region'. . .all of the northwest, most of the Rocky Mountain time zone and a fair hunk of the nation's middle plains is a big one.

NON-TV CHANNELS

Not all of the program materials being talked about for cable are going to be coming directly from the likes of WTCG via Southern Satellite Systems. For example, the **Christian Broadcasting Network** (they own and operate WYAH-TV in Norfolk, WHAE-TV in Atlanta, KXTX-TV in Dallas and hold construction permits for WXNE-TV in Boston, WMTU-TV in Memphis) is reported to be getting ready to come off of the bird; for at least a portion of the 'broadcast' day.

CBN is best described as speciality station programming; largely religious, and largely supported by viewer donations and contributions. The network has been very successful with providing stripped programming (such as their 'Club 700' talk-religion-show) to perhaps a hundred commercial stations nationwide, and a fair number of cable systems are already carrying CBN's 'Club 700' on their local origination channels via tape. CBN has a **different** approach in mind than WTCG.

First of all, WTCG does not itself own or operate the facility via which their program gets into the SATCOM-I transponder and then back down to the ground. This is done by a fellow named **Ed Taylor** who headquarters in Tulsa, Oklahoma. Taylor owns something called **Southern Satellite Systems**; which is a brand new breed of (television) common carrier. Taylor's 'SSS' is not unlike the terrestrial microwave common carriers which bring off-air television signals to distant points for cable replay. Down in Atlanta, at a point 8 miles away from the WTCG transmitter site, Taylor's 'SSS' installed an off-air pickup from WTCG. There it demodulates the WTCG signal, cables it into an uplink transmitter in the 6 GHz range, which in turns travels 22,300 miles to the SATCOM-I transponder receiver. Taylor is on his own; he has **no connection** with Ted Turner's WTCG other than having selected WTCG for his feed-source. When a cable system wants to utilize the WTCG signal, it contracts **not with WTCG** but with Southern Satellite Systems. Taylor is the one who won FCC approval in December to deliver, via satellite, the WTCG signal to cable systems. Taylor is the one who is paying rent to RCA for use of their transponder number six. It is Taylor who makes a buck or loses his shirt on this deal. Yes. . .WTCG stands to make out very well if the concept flies, but only **after** their audience goes up and **after** Ted Turner's people are able to convert that increased audience into increased advertising bucks.

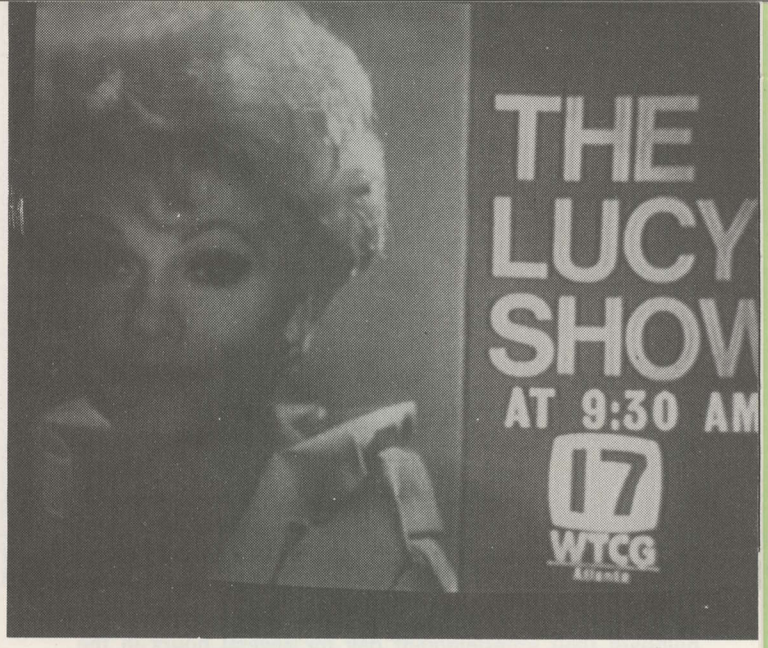
There are three plans available at 'SSS'. Number one is you take the WTCG signal seven days a week, twenty four hours a day (except Sunday night when they are off for a few hours for testing). And you pay Ed Taylor the fee his 214 (common carrier tarrif) filing states. **That is ten cents per cable home per month**. You sign an agreement with Taylor and you tell him how many subscribers you have going in (Newton, Kansas when it turned on in December had 17(!) subscribers and their check for the month was a whopping $1.70). Then each June/July, under the contract, you provide 'SSS' with a copy of your annual 325/326 form so he can verify and update your billing. You don't adjust monthly; just once per year.

Now back at CBN, their plan is different. First of all, they don't offer Ted Turner's kind of big sports and movies (although there might be a market for 'live-from-the-coliseum' gladiator bouts). They offer religion. They recognize that at best you may have a bit of trouble turning God into new subscriber dollars **on a par with** Atlanta Braves baseball. **So they are going to give it to you**. Free. Initially they will feed you around 8 hours per day of religion. Probably as a direct video feed, meaning you won't be getting their WYAH-TV (Norfolk) via the bird; you will simply be getting a "direct via satellite video feed" to put on a channel of your choice. Your obligation is to provide the terminal (which we will assume you already have on) plus the receiver tuned to their transponder channel plus a modulator to put it on your cable. Later down the road. . .they say. . .there could be as much as sixteen hours a day of this type of "programming" from CBN via the bird. CBN will pick up the cost of the transponder time, which will be a healthy bite. CBN obviously figures the added homes they reach will result in added donations, at least enough to service the transponder bill. **This**

service is scheduled for a springtime start this year.

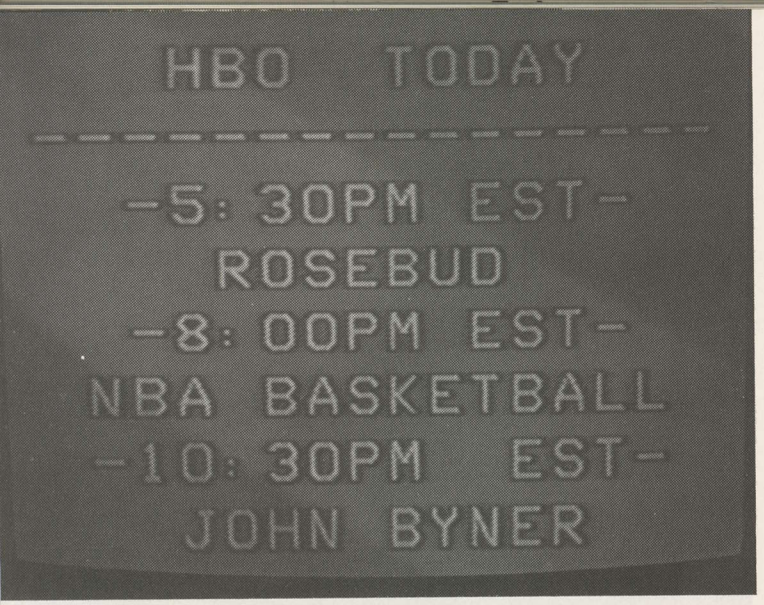
Back at 'SSS', there are two other offerings available. Let's say you already have your full share of FCC-allowable independent signals in your market. OK- 'SSS' will contract with you so that you can carry the WTCG 'wee-hours' programming, during that portion of your cable day when you are allowed to add an **all-night** (movie) **station**, for two cents a subscriber a month. Or, if that is not your cup of tea, let's take a system located in a market where because of existing signal carriage WTCG cannot be carried fulltime. . .but it could be used effectively as a "fill-in" program source on a "wildcard basis" for blacked out programs that get hit by the exclusivity crunch. **That will cost you one penny per month per subscriber**. Your 'SSS' contracts, by the way, are for two year periods with a six-month termination clause if you want out for some reason sooner than that.

Then there is the project over at **Federal Broadcasting Company** (Pleasantville, New Jersey). FBC has been around awhile providing sports and other speciality programming tapes to cable. They have been quite successful at it and a fair number of larger market systems are running their all-sports channel and other offerings as a local origination package. Well, FBC is about to get into the satellite program delivery business. And it makes good sense, since they seem to have the programming aspect



MORE OF TED TURNER'S MAGIC—By sticking to older syndicated shows, with universal (seemingly endless) **appeal, Turner will avoid many of the problems other stations might well have with long-haul-importing into distant markets. Photo off of USTC terminal, after a 44,600 mile trip.**

of the project pretty well under control. FBC is actually in two types of business. They recently signed a whopping contract with ITT Space Communications involving 50 larger-type TVRO terminals; these are scheduled to go to non-network TV stations spread throughout the United States, starting this fall. The concept in this phase of FBC's activities is to provide **the indie stations** with regional and national sports



HBO VIA THE BIRD—the pay cable channel people currently billboard their entertainment day for several hours in the afternoon prior to the start of their "broadcast day". Photo via USTC terminal Afton, Oklahoma.

and special events feeds, **via the transponder**. If there is even the germ of a fourth network starting anyplace, **this could well be it**. But under a per program concept, not a blocked across-the-board sign-on to sign-off approach the three (major) networks play. This project has a fall of 1977 start date.

The FBC **cable** network **concept** (network is our word, not their's necessarily) is a little different. They will phase from their present tape distribution to network distribution and like CBN (Christian Broadcasting Network) you won't have to mess around with a CAC to carry them. They won't be a "broadcast type signal". . .rather they will be a closed circuit program source type feed. Their programming concept is not generally available, but it is sure to be a big topic of conversation around April of this year when the clan gathers in Chicago. The type of material they have available to them, in addition to their sports features, includes the likes of Norman Lear (MH/MH) pilots, MGM Movies and Marvin Sugarman sports spectaculars.

Under the present scheme of things, a person coming **off of** a satellite has three ways to go:

(1) Via an established common carrier (i.e. Southern Satellite Systems),

(2) Via the self owned route (like HBO or as CBN will do)

(3) Via a new, yet to be established, common carrier.

'SSS' had to go to the FCC under a rather limited approach of planning-to-distribute **only** WTCG at the present time, largely because **it was a pioneer**. The FCC put several tough restrictions on 'SSS' and whether these hold up for **any** 'satellite common carriers' who might wish to follow the 'SSS' example will have to be seen. Under the present 'SSS' authorization, it can supply **only** WTCG programming. Another approach, rather openly discussed, is for a company to set itself up as a general carrier of programming via satellite and as a common carrier. It might choose to "mix" its programming, carrying "closed circuit" or self generated materials a few hours a day, special events such as sports another segment of the day, **and** a mix of one or more off-air television stations (such as KTVU or others) the balance of the "programming day". None of this will be automatic; the FCC is going to have to see any application to transmit from the ground to a transponder input channel (and simultaneously through the transponder back down to the ground on an output channel). And if the application involves any "novel" approaches, such as common carrier and other mixed equations, there is a good chance the application will sweat a little blood before it is approved.

Restrictions Et Al

Not everyone is home free, even with the HBO or WTCG programming, under the recent relaxation of the 9 meter standard. The continental 48 states are covered by the size relaxation; Alaska, Hawaii, Puerto Rico and so on are not. Again, in the case of Alaska and the HBO "west coast" feed, it is not a matter of making the smaller terminals work technically; it is back to the drawing boards for political considerations. There are already around 100 small (i.e. 4.5 meter) terminals in use in Alaska **on another project**, and we've heard from some oil-field-electronics people who tell us about watching HBO programming in their "communication huts" off of their existing 4.5 meter terminals.

One of the pending actions at the Commission is a "related" field is giving some concern to the likes of Ed Taylor at 'SSS'. **And that is translators**. The FCC is scheduled to give serious consideration to a long pending rule making proposal which, if passed, would allow television translators to take microwave (or **common carrier**) feed of television signals. Translators currently rely on either direct off-air signals of signals "relayed" to their location by other translators. This is restrictive of the distance which broadcast signals can be "extended" beyond their normal coverage area; and the translator people want "parity" with cable people. Parity to the translator people means use of microwave.

"What happens" we asked Ed Taylor **"if the FCC approves this microwave fed status for translators and a potential translator operator comes to you for service?"**

Taylor allowed as how under his 214 filing he could not refuse WTCG service to anybody who was qualified to take it.

"Now suppose that person wanted to install a 1 kW UHF translator in say Tulsa (Oklahoma); **where the Tulsa cable system operates. Under the FCC rules the translator operator could** demand **carriage by Tulsa's cable system. Could the Tulsa system** refuse **to carry the** 'local' **UHF translator simply because it was already carrying its FCC allocated share of two independent signals** (one from Dallas and one from Kansas City)?"

Taylor thought not; and an FCC source we checked with agreed.

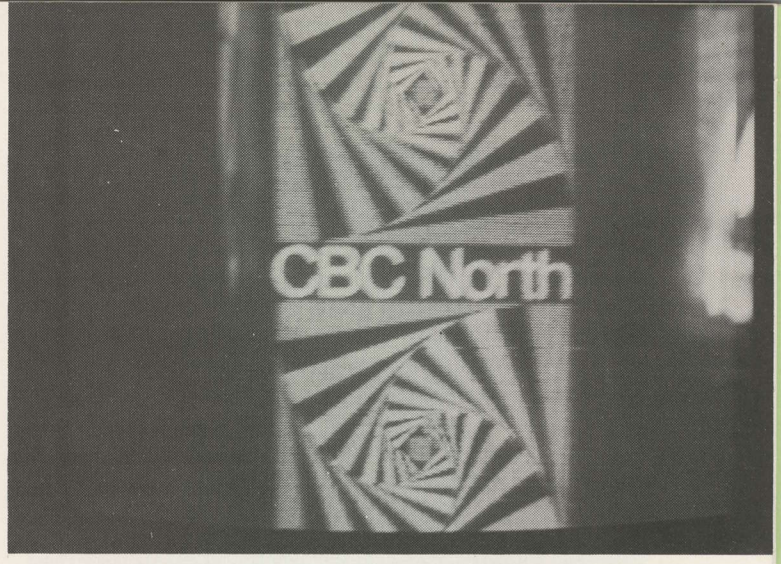
"OK. . .now the FCC rules allow the translator operator to strip time out of each hour and produce and sell, as a fill in the stripped time, local commercials to pay the cost of his translator operation. Now we have an Atlanta, Georgia independent station, delivered via common carrier (satellite) **to Tulsa, Oklahoma, translator re-broadcasing over Tulsa and through the local Tulsa cable system, sponsored by 30 second commercials which the translator operator sells locally to local merchants."**

Taylor shook his head in wonderment. The FCC contact we discussed this with thought this would be in the spirit of "good competition". We didn't discuss this with the Tulsa television stations. We figured that maybe they had it coming.

Taylor admitted he would have some difficulty arriving at a "rate" for the translator service. **"After all, we base our cable rates on each subscriber home. How do you compute rates for a translator? Every home within the coverage area? I don't know. . .but it could turn out to be cost-prohibitive."**

Synopsis

We mention this here because it typifies the kind of free-thinking, open-ended **new world** which TVRO's have brought to us. We are, without a doubt, in the very early stages of a revolution in the CATV business. Many of the changes we will like; a few will be individually or collectively unnerving as they unfurl. It is, none the less, fair to say that no matter what you have been through to date, **". . .you ain't seen nothing yet!"**



CBC NORTH— one of three ANIK transponders on the air the better part of the day (and night) with programming (in this case) for Canadians living "far north". The transponder feeds largely unattended earth terminals that in turn feed largely unattended low power VHF "satellite TV stations" in the Northwest Territory and Yukon. Picture off USTC terminal, Afton, Oklahoma.

The Hardware Connection

Much of the credit for the realization of the small earth terminal program must go to a handful of dedicated equipment suppliers who saw the feasibility of such terminals.

Everyone going in knew that **if** small terminals could be approved there were dollar savings for operators possible. It is probably too early to know just how big those savings are today or will be tomorrow. The earliest 10/11 meter terminals were priced in the $90-$100,000 range, more or less installed. As the competition heated up for this size terminal, the prices came down so that this past fall installed prices in the $65,000 region were being reported. How much lower 10/11 meter terminal prices might have dropped, if the smaller terminal approval had not come along, is pure conjecture. But we doubt very much below the $65,000 number.

In the larger terminals, the primary cost is the antenna array, including the mount and the support structure. The electronics sort of tagged along, seldom making up more than 40% of the total package price. The analogy was not totally unlike building a conventional off-air CATV headend site with a 500 foot stick in the mid-west; the tower costs are often more than half of the total headend package price.

The smaller terminals must be approached from a different direction, because now for the first time the electronics becomes the dominant factor in the package. This is an important change, because where before it was the antenna manufacturer you dealt with for the package (because his portion was the largest), now **in many instances** it will be the electronics manufacturer or packager with whom you will deal for your "system". (This presumes that you are dealing with a supplier who does **not** in-house manufacture or supply the total package.)

For a starting point, let's look at the ballpark kind of numbers you will be dealing with for each of the major component parts for the small earth terminal system:

1) **The antenna**

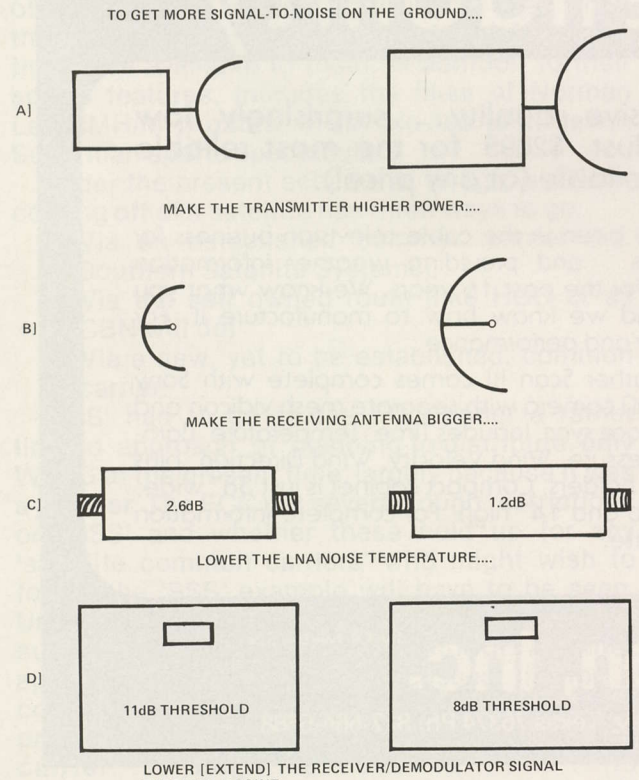
This can be any size parabolic dish from the 4.5 meter small version up to perhaps a 6 meter 'slightly-bigger-than-small' version; or a 14 foot 'horn'. You will find the antenna quoted 'FOB' its point of manufacture, or, delivered to your site (ready for you to install), or installed. The only valid price for the antenna itself is the FOB price; the rest is necessary for your acquisition but not the actual antenna cost alone. Prices will start between $10 and $11,000 and work up. Prices are expected to stay stable.

2) **The LNA**

You are buying two primary things; gain and noise figure. The noise figure (or noise temperature) is the most expensive part. Prices for 30 dB of gain and 2.6 dB noise figure start around $900. and then work upward in the GaAs-FET versions to around $4,000 for 50(60) dB of gain and 1.3 dB type noise figures. Prices for all LNA's are expected to stay fluid, with better noise figures and lower prices going hand in hand as the year matures.

3) **The receiver**

The receiver represents two things; a microwave region receiver that demodulates to video and (sub carrier) audio, and a tuning device. To a small extent you are buying 'specs' in the receiver FM threshold department, but most receivers are fairly comparable in this area excepting where there is 'threshold extension' offered. State of the art suggests you are looking for an 11 dB FM threshold in a standard receiver, down to 8.5 dB FM threshold in a 'threshold extension' unit. Beyond that spec, the tuning range and format is where you will spend your money. Single (transponder channel) frequency receivers are the lowest priced; multiple channel receivers (either fixed tuned or continuous-tune) cost more. Look for receiver accessories or options to dominate the receiver field in the next couple of years; remote tuning of the receiver (changing the input channel from a remote location by remote control) is already here and other innovations are sure to follow. Prices are hard to pin down largely because of stiff competition; but we have heard prices as low as $4,500 quoted for single channel (not adaptable to more than a single channel) receivers with $12,000 per receiver close to **the top** for a unit that offers most of



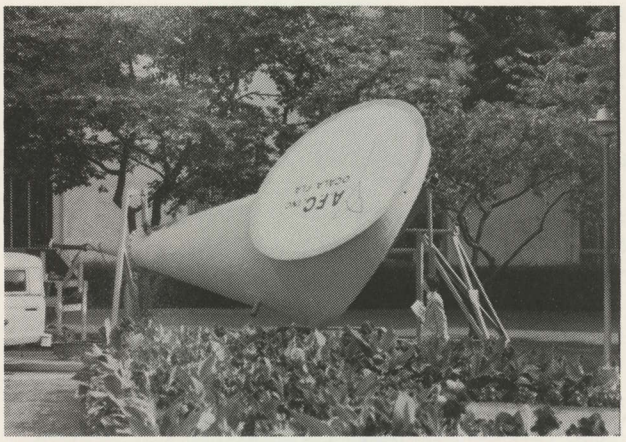
the present-day 'whistles and bells'.

In addition to these basic parts, you will also need the transmission line to the receiver (from the LNA at the feed or antenna) and an RF modulator to reconvert the satellite signal back from video/audio to a CATV carriage channel. Most of the installations are using 7/8" line for the downline run and typical runs are in the 100-200 foot class. (The longer the run from the antenna/LNA combination to the receiver in the headend, the more gain you will need in your LNA; line losses at 4 GHz are on the order of 3 dB per 100 feet for Andrew HJ5 type cable [7/8" air-dielectric Heliax] for example.)

With those basics out of the way, let's take a look at the specific services and equipment which are available at this time. We have attempted to collect into this summary all of the companies currently engaged in this area, but **not all** have chosen to supply the data we requested. Consequently, this is an about 90%-complete listing in each area. As additional sources of services and equipment come along, we'll update this report from time to time:

The Programming Sources

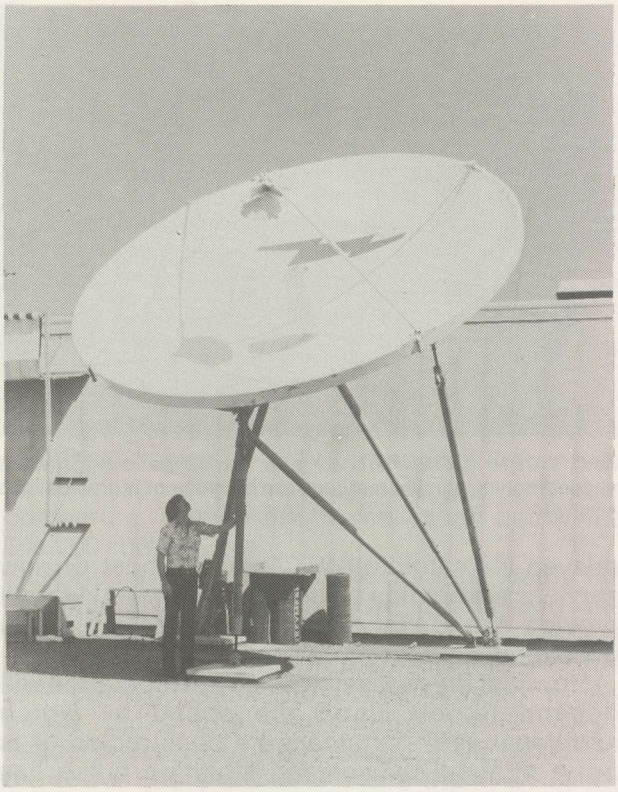
This will be a year of 'transition'. The established service (HBO) has been joined (since mid-December) by the first TV broadcast service



AFC HORN ANTENNA has strange shape but provides exceedingly low noise temperature because of high side lobe control.

relayed via satellite (WTCG) and a host of new services are coming on line. Each new service will provide the CATV system operator with new decisions.

How fast the new services go into operation will depend largely upon the speed by which additional earth terminals are constructed. It is not a straight chicken-egg situation but it has similarities. Because there are already operating services (HBO and WTCG), sufficient incentive already exists for many systems to install the relatively speaking expensive TVRO equipment. As this happens, other satellite delivered services



ANDREW 4.5 METER terminal has special mounting system allowing it to be roof mounted where space is a problem.

will weigh each new system 'on line' and eventually make up its own mind as to whether it wishes to contract for the expensive satellite delivery time.

CBN - Christian Broadcasting Network (Pembroke Four, Virginia Beach, Va. 23463/804-393-2503). CBN presently operates several UHF television stations which qualify as 'speciality stations' because of their largely 'religious programming' formats. CBN has experimented with satellite delivery of religious 'telethons' and they appear to be thoroughly commited to satellite delivery. It is expected that sometime during March or April of this year CBN will begin distributing via satellite (SATCOM-I is likely but no sure decision yet) approximately 8 hours per day of 'closed-circuit' (meaning non-broadcast type) programming with a religious flavor. Early indications are that the cable systems using this programming will **not** be charged for its use. CBN will finance this project through solicitation of donations on their programs.

FBC - (Federal Broadcasting Company, 600 Fire Road, Pleasantville, N.J. 08232 / 609-641-8637) FBC has been servicing via tape approximately 60 systems (with over 750,000 subscribers). They have recently inked an agreement with sports-entrepreneur Marvin H. Sugarman and are planning a "bird-start" around April 1 with movies, special target programming and commercially-sponsored sporting events. Look for some innovative new wrinkles regarding how you as a system operator use their programming and recover your costs for the terminal with this group.

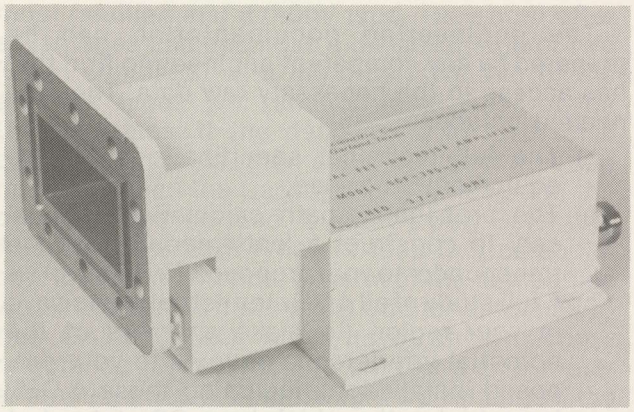
HBO - Home Box Office, Inc. (Time & Life Building, Rockefeller Center, New York, N.Y. 10020/212-556-2433) started it all via transponder. HBO currently feeds CATV systems in 40 states (275 CATV systems at last count) with an excess of 600,000 subscribers. Approximately 50% of the existing CATV-system-affiliates at HBO are receiving their HBO material via the satellite, the balance via terrestrial microwave. In 1977, the scale will tip towards the satellite inter-connected systems and stay that way from this point forward. Major, late release, movies are the primary element of HBO's program package although HBO feels there will be a gradual increased emphasis on special programs developed specifically for HBO in the years ahead.

Sporting events are also very important to HBO's schedule, and emphasis is on providing a balanced sports coverage of events not otherwise available on (commercial) television.

HBO currently "programs" from 5:30 PM (start time) to past midnight on weekday nights, 3 PM (start time) to past midnight on Saturdays and Sundays. There are two HBO feeds, one for the eastern and centime zones (on SATCOM-I transpounder number 24) and another for the mountain and Pacific time zones (on SATCOM-I transponder number 20).

HBO is in essence "your partner" in the pay-cable channel programming, providing the programming, sales materials, marketing assistance and other software for approximately 50-60% of your pay-cable channel gross (subscriber) revenues. You provide the hardware and the channel.

HUGHES - (network) is presently an unknown quanity in the CATV world, may **not** develop into something with direct-for-CATV programming. Hughes was recently purchased by Paramount Pictures Corporation, having been largely a sports and special events coverage 'network' made up of television stations that signed on for a program by program basis. Until the purchase by Paramount, there was no CATV direct involvement. However, the new Hughes owner has ordered from RCA American Communications, Inc. (SATCOM-I) a minimum of '5,000 hours of transponder time per year' for the next two years, growing to 24 hour



SCIENTIFIC COMMUNICATIONS GaAs-FET low noise amplifier. Unit mounts at end of wave guide from feed (antenna) or horn antenna bolts to open end (left). Standard type "N" fitting for transition to downline is on opposite end (right).

per day useage during the third year. This much transponder time strongly suggests regular program service to 'somebody' and CATV terminals **may be** part of this program. In another related action, Hughes has signed a long term agreement with the Spanish International Network (SIN) for 2,900 hours of Hughes' transponder time (sort of a sub-letting agreement it appears). That boils down to Hughes using 5,000 hours per year (13.7 hours per day) and of the Hughes 13.7 hours per day, SIN will be using 7.9 hours per day. SIN operates Spanish language television station KMEX (Los Angeles) and has an interest in Spanish language stations KWEX (San Antonio), WLTV (Miami), KFTV (Hanford, California), WXTV (Paterson, N.J.) and is associated with KDTV (San Francisco). Some of the SIN programming comes from XEW-TV (Televimex S.A., Mexico City) and recently "transponder watchers" have observed XEW programming being relayed via satellite transponder.

SSS/WTCG - Southern Satellite Systems, Inc. (P.O. Box 45684, Tulsa, Oklahoma 74145/ 918-664-4812) is the common carrier with whom CATV systems contract for carriage of WTCG service. WTCG currently programs 24 hours per day, six days per week and is in the process of converting to seven days per week, all the time. Station programming includes 40 movies per week, 'ageless' off-net offerings such Flintstones, Mickey Mouse Club, Gilligan's Island, Beverly Hillbillies (etc.) and professional sports including Atlanta Hawks, Flames and Braves games and NBA game of the week. WTCG has a 'Country Music Night' on Saturdays. CATV systems contract with Southern Satellite Systems at full time rate of 10 cents per subscriber per month, or other

AIL 4060F PARAMETRIC LNA accepts waveguide input (top) and in apparent move directed at CATV market has "F" type output fitting.

lesser-time carriage options. WTCG has been reported to be very helpful with new cable 'affiliates' in getting local promotion for the station in your cable market, and in some instances cable operators report WTCG has established a local advertising allowance to help the system promote the channel 17 programming.

Note: Any station planning carriage of WTCG must obtain through the FCC a certificate of Compliance for WTCG signal carriage **prior** to making application for a TVRO facility. However, CAC approval is **not** required for non-broadcast signals (such as HBO, etc.) although FCC licensing of the TVRO facility **is** still required.

The Preparation Sources

Having determined the transponder signal sources your system will utilize, the next step is the 'design and feeding' of your TVRO facility. This involves preparing your system layout, determining which antenna, which LNA, which receiver/demodulator will be utilized and how it will all lash together and where it will go. The detailed explanation of the planned TVRO facility must accompany your application (see **The Approval** elsewhere in this issue) and much of this is rather involved engineering.

Your application for your TVRO facility breaks down into two areas:

1) The engineering attachments;
2) The legal documents including your actual application for a TVRO facility.

The engineering documentation can be prepared by any competent engineering firm that has access to the necessary raw data. The data needed includes:

a) The full technical specifications for the equipment to be used;
b) The propagation-path calculations necessary to construct a 'path-model' from the transponder to your proposed TVRO site;
c) A full study of all 4 GHz terrestrial microwave in your region (to make analyses of the potential interference sources to your proposed installation), including those 4 GHz terrestrial paths which have CP status but which have not yet been constructed.

There are two firms in this business who specialize in just this type of work, plus a probably very large number of (consulting) engineering firms who have the capability to do this type of work. We will list the two 'speciality' firms only here:

COMPUCON, Inc. - (13749 Neutron Road, Dallas, Texas 75240/214-233-4380) handles all phases of site selection (for the TVRO facility), and preparation of the FCC required engineering paperwork to satisfy the Commission's requirements for signal to noise, carrier to noise and carrier to interference ratios. Compucon is essentially an engineering firm (with in-house computer facilities) with heavy mathematical emphasis. Compucon is also a major supplier of microwave frequency coordination services and has been in business since 1968.

SAFE - (Spectrum Analysis & Frequency Engineering/1601 N. Kent Street, Suite 1010, Arlington, Virginia 22209/703-527-7500) is a wholly owned subsidiary of Rockwell International Corporation. Rockwell also owns Collins Radio, a major supplier of microwave radio equipment. The company handles frequency planning, frequency monitoring, satellite earth station placement and coordination, microwave path engineering and route design. The company also maintains an office in Dallas, Texas. By maintaining a computer data base of all known 4 GHz terrestrial transmitters in the United States, the company is able to derive interference source models for all applications of TVRO facilities. The published charge for preparing a receive-only earth terminal for CATV coordination package is $1,200.

The Antenna Sources

There are two basic decisions to make with your antenna selection, and they may well be determined by your location and interference potentials from terrestrial sources. The first decision to make is to choose between a parabolic antenna (that type with which we are all

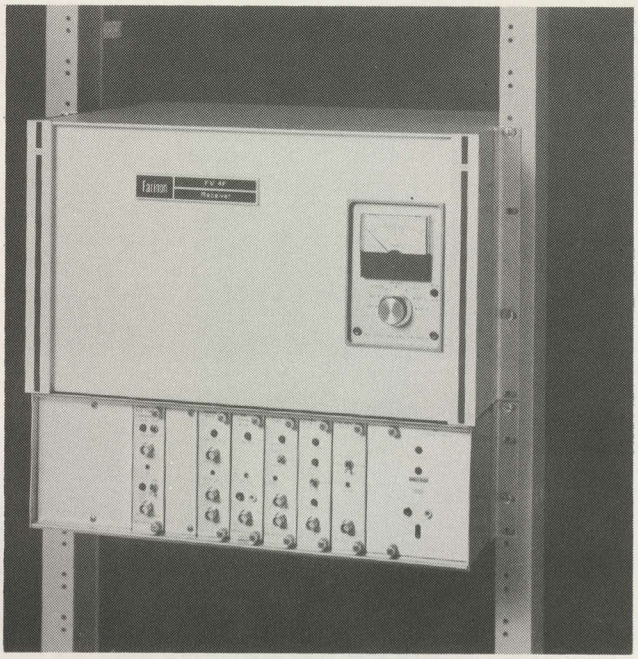
most familiar) and a 'horn' type. They both offer advantages and each has a dis-advantage or two (when compared with the other). Neither of the antenna 'types' will function in all areas of the United States. If the decision is in favor of a parabolic antenna, then a sub-decision must be made between the Cassegrain type feed and the prime focus type feed. Currently only Scientific Atlanta offers both types of feed in a parabolic configuration antenna. Several of the companies who have been offering 10/11 meter antennas to the CATV TVRO field have shown some reluctance to get into the smaller-than-9 meter antennas; a decision that might well change if the market grows as rapidly as many now forecast. Consequently, at the present time there are only a relative small number of 4.5-6 meter antenna suppliers in the field.

AFC - (Antennas For Communications, 486 Cypress Road, Ocala, Florida 32670/904-687-4121). AFC is the only 'horn antenna' manufacturer with an interest in the CATV marketplace. The horn antenna is likely to be the subject of much interest in the years ahead because of its unique design and unusual operating parameters. AFC supplies horn antennas to major terrestrial microwave users. The CH-14M 'horn reflector' was specified in two early small terminal applications put on public notice by the FCC on January 11th (Gaithersburg, Maryland and Radio Broadcasting Company, Philadelphia [MDS operator]). The specifications on the CH-14M horn are as follows:

Gain at 4 GHz ..... 43.5 dBi
Operating frequency range.... 2-20 GHz
Envelope of side lobe peaks..... substantially better than 32 -25 log theta
Side lobe level 180° +/- 100° ..... better than -80 dB
Noise temperature . does not exceed 3° K at 5° elevation

The very high side and rear lobe rejections will undoubtedly play a large role in allowing CATV TVRO terminals in 'congested terrestrial areas' to operate without interference from terrestrial sources. The low noise temperature works to the advantage of the system planner faced with low EIRP values and potentially high LNA costs.

ANDREW - (10500 W. 153rd Street, Orland Park, Illinois 60462/312-349-3300). Andrew was heavily involved in the 10 meter installations for TVRO systems (see **CATJ** for **February 1976,** page 10) and was one of two companies to demonstrate working 4.5 meter terminals at CCOS-76 in August of 1976. The Andrew 4.5 meter 'earth station antenna' is already installed in some



FARINON FV 4F satellite TVRO receiver rack mounts.

200 sites throughout the world. The antenna mounts on a wide 3-point pickup to reduce foundation loads while holding the antenna rigid in strong winds. Fine adjustment (+/- 10° of orbital arc) is accomplished with threaded rods. The specifications on the Andrew type ESA-46 antenna are as follows:

Gain at 4 GHz ..... 43.8 dBi
VSWR maximum ... 1.3
Half-power beam-width, degrees ..... 1.2°
First side lobe (dB) . -13.0
15 dB beamwidth, degrees ..... 2.4°
Noise temperature at 40 degrees elevation ..... 22 degrees

PRODELIN - (1350 Duane Avenue, Santa Clara, California 95050/408-244-4720). Prodelin was an early backer of the 4.5 meter antenna concept and demonstrated at CCOS-76 with an operating terminal. The Prodelin 4.5 meter terminal is fiberglass constructed prime focus feed antenna. More than 150 Prodelin small earth terminal antennas are operating throughout the world. The fiberglass construction lends to high surface contour accuracy and Prodelin advises the antenna is useable now on the 4 GHz downlink range as well as the future 12 or 14 GHZ bands. Manual or motor driven azimuth and elevation steering is available.

The specifications for the Prodelin MASAR antenna are as follows:

Gain at 4GHz ..... 43.7 dBi
VSWR maximum... 1.2

CANADIAN ID SLIDE—one of the three Canadian Anik channels utilizes this modernistic montage of "C"s to identify itself. Wonder what they would say if they knew they had viewers down in Oklahoma?

Half-Power beam-
width, degrees..... 1.1
First side lobe (dB) . -18
15 dB beamwidth,
degrees 2.0
Noise temperature
at 30 degrees
elevation 22

RF SYSTEMS - (R.F. Systems of Florida, Inc., 8720 S. Orange Avenue, Orlando, Florida 32809/305-857-0036). RF systems, a world-wide supplier of sophisticated earth terminal antenna systems, is an unknown quanity at the present time in the smaller-than-9-meter marketplace. If the company has made a firm decision regarding their antennas for this field, such a decision has not been released. **It is known** that they have a **6 meter** terminal antenna. RF antennas are all-aluminum constructed (skin surface plus all supporting structure), employ a 4-point mounting system (polar mount), prime focus feed. The company recently moved its satellite earth terminal and CATV products division to Florida.

SCIENTIFIC ATLANTA - (3845 Pleasantdale Road, Atlanta, Georgia 30340/404-449-2000). S/A started it all with the first 10 meter installations in September 1975 (see **CATJ** for **October 1975**, page 21) and has been a leading supplier of antennas and complete TVRO systems since that time. S/A has recently introduced a 5 meter terminal for the smaller-than-9 meter market. The specifications for the S/A 8008 antenna are as follows:

Gain at 4 GHz ..... 44.3 dBi
VSWR maximum ... 1.3
Half-power beam-
width, degrees ... .86
First side-lobe (dB) . -13
15 dB beamwidth,
degrees 2.0
Noise temperature
at 30 degrees
elevation ..... 22 degrees

USTC - (United States Tower & Fabrication Company, P.O. Drawer 'S', Afton, Oklahoma 74331/918-257-4257). USTC is a new entrant in the earth terminal field, with an aluminum-skin surface 6 meter prime focus feed antenna. The antenna (shown throughout this special issue) is **not** yet available to the market and **will not** be until the company has completed antenna pattern measurements and submitted that data to the FCC for correlation with existing antenna design parameters and acceptance for the CATV TVRO service. Specifications, pending completed field pattern measurements, are not available. The pricing category will be in the $10,000 range FOB Afton, Oklahoma.

The LNA Sources

The microwave world / earth terminal world is filled with LNA suppliers. Just pick up a copy of any recent issue of **Microwaves Magazine,** and your mind boggles with the numerous (perhaps a dozen) suppliers of "low noise 4 GHz LNA's" advertising their wares. For some reason, most of these companies have failed to discover the peculiar (to their way of thinking) marketing required to sell in the CATV world. Most LNA people manufacture-for-sale to the companies which design and install complete earth terminals. They are **not** accustomed to selling **directly** to the earth terminal user, and may even be reluctant to provide data to such users. At least one supplier of LNA devices realizes that in CATV the end user is the guy who is going to spend the bucks, and has definite if not deciding input on the matter of selection of an LNA. This may change the marketing approach of other

companies in this particular field, but for the time being if you want an LNA you talk either to the company that supplies your antenna, your TVRO receiver, or in the case shown here, directly to the LNA supplier.

AIL - (A division of Cutler-Hammer, Melville, Long Island, New York 11746 / 516-595-4440). AIL manufactures a line of very low noise (temperature) **parametric** LNA devices. These units are generally accepted as the state-of-the-art (no holds barred) approach to establishing super-low noise figures at the LNA. The AIL approach will be of interest to people who are looking for **an alternate** to the GaAs-FET LNA devices now on the market. The ultimate goal of the GaAs-FET people is to get noise figure (temperature) down into the sublow region now commonly met by the (more expensive) parametric amplifiers, offered by companies such as AIL. AIL has five TVRO 3.7 to 4.2 GHz LNA's available, as follows:

Model Number	Maximum Noise Temperature	Typical Noise Temperature
4060A	48°K	44°K
4060B	54°K	49°K
4060C	72°K	65°K
4060D	80°K	74°K
4060F	130°K	118°K

SCIENTIFIC COMMUNICATIONS - (3425 Kingsley Road, Garland, Texas 75041/ 214-271-3685). SC offers a fairly wide choice of GaAs-FET and parametric type LNA devices for the CATV TVRO service and they have developed a marketing department to work with CATV system operators who are interested in working out the best LNA/antenna configuration for their system. In the parametric amplifier, the company has four models that have a center frequency of 3.995 GHz with noise temperatures ranging from 65° K to 130° K and 50 dB of gain. In the CATV TVRO area for GaAs-FET LNA's, SC has 8 different models ranging from 30 dB of gain and a 3.5 dB noise figure to a 50 dB gain and 1.5 dB noise figure version. An "under 1.5 dB noise figure" model is now under development. The price ranges are from $950 to $3,000 depending upon model and quanity. Four of their more applicable models include:

Model Number	Frequency Range	Noise Figure	Gain
SCF-395-505	3.7/4.2 GHz	1.5 dB	50 dB
SCF-395-50D	3.7/4.2 GHz	1.8 dB	50 dB
SCF-395-50A	3.7/4.2 GHz	2.0 dB	50 dB
SCF-395-50	3.7/4.2 GHz	2.6 dB	50 dB

NOISE TEMP vs. NOISE FIG

As the noise figure goes lower and lower in LNA products, the ability to accurately calculate the noise figure contribution to the total system noise becomes burdensome if you stay with normal noise figure calculations. The LNA industry therefore commonly employs **system noise temperature,** which is in truth a measurement of not only the LNA noise figure but the whole system noise temperature. Contributions to system noise temperature **include** terrestrial noise (from the heated mother earth), space noise, LNA noise, and as a function of degrees K (Kelvin) even the contribution to 'noise' offered by feedline losses, connector losses and so on. We'll investigate this in some detail in an early issue of CATJ but for now here is a spot-point table which will allow you to translate the confusing-because-it-is-new noise temperature for LNA's into noise figure:

LNA Noise Figure of:	Equals A Noise Temp of:
3.0 db	**290°K**
2.5 dB	225°K
2.3 dB	205°K
2.1 dB	180°K
2.0 dB	**170°K**
1.9 dB	160°K
1.8 dB	150°K
1.7 dB	140°K
1.6 dB	130°K
1.5 dB	**120°K**
1.4 dB	110°K
1.3 dB	100°K
1.2 dB	93°K
1.1 dB	84°K
1.0 dB	**75°K**

Note when studying LNA specifications that not all GaAs-FET LNA devices maintain their "specified" noise figure/temperature **over the full 500 MHz wide** 3.7-4.2 GHz band. Many LNA suppliers are able to attain their rated numbers only over a portion of the band, **such as** 80 MHz or 300 MHz. If you are going to use two widely-separated infrequency transponders (such as WTCG on transponder 6 [3820 MHz] and HBO on transponder 24 [4180 MHz]) you will want to be sure your LNA has its necessary specified noise figure/temperature over the full frequency range; or alternately, allow for degraded carrier-to-noise/signal-to-noise on the end of the frequency range where the LNA performance falls down.

The Receiver Sources

Talking with a receiver supplier early makes excellent sense because much of the financing available will come from receiver suppliers who are in the business of selling you a complete system. There are going to be a number of innovative developments in the receiver field in the months and year ahead, and some of these may shatter existing pricing and operational formats.

Most people will want the flexibility of a multiple channel receiver. That puts you into the decision-mode early on. You can order a receiver that is frequency expandable (meaning you can order it with one or two transponder receive channels in place and operating, and then order expansion channels later on), or you can order

receivers which have the built-in ability to tune through the whole 500 MHz slice going in. You may not be planning to use more than a single signal to begin with (such as WTCG), but with all of the noise being made by people who **plan** to be on a transponder in the year(s) ahead, it would pay to have the ability to at least in the comfort of your own headend to be able to tune the receiver to a different channel or two at your option just to see what is going on or what the new (as they are activated) transponder signal offerings look like.

Some of the more important options include the format of the receiver sub-carrier demodulator (you want to be sure your receiver will demodulate all of the commonly employed audio sub-carriers. . .there is nothing more frustrating than watching a beautiful picture on a transponder-tuned-in channel and having no audio!), alarm circuits (warn when a signal level is low or no signal is present, when various portions of the receiver are operating out of tolerance or spec), metering circuits (metering of essential in-receiver circuits seems like a good idea, and having a front panel meter to observe received carrier level and/or video output and audio output levels is also helpful).

Individual receiver specifications are far to complex and detailed to be fairly presented in this format in CATJ. Any attempt at listing such detailed operating parameters would fail miserably in the "apples and apples" comparison approach. Therefore we present the **sources** for CATV TVRO receivers with a few notes about the general type of products offered by each supplier.

CALIFORNIA MICROWAVE - (455 W. Maude Avenue, Sunnyvale, California 94086/408-732-4000 with offices in Englewood, Colorado and Arlington, Virginia). A leading supplier of earth terminal receivers with equipment in approximately 135 terminal installations in Alaska and Algeria. Offers model TV42 and TV42S "television" receivers in the 3.7-4.2 GHz range. Receiver has a threshold extension circuit, 12 channels (manual or switch select tune), operates from DC supply source (-48 VDC) or AC (115 VAC). Demonstrated receiver at CCOS-76. Request Application Note COO3-TVRO for a complete discussion of the receiver.

DELTA-BENCO-CASCADE - (124 Belfield Road, Rexdale, Ontario, Canada M9W 1G1/416-241-2651). DBC made an early run at the 1975 start-up TVRO business, and after several public demonstrations of their complete terminal, dropped back out of active contention. They were probably **the first** people to actively push the smaller-than-9 meter concept, but with such small terminals not licenseable at the time, their impact was not immediate. The company has the capacity to supply the units, although at the present time there is no CATV market for TVRO facilities in Canada. Whether they will be active in the new era of small terminals in the United States remains to be seen.

FARINON - (1691 Bayport, San Carlos, California 94070/415-492-4120). Farinon has been supplying microwave receiver systems to CATV and other users for quite some time and is now completing packaging of a complete line of TVRO equipment. Included is their new model FV4F/FV-45 TVRO receiver. This is a dual conversion 12 channel receiver, with local or remote switching (between channels) or (optionally) a single channel, crystal controlled receiver. The receiver covers the 3.7 to 4.2 GHz range, has a noise figure of 10 dB and operates from power sources of -24 or -48 volts DC or 115 or 220 VAC. Farinon's Jim Hurd says the company is offering a complete TVRO package that includes antenna selection from Andrew, Prodelin or RF Systems, and an LNA from NEC.

HUGHES - (Hughes Aircraft Company, Microwave Communications Products, 3060 West Lomita Blvd., Torrance, California 90509/213-534-2146). Hughes brings to the TVRO business an interesting background of being on both ends of the system; having started this industry back in 1963 with the manufacture of early satellite (transponder) units. Hughes is offering a complete TVRO facility, from the antenna through to the receiver with all necessary cables, LNA, hardware and so on. There are two different Hughes approaches now offered. One format being offered is a 'synchronous degenerate parametric amplifier receiver' which has the unusual facility of placing the **full receiver at the antenna.** The normal LNA as a separate piece of hardware is bypassed in favor of a receiver-mounted parametric front end. This receiver can tune over three adjacent satellite channels, either on site or by remote control. The other (more conventional) approach from Hughes employs a 24 channel synchronous (tuned) phase lock(ed) receiver, which mounts in the headend while your separate-piece LNA goes out on the antenna. The twenty-four channel receiver can switch through any of the satellite channels with local or remote tuning. Hughes has announced that "depending upon the subsystems selected, U.S. prices for the complete receiving terminal start at $28,000." Hughes has a number of application note bulletins available.

ITT - (ITT Space Communications, Inc., 69 Spring Street, Ramsey, N.J. 07746/201-825-1600). ITT probably has more extensive and diversified experience in

the space **terminal** business than virtually any other worldwide supplier. ITT is essentially in the terminal system business, with the emphasis on **'system'.** ITT began in the satellite business with the 1959 'Courier' tests (initial Air Force satellite test project), has been through Intelsat and a number of other programs (including the USA/USSR 'Hotline'). Available is a complete TVRO terminal either turnkey or for your own installation or the ITT produced receiver (alone) if you are putting together the pieces from several sources and assembling your own terminal. ITT demonstrated their receiver at CCOS-76. There are two ITT receivers packaged by selecting from four separate receiver-mainframe modules. The choice includes a single conversion-tuneable receiver, a double conversion-tuneable receiver (both 24 channel), an FM demodulator and the power supply. Sub-carrier audio detection from 5.8 to 8.2 MHz is available (choice of any two). The package operates from 115 or 220 VAC. A wide selection of other options, including local and remote tuning are also available.

MICRODYNE — (Microdyne Corporation, Box 1527, Rockville, Maryland 20850/301-762-8500). Microdyne offers complete turnkey small aperture TVRO systems and a stand-alone receiver for people putting their own terminal together. They have a very complete line of satellite receivers including at least 13 separate models designed to receive everything from telementry and wideband data to WEFAX and television signals. There are two TVRO receivers in the group, including models 1100-TVR(VT) and 1100-TVR(SYN). The 1100-TVR(VT) is a 12 or 24 channel voltage-tuned (varicap) receiver covering 3.7 to 4.2 GHz with an RF head that **can be** installed at the antenna proper (the 70 MHz i.f. comes down the transmission line to the headend shack) and channel changing is optionally remote controlled. The 1100-TVR(SYN) is a frequency-synthesizer receiver that can tune through the full 3.7 to 4.2 GHz band in 250 kHz steps. **Optionally,** the RF head can be located at the terminal antenna and feed i.f. (70 MHz) signal to the headend located demodulator. Other options include automatic redundancy and alarm circuits.

TERRACOM — (9020 Balboa Avenue, San Diego, California 92123/714-278-4100). Terracom's approach to receivers for the TVRO application can best be described as "maximum flexibility". There are three separate receivers, and each of these has a long list of options. Terracom has been providing TVRO receivers since early in the 10/11 meter era (see February 1976 CATJ, page 10), and draws from their extensive experience in supplying terrestrial microwave receivers in the 1.5 to 15 GHz region(s). Models FSR-SR offer fixed tuned single channel or manual of all channels; this is their 'economy' receiver. Models SR-2 are single conversion 12 or 24 channel format automatic tuning with two preselected channels for "punch up" display either locally or from a remote point. Models SR-3 are dual conversion receivers with 12 or 24 channel "punch up" display either on-site or via remote control. Terracom receivers can be switched to the 12 GHz band(s) by replacing a module in the receiver. Receivers are available as rack mount, portable and other mounting configurations. Terracom also provides a wide choice of manual and automatic redundancy options including automatic switchover of either/or the receiver and the LNA should either piece of equipment fault or lose signal acquisition.

SCIENTIFIC ATLANTA - (3845 Pleasantdale Road, Atlanta, Georgia 30340/404-449-2000). S/A is another firm with a long history in satellite communication terminals; going back in **our** industry to the first CATV TVRO facilities installed in September of 1975 and going back many years prior to that to hundreds of satellite terminals throughout the world. S/A provides a complete turn-key installation of their five meter terminal using equipment largely manufactured by S/A. The model 411WB series receiver covers the 3.7 to 4.2 GHz range with a wide choice of options. Included is manual tuning, frequency synthesizer tuning or remote (channel) tuning. This is a dual conversion receiver (see detailed discussion starting page 21 of **October 1975 CATJ**) with audio sub-carrier options and a host of options. The 411WB receiver has extensive front panel metering and a built-in audio display (with speaker).

Peripheral Equipment

The rapid expansion of the TVRO terminal business this year and next can be expected to spawn a host of related businesses for everything from test equipment for the TVRO facility to expanded availability of low-cost mid and super band equipment for additional cable plant signal carriage. We are, at the present time, just seeing the earliest developments in these areas.

TECHNICAL TOPICS

Illegal As Hell

"December 1976 issue of CATJ has a letter from a Jim Rieger in California describing how he combats CB TVI by deliberately jamming the CBers. Ingenious, but illegal as hell. The real shocker is your endorsement of the scheme and a call for schematics. Your publication constantly laments the plight of the poor CATV operator who is fined a couple hundred bucks for violation of FCC technical standards. You rail against the FCC because you are lucky enough to be beyond their reach. But you are doing your members a dangerous disservice if you support jamming. Deliberate interference with communications, **any** communications, is a violation of the Communications Act of 1934, and as such is good for a $10,000 fine and a year in the pokey—the Federal pokey. The distinction is this: failure to live up to CATV technical standards is to violate the rules and standards of a government agency, while intentional jamming of Communications is to defy Congress. The Communications Act of 1934 is **law**, and as such the violator may be prosecuted by the Attorney General of the United States instead of by some over worked RI out of the district FCC office.

"I urge you and everyone else who has thoughts about jamming those pesky CBers to carefully read or reread Sections 301, 303 and 501 of the Communications Act of 1934. Excerpts are enclosed."

Sanford T. Terry
Chief Engineer, WWBT-TV
Richmond, Va. 23201

Mr. Terry (sir):

Your points are well taken. Believe it or not, our tongue was **firmly planted in the side of our mouth in our** 'response' **to reader Rieger's letter. Apparently you failed to notice the protrusion on our cheek. Be that as it may, the solution to the CB problem at CATV headends is** not to be found **in Sections 301, 303 or 501 of the Communications Act of 1934. Now that CATV "Certificates of Compliance"** are **considered by the FCC to be "licenses", CATV systems have the same status at the Commission as say WWBT. When a CB operator parks under our antennas on our hilltop, cranks up his 4 or 40 or 400 watt rig and blasts into the ether looking for** "good numbers" **and** "wall paper", **whether he is aware of it or not, he is interfering with** our **communications "system" (which begins** at your **transmitter and ends at** our **subscriber's CRT). His** "deliberate" **interference to our CATV system (and our subscriber's reception)** is our **problem. An over worked and under staffed FCC Field Office Bureau cannot police our hilltop. We can. Keeping the guy off of our hilltop may not always be possible, as California reader Rieger points out. But making it** undesireable **for him to be there. . .that is another matter. Perhaps operating a low power broadband noise generator is** not **legal. . .if our** intent **is to** deliberately **interfere with his communications. No more legal, certainly, that** his **operating his CB transmitter if his** intent **was to** deliberately **interfere with** our **"communications system". We are sure he can find several dozen** reasons **why he is on our hilltop transmitting;** and none of those reasons will be an admission of his intent to screw up our reception. **We can probably find a couple of reasons for operating a 27 MHz broadband noise modulated low power source. . .which** also **won't include** an admission **of a** willful attempt **to block his reception.**

We advocate nothing. . .merely point out that grinning and bearing the problem is no solution.

Clear As Mud

"Your otherwise excellent December issue article on ADI's was marred

by a serious error in the definition of Net Weekly Circulation. According to the same TV FACTBOOK you quote (page 4-b of #45), Net Weekly Circulation is clearly defined as **'the estimated number of different television households viewing a particular station at least once per week, Monday-Sunday, Sign-on to Sign-off'.** No other definition of Net Weekly Circulation appears in TV FACTBOOK, or anywhere else in the industry for that matter.

"I wonder upon what authority the writer of the article 'arbitrarily' selects **'three times per week or more'** as his definition of Net Weekly Circulation. Since VPI's Significant Viewing Surveys result in cable systems adding distant signals—based upon criteria such as Net Weekly Circulation (and share of viewing hours)—we believe we know whereof we speak.

"Aside from the NWC definition error, the article was the best and clearest explanation of the whole ADI market/signal/county overlap problem I have yet seen. I know whereof I speak once more, since I was with ARB back in the early 60's. . .attempting valiantly to sell and explain the concept to the TV industry."

Robert Schultz
President
Video Probe Index, Inc.
Bayside, New York
11361

Robert:

Of all of the material we have attempted to research, to boil down to plain English as it were, the ADI story (part two will appear shortly) **was perhaps the most perplexing to date. We are guilty of misdefining Net Weekly Circulation; the definition we gave was laboriously dragged out of a broadcaster interviewee. Apparently the** "valiant attempt to sell and explain the concept" **to broadcasters back in the 60's** "missed" **this particular broadcaster!**

Radiation Tests & Noise

"Regarding 'Richey on Radiation Tests', CATJ for December 1976; it appears Mr. Richey has neglected one very important factor when selecting transistors. And that is the noise (figure) of the transistor selected for his radiation amplifier. The noise floor limits the measurement capability of the radiation testing. For example, a typical 727 can accurately measure to -35 dBmV. However, a typical 20 microvolt per meter signal at channel 13 equals -48.5 dBmV. With the addition of a 15 dB gain antenna amplifier, the allowable channel 13 radiation is now at the -33.5 dBmV level. So far so good. But if the transistor chosen for the amplifier stage has a high noise figure, say 10 dB, we find:

Noise output = -59 dBmV + NF + gain and, -34 = -59 +10 +15 plus 4 dB improvement
attained from the reduced bandwidth of the 727.
This equals a noise floor of -38 dBmV.

Good engineering practice dictates that a measurement system should accurately measure by a factor of two (20 Log $_{10}$ 2/1 = 6 dB). Therefore the noise floor should be 6 dB **below** the radiation level we are trying to measure. This requires that the antenna amplifier have a noise figure of 8 dB or better.

A cheap but not so dirty method is to make a subjective radiation measurement with a calibrated TV receiver; most receivers are capable of detecting the presence of a signal at -55 dBmV. If any signal can be seen on the TV set, that is the point to break out the SLM and dipole and amplifier.

Roger Pience
TRIAD CATV
Marshall, Michigan

Roger·

Richey on page 41 for December suggested using only TO-39 type metal can transistors and suggested using "anyone of the commonly available VHF units such as Amperex A-210, TRW PT-35XX, Motorola MM 8002, Solid State SD1005". **Exceptions would be the SA 1700 or A 1700. We can see getting a 10 or 12 dB noise figure with a 2N3563 or 2N3564 but a fellow would really have to butcher up one of the TO-39 units to go much above a 4-5 dB noise figure. Typical checked noise figures are in the 3.2-3.5 dB range. Thus if the directions are followed, the builder should be well under the 8 dB threshold you suggest. Many systems are, as you suggest, patroling systems with a VHF TV set and a dipole looking for signs of signal on a locally vacant channel; and then breaking out the SLM and dipole with amplifier whenever a signal is found. After a few hours of this exercise, a guy develops a set of calibration points of his own (i.e. such as only stopping to**

check with the SLM when the sync holds stable) related to his own testing system.

NOTE: This would be a good point to get Richey off the hook on his schematic on page 41 for December. There are three corrections. In the upper left hand corner, where the 12 VDC line comes in, add a 510 ohm (1/2 watt) resistor on that vertical circuit connection line between the connection point for the +12 VDC and the right hand side of the 6T, 1/4" form coil. To the right, the vertically drawn "4X1 transformer on a 2 hole ferrite core" should have a tap at the bottom. Where it joins the 6T, 1/4" form and the .001 cap, add a full turn below the junction point (leading to the transistor). Finally, the power supply should specify a 10 volt zener diode not a 12 volt zener.

Leased Microwave Service?

"George Harvey, Perry Everett and I have formed a partnership called Communications Leasing Company. Our plan is to provide, throughout Western Tennessee and there abouts, co-op microwave distribution of WTCG (channel 17 Atlanta) and other signals to CATV systems in this area. We will be using the signal received from the CATV TVRO terminal located at Jackson, Tennessee. We will contract to lease the equipment and maintenance to provide the channel 17 (and possibly) other signals to CATV systems that are interested in this service, but who do not have the subscriber base to sustain the cost of a terminal on their own. We are initially looking at between 10 and 20 hops of service in this region.

We will also be providing consulting engineering for not only microwave but other CATV system services and problems. I hope that my mixture of practicality, inventiveness, and 'expertise' will be of use to some of our fellow CATV system operators throughout this region."

Bill McVay
Communications Leasing Co.
P.O. Drawer B
Jackson, Tn. 38301

Bill -

Congratulations on the innovation! For those who do not know Bill McVay, may we add that here is one very fine, terribly practical and terribly down to earth kind of engineering guy. Bill has been quietly building some of the best CATV systems in the mid-south for years, and anyone who wants to talk (901-424-3419) to a guy we consider one of the real pro's in this business (on your consulting terms of course Bill!) **should take advantage of this new opportunity. The industry needs several hundred more Bill McVays!**

Texscan Technical Seminar

The next in the series of ongoing Texscan CATV Technical Seminars will be held in Portland, Oregon the week of March 21-25. Location is the Cosmopolitan Motor Hotel, 1030 NE Union. Subject matter includes system testing, measurements, proof of performance and everything else you need to know about making a system operate properly in the technical arena. Fee is $125.00 for the course and work book, conducted by well known Texscan emissary Raleigh B. Stelle, III. For information and reservations contact Mr. Stelle at Texscan Corporation, 2446 N. Shadeland Avenue, Indianapolis, Indiana 46219 (317-357-8781).

Wrong Funding Source

"In your September CATJ you reported on R and D expenditures by various manufacturers of CATV equipment. Your report made several very valid points, however when you discussed the converter developed by Jerrold Canada for National Cablevision, you included one substantial error. The funding for the development of the converter was provided totally by Jerrold Canada and not by National Cablevision Ltee as you reported.

Your description of National Cablevision Ltee's involvement in this program is otherwise very concise and I must say it was a great asset in the development of the product to have National totally committed to researching and consulting the final form of what both companies believe is the optimum converter design. This involvement on National's part was not without cost to National who undertook formal market research studies and extensive engineering evaluations of present generation converters to evolve the profile of the product desired for their systems.

I believe a point should be made that this close cable operator/supplier interaction is exceedingly healthy from the standpoint of both parties."

Colin J. O'Brien
VP and General Manager
General Instruments of Canada, Ltd.
Toronto, Ontario M6B 1P8

Colin:

We stand corrected on the funding. National reported through Canadian sources they had invested "around one million dollars" in the converter's research. To this now must be added a significant expenditure on the part of The Jerrold Division of GI-Canada.

Frayed Fiber

"The August 1976 issue of CATJ contained an article titled 'CATV vs. Fiber Optics'. This report incorrectly creates the impression that optical-fiber waveguides can provide virtually 'unlimited' bandwidth for transmission of thousands of TV channels. This is far from the truth. The easy-to-use optical-fibers with large core diameters (such as 100 uM) have a limited transmission bandwidth on the order of 100 MHz over a kilometre length. This bandwidth also decreases at least proportionally to the inverse square root of length. An optical-fiber with a 500 MHz transmission bandwidth over a kilometre length therefore may have less than 160 MHz bandwidth over a 10

kM length. Many easy-to-use fibers will have a much smaller transmission bandwidth.

Since pulse-coded-modulation (PCM) digital colour TV transmission requires bit rates in the neighborhood of 100 Mb/s unless some information processing is applied, transmission of many TV channels over a long single fiber becomes difficult. Spatial division multiplexing (SDM) with many fibers, each carrying a single digital TV signal, may be the more sensible approach in designing long distance trunk lines.

An intensity modulated (IM) analogue optical transmission system where a frequency division multiplex (FDM) scheme is used will make efficient use of the available bandwidth. However, the total optical power is divided among the multiple TV channels and because of the limited power coupled into the fiber, transmission of more than a few TV channels over a single optical fiber becomes difficult with currently available light sources.

The future applications of optical fibers in cable TV therefore may take the form of a centrally switched distribution system analogue to the 'Rediffusion' system, with the exception that transmission distances exceeding 5 kM may be considered. If 2 fibers are supplied to each subscriber, an integrated communication service encompassing Pay-TV, Subscription-TV, Free-TV, data and telephone communication can be provided. I believe a review of the technology in a future issue will be of value to your readers."

Elmer H. Hara
Communications Research Centre
Ottawa, Ontario
K2H 8S2

Elmer:

You've got us. A review is not only in order but coming up as quickly as we can put the final touches on it. As we are all learning, there is much more involved in fiber optics than the mere transition from RF to lightwaves. And as you point out, an optical-fiber cable, unlike coaxial cable and RF, tends to self-limit in bandwidth as lengths of plant increase. It is a very interesting exercise. . .and we caution readers that as this new technology evolves, they should be asking just how does it affect CATV, at every step of the way.

Copperweld With An "r"

"We are most appreciative of the fact that you have referred to Copperweld (r) wire a number of times in the CATV system rhombic antenna design which appears on the outside front cover of your October 1976 issue. Since "Copperweld" is registered with the U.S. Patent Office as a trademark, may we suggest that in future references you reflect this fact by using the circled initial cap "R" registered mark following the word. You have, of course, correctly used the generic word "wire" with "Copperweld". By following this recommendation for the use of the registered mark, you will help us to keep our trademarks proprietary in nature as they are intended to be. Thanks very much for your assistance in this matter."

J. G. Beymer, Manager
Marketing Services
Copperweld® Bimetallics Division
Glassport, Pa. 15045

Mr. Beymer:

Apparently your trademark has been around for quite some time. Our October front cover 'diagram' was actually an artist composite of several diagrams originally appearing in a 1940 published Bell Labs book entitled (appropriately) 'Rhombics'. Correction noted of course. . .but perhaps Bell Labs needs to be advised as well!

New Fan

"I picked up your magazine at the Western Cable confab in Anaheim. Discovering CATJ alone was worth my expenses to Anaheim!

I have only been in the CATV business for the last two years and there is so much to learn; the one copy I have seen of CATJ has been a great help in pointing out where there are answers available. In the December 1976 issue in your Technical Topics column, you had a letter regarding Rhombic antenna supplies for an article that apparently ran in your October CATJ. Please enter my new subscription and include that October issue. I have been avoiding designing three rhombics which I need. . .and now someone else has done that 'labor' for me!"

John F. Crown, III
Chief Engineer
Mono Sierra Services
Coleville, Ca. 96107

John:

October 1976 issue supplied. . .but a word to everyone else. That October issue on Rhombic design is now exhausted. We'd appreciate photos from readers who have or will construct Rhombic arrays from that article/report. From telephone reports we've had, any number of new Rhombic arrays are going in as a result of this CATJ in-depth study. And we think readers would enjoy seeing how others have done it. Of special interest is the matching and phasing and stacking of arrays, and perhaps some Rhombic versus more standard array off-the-screen photos showing how much better Rhombic pictures look (shoot with Tri-X film, 1/30th of a second, F 5.6 or there abouts).

cata ASSOCIATE MEMBER ROSTER

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.

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