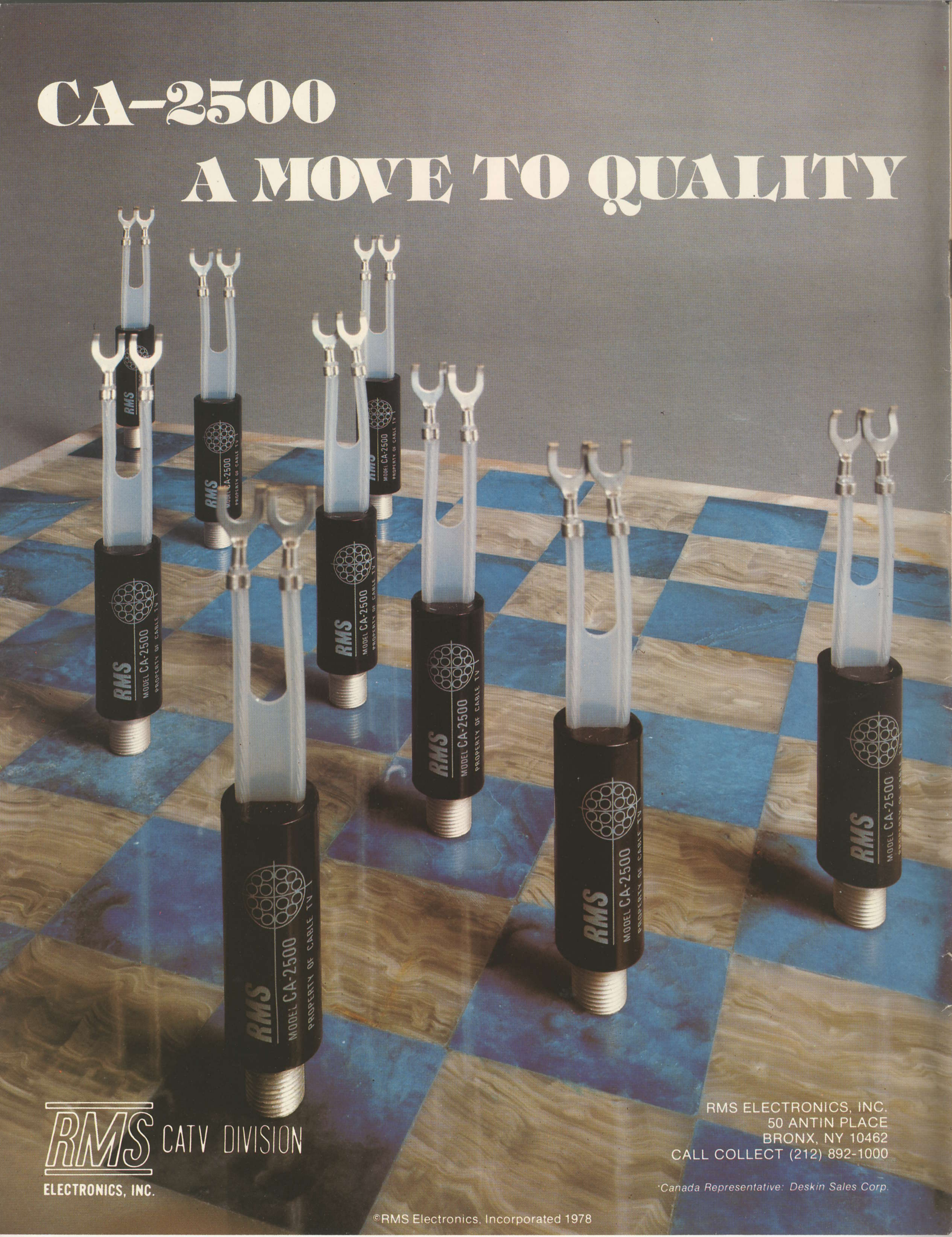
CATJ

NOVEMBER
1978

OFFICIAL JOURNAL
OF THE
COMMUNITY ANTENNA
TELEVISION ASSOCIATION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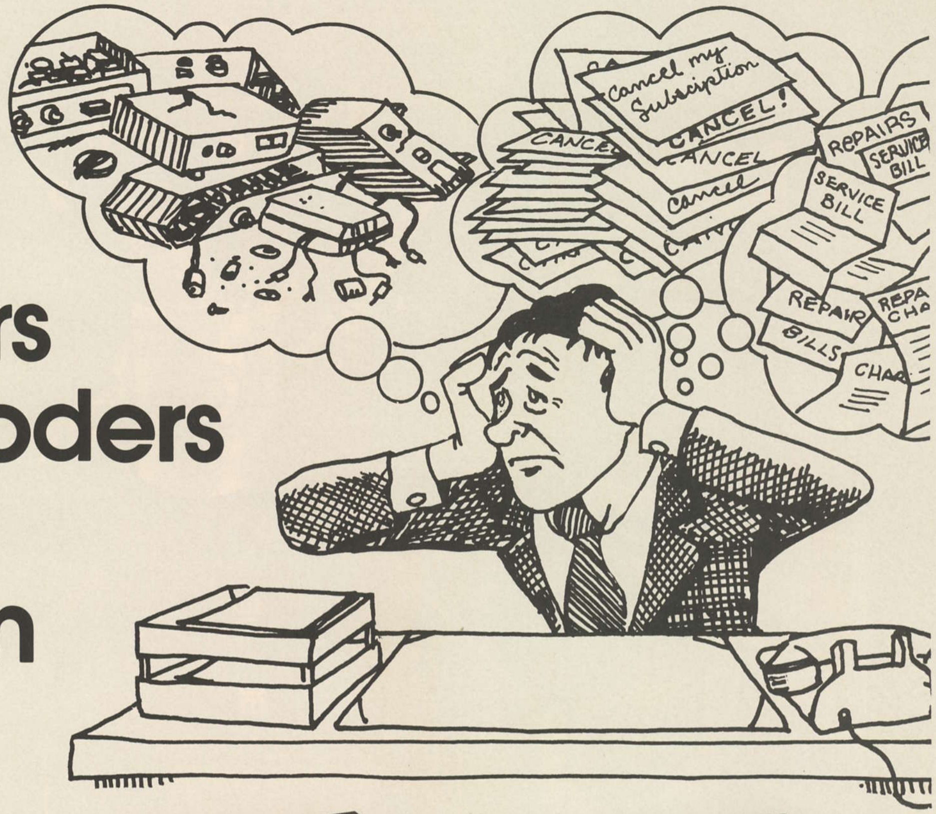
OAK converters and decoders save you more than money.



When you're looking for converters or decoders, you have to look beyond price, and look for the best in performance and reliability as well. The lowest priced terminal in the world would be a bad buy if poor performance and reliability caused frequent service problems, lost revenue and lost subscribers. You can fill your system needs without compromise, because Oak offers a wide product selection.

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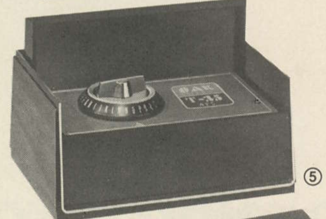

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Oak offers a full line of converters and decoders and converter-decoders, including: ①SCC single-channel converter, ②Econobloc 7-channel converter, ③Trimline II 35-channel converter, ④Multi-Code 35-channel converter-decoder and ⑤companion Jewel Case remote unit, ⑥Econo-Code single- and two-channel converter-decoder and ⑦Mini-Code single-channel low-band decoder. Contact Oak for all the details.

⑦

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Let Belden come through for you. Contact your Belden CATV Distributor or Belden Corporation, Electronic Division, P.O. Box 1327, Richmond, IN 47374; 317-966-6661. Out West, contact our Regional Sales Office in Irvine, CA at 714-833-7700.

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CATJ

NOVEMBER 1978

VOLUME 5 NUMBER 11

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 AND BROADBAND VIDEO/AUDIO DATA COMMUNICATION SERVICE.

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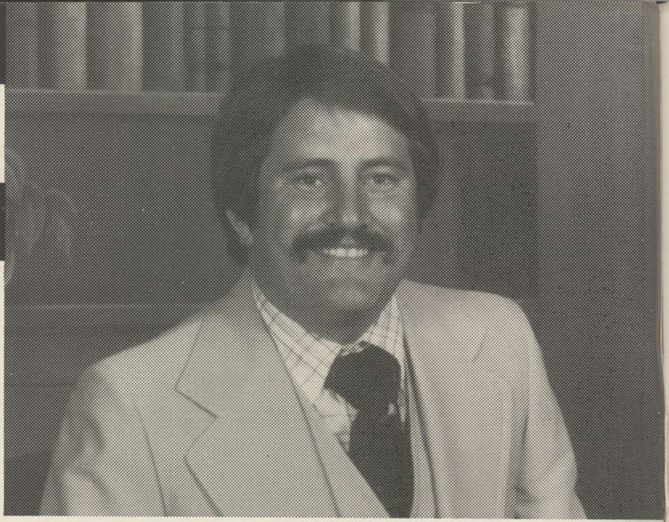
—FEATURES—

—DEPARTMENTS—

OUR COVER

Elevation measurement. A 29 cent piece of plastic, a piece of string and a bolt are all you need to check for proper TVRO (or microwave) dish elevation angle. Life gets simpler every day as this month's feature on finding Intelsat class "international" birds describes starting on page 14. Photo taken at CATJ Lab near Oklahoma City; 6 foot Prodelin dish is oriented on WESTAR I bird.

CATA ~ TORIAL



BEN CAMPBELL, President of CATA, Inc.

C-SPAN / An Opportunity To Shine

Inspite of the best of intentions and twenty five years of trying. . .the cable industry has never been particularily successful in creating a totally **unique** service. One that says 'only on cable' on it.

Whoops. . .before I hear from the fine folks at HBO, Showtime, Fanfare and HTN. . .or from the other services coming in via the bird these days, let me clarify that statement. **A totally unique service** is one that we offer and nobody else offers. Anywhere, at anytime, or for anyprice. As fine as the pay channels are (and I use them extensively on my 'small' systems throughout the southwest) they compete for audience against the local movie theaters, the local rock concerts, and the local sporting events.

A few systems have done some unique things on local origination. But these by events have never had regional or national distribution. Which brings us to C-SPAN. The Cable Satellite Public Affairs Network.

C-SPAN is the brainchild of a very bright person, Brian Lamb. Brian (and he probably had plenty of help from others in putting C-SPAN together, which only proves that two bright people are better than one bright person. . .and so on into log square functions) deserves the lion's share of credit for recognizing that there was developing, within our national capital, a situation tailor made for cable. Here is what it is all about and why every single cable operator with a TVRO terminal now installed or planned should get behind C-SPAN.

The U.S. House of Representatives has voted U.S. taxpayer money to purchase, install and man a six (color) camera installation designed to televise the regular meetings of the House. The House television system will deliver baseband video and audio to anyone who wants to plug in. That includes the networks, the PBS folks. . .**and the cable industry.** In the order of magnitude of Washington expenditures the cost of the system is around seven levels below pin money. It may turn out to be the most important expenditure the House spends in 1979. On or about February 1st of the new year the system is to be installed, up and running.

C-SPAN is a non-profit corporation put together to plug into that House television system, to carry the baseband video and audio to American homes from coast to coast and border to border; via satellite. C-SPAN has a board of directors, including around 15 of the larger cable companies who have put up 'seed money' to get the project off the ground. With the initial seed money pledged Brian Lamb placed an order with Scientific-Atlanta for a ten meter uplink station. That station, to be installed in the Washington, D.C. area will feed the C-SPAN 'connection' to the House of Representatives directly to RCA's F1 satellite on transponder 9. The time on 9 will be shared with Madison Square Garden Events which is as most know a nighttime type of service. The 'live coverage' of the House of Representatives in session will primarily be a daytime event (the House typically meets between 10 AM-noon and 6 PM with Wednesdays an exception when they may run as late as 9 PM eastern).

C-SPAN is a no-stock corporation; nobody can make a dime out of it. It is very similar to the CATA non-profit framework and because of that we feel very comfortable in saying to others. . .**"Do as I have done and sign up your system right now".**

What will having the full sessions of the U.S. House of Representatives on cable do for you in your town? Many things. The schools will love it. What better way to learn civics than to turn a classroom into a 'gallery' of the House! Most subscribers will appreciate having it available, not because they will sit and watch the gavel to gavel coverage; but rather because it will help reduce the 'distant feeling' most Americans have developed about the Washington establishment. And while few members of the House can be expected to unilaterally love it, **none can afford to be against it in public.** If your Representative never really knew anything about cable, or your business before. . .the fact that your system will be taking him 'back home' to his constituents on a daily basis will make him sit up and take special notice of you in the future.

C-SPAN will give cable a very much needed PR 'lift' in an area that people will talk about in a positive way. Sure people talk about pay services, but because of some of the programming content it is not always 'positive talk.'

The C-SPAN project has been talked about for more than a year. Like many things proposed for cable (and in particular the satellite) it attracted moderate initial interest followed by a slow but steady decline in visibility. Brian Lamb has been a very visible kind of guy through his **Cablevision** column for several years and he was able to corner a number of the top people at various MSO firms long enough to sell them on backing the project with seed money. From most of the initial participants he raised $25,000 per company; money that is now being spent for the uplink terminal, for a terrestrial microwave hop, and for a handful of other small things necessary to get the job done. Not all of the seed money has come from the bigger operators; some has come from less sizeable firms at levels of $1,000 to $1,500 per firm.

By teaming up with Madison Square Garden on transponder nine several important pluses are brought into the equation. The combined purchasing power of satellite time of MSGE and C-SPAN becomes great enough that relatively low RCA rates are possible. That's why the per cable subscriber rate is to be 1 cent per home per month. When you think in terms of satellite delivery of an average of perhaps 35-40 hours of 'programming' per week, or in excess of 140 hours per month that 1 cent a month per home is extremely reasonable. That 1 cent a home also is important because it says to your Congressman that you as a private businessman are willing to invest money in bringing home 'his image'. The fact that private industry **(you)** is paying for this and not some U.S. Government slush fund will not (or should not) be lost on him either. With breaks for Congressional recesses and the like Brian calculates the C-SPAN service will run to 1100-1200 hours per year. Not an insignificant amount of 'only on cable television' programming'.

Is there a glitch in the project? The only one I can see is that it is on vertical polarization; a temporary impediment to universal coverage. On the other hand with so many services going on vertical (see **Satellite Technology News** this issue) it should only be a few months before most cable systems are equipped for both polarization modes. And if you have delayed placing the order for the necessary vertical equipment for your own system. . .well, now you have another reason to get the order in line.

C-SPAN. Brian Lamb is the man to talk to and the place to find Brian is at the C-SPAN office (Suite 308, 1745 Jefferson Davis Highway, Arlington, VA. 22202). If you are in a real hurry the C-SPAN telephone number is 703-892-4200. And the next time you are in Washington, plan to visit the cable industry's owned and operated uplink terminal. With pride you will be able to gaze upon its steel members and smooth face and realize that cable. . .and only cable. . .now offers a service that no elected official can ignore.

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Level Accuracy	±1 dB
Temperature Accuracy	±1.5 dB from 0 to 120°F.
Power Requirements	10 AA cell batteries
Size	3"H × 7-1/2"W × 7-11/32"D
Weight	4 pounds
Price	$225

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Frequency Range: 1 to 350 MHz; continuously variable center frequency.
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RF Output: +51 dBmV calibrated; 50 dB variable in 1 dB steps.
Harmonic Distortion and Spurious Signals: 30 dB down, typical
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Gain or Loss: ±1.0 dB calibrated at 20 dB loss (accuracy near 20 dB better than ±0.5 dB)
Return Loss: ±1.0 dB calibrated at 26 dB return loss (accuracy near 26 dB better than ±0.5 dB)
Display: Long persistence CRT, P7 phosphor, useful area 5.5″ × 7.5″; sensitivity 0.2 mV/div. to 0.2 mV/div.
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SPECTRUM ANALYZER

Frequency Range: 0.4 to 350 MHz
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Resolution 3 dB Bandwidth: 200 kHz, 10 kHz, and 500 Hz switch selectable.
Shape Factor: 60 dB/3 dB ratio — 200 kHz 20:1; 10 kHz 4:1, 500 Hz 8:1.
Noise Sidebands: Greater than 70 dB down 15 kHz or more from input signal.
Intermodulation & Harmonic Distortion: 3rd order more than 70 dB down from two +10 dBmV signals separated by 1.5 MHz, at less separation, 60 dB down. 2nd order down 55 dB from two +10 dBmV signals.
Frequency Markers: Six plug-in jacks. Accepts single frequency or harmonic markers for frequency identification. Provides frequency identification in all modes. Accurate to ±0.05% during spectrum analysis and ±0.005% during sweep testing.
Dynamic Range (On Screen); 80 dB (121 dB total possible).

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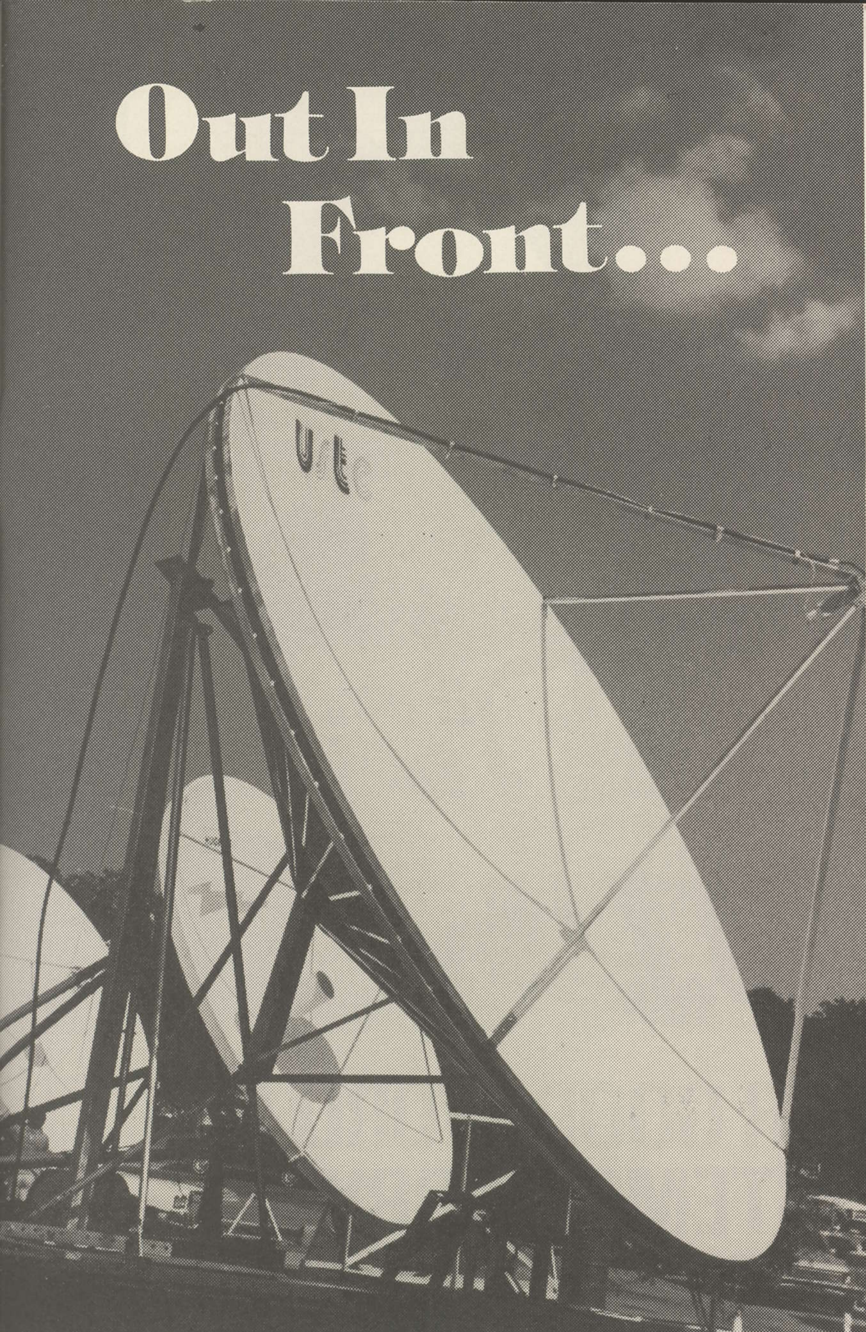

PHOTO BY JAY CONRAD STUDIO

Because We Have The Most Cost-Effective TVRO Terminal Available Today!

A recent study of FCC data provides the proof (see CATJ for September, page 34). USTC six meter TVRO terminals cost less-per-channel to construct than any other large terminal available. Cost-per-channel delivered is the best way we know to compare competitive terminal prices. Cost-per-channel delivered takes in all factors. . .the cost of the antenna (installed), the cost of the LNA and the cost of the receivers provided. **FCC published data proves it!**

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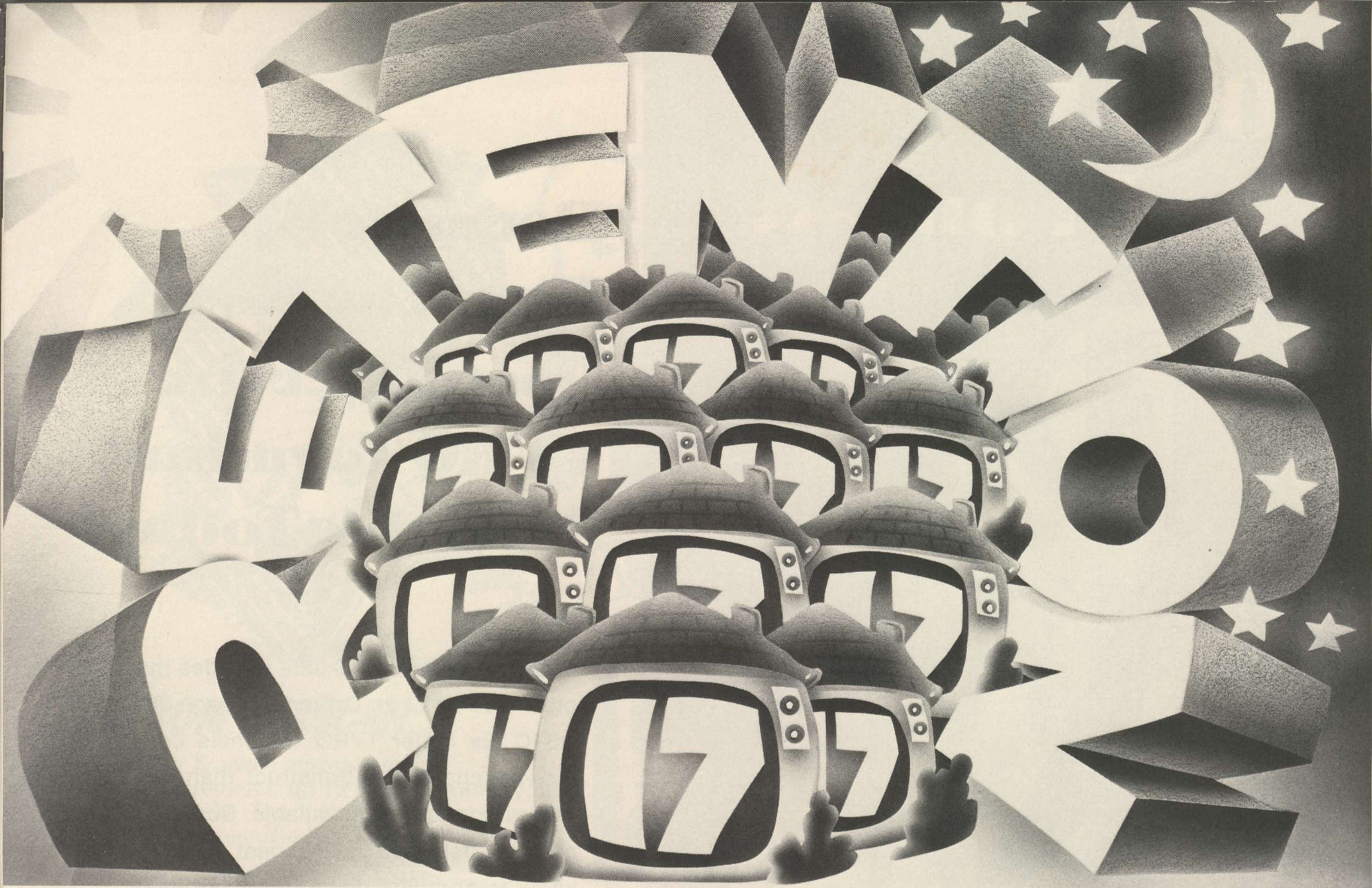


RETENTION. ANOTHER GOOD WORD FOR THE 325 CABLE SYSTEMS CARRYING CHANNEL 17.

Cable Operators know that keeping subscribers happy, keeps subscribers.

And, Channel 17's 24-hour movies, sports, and family entertainment is helping 325 satellite-served cable systems to retain happy subscribers in more than 1.5 million homes nationwide.

"In recent polls, our cable subscribers rate WTCG higher than WGN of Chicago and WTCN from Minneapolis."... St. Cloud, MN.

Here's what the A.C. Nielsen TV audience rating service is telling us about Channel 17's cable viewers:

After only a few weeks, more than 50% of the cable homes view Channel 17 regularly, and viewership increases in succeeding months.

Cable viewers nationwide spend as many hours per week watching Channel 17 as off-air viewers in Atlanta.

Cable viewers watch Channel 17 more or as often as other closer-in independents carried on many cable systems.

Estimates based A.C. Nielsen special tabulations for May and November 1977, February and May 1978.

"Most popular channel— People watch Channel 17 60-70% of the time as compared to network shows. Biggest draw to cable system."... Kenner, LA.

And, from across the nation, Cable Operators are also giving us the good word about Channel 17 viewers and the retention they have experienced.

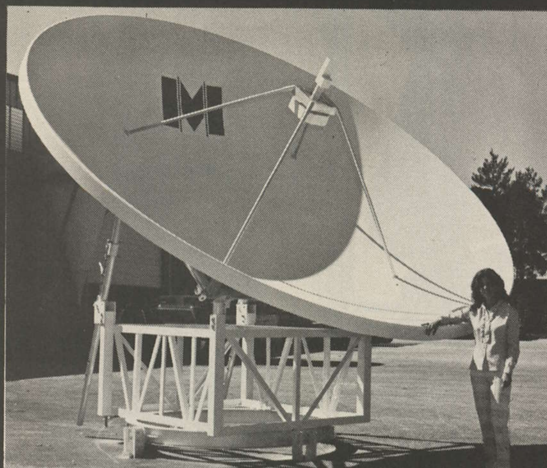
"Almost immediately after adding Channel 17 our basic subscriber churn slowed down."... Little Rock, AR.

How can Channel 17 improve *your* subscriber retention... and growth? For information, write Cable Relations, WTCG, Channel 17, P.O. Box 4064, Atlanta, GA 30302. Or call (404) 522-7250. We'll get the good word to you.

ATLANTA'S SPACE AGE TV STATION WTCG

YOUR CABLE CHANNEL

Let Microdyne turn you on . . .



The 'Let Microdyne Turn You On' theme introducing our SATRO-5M Five Meter TVRO Terminal and companion 1100-TVR (X12)/1100-FFC(X1) receivers at NCTA '78 was a tremendous success. The system's high reliability, unsurpassed performance and competetive price — without hidden installation or replacement costs — is continuing to turn on the CATV community.

1100-FFC(X1)

1100-TVR(X12)

Here's why . . .

- Microdyne's antenna foundation typically requires only 3 to 4 cubic yards of concrete.
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Over 70% of all CATV Earth Terminals are now using Microdyne Satellite Receivers. So, why not let us turn **you** on by calling Microdyne Today!

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No separate transmitter required. Both receivers operate with any cable TV video or pilot carrier.

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The "Tracer" Model TR-1

is a calibrated receiver system which assures absolute compliance with FCC regulated radiation limits. Its 40 dB logged scale is accurate to ±1 dB.

The system includes tuned dipole antenna with magnetic base, head phones and AC adapter/charger. Gell Cell batteries provide up to 50 hours of operation on a single charge. Weight: only 5 lbs.

The "Tracer" Model TR-2

is an economical field unit that can detect and locate RF leakage and can measure radiation with sufficient accuracy for general trouble shooting. Ni-Cad batteries provide up to 15 hours of use on a single charge. Includes AC adapter/charger. Weighs only 1.5 lbs.

"Tracer" TR-2 . . . for locating RF leaks **Only $300 ea.**
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FINDING INTELSAT BIRDS WITH 'SMALL' CATV TERMINALS

The Signals Are There

With the relatively speaking strong signals which U.S. and Canadian TVRO terminals have available from the domestic satellites (SATCOM, WESTAR and ANIK) and the rapid advance of technology in receivers and LNAs, the challenge to get a signal. . .a useable, good quality signal, is just about gone for anyone utilizing a ten foot or larger receive antenna. Because we at CATJ happen to believe that in the not too distant future there will be other satellites carrying video programming in the sky, satellites which are perhaps not U.S. owned and which offer programming to U.S. and Canadian cable systems, it might be appropriate to begin setting out some guidelines to **'distant satellite reception'.**

For our temporary purposes, a 'distant satellite' **shall be defined as** any bird that is **not** a part of either the U.S. or Canadian domestic satellite system. We'll overlook whatever legal restrictions there may be to intercepting and/or utilizing such signals from such **present birds** on the premise that this is primarily an exercise in technical feasibility and a pre-learning process leading towards the eventual day when such reception will not only be legal but encouraged.

The significance of the present day satellite reception of CATJ contributing editor S.J. Birkill from his home in Sheffield, England, is of considerable importance. With a smaller-than-CATV terminal antenna (8 foot) and a higher-noise-figure-than-CATV terminal LNA (typically over 200 degrees K), editor Birkill is regularly intercepting lower-power-than-CATV transmissions from various international satellites, including the Intelsat series which provide trans-oceanic television services between continents. We suspect that if more U.S. 'large-antenna-operators' with low noise front ends were aware of these transmissions and their location, they would be at least indulging in a bit of old fashioned 'DXing'' which is old time radio talk for 'seeing what you might pick up from some distant point' just for the sport of having a try at it!

Careful study of the **CATJ Satellite Data Chart** reveals that there are Intelsat satellites sitting off both coasts of the U.S.—east over the Atlantic and west over the Pacific.

Knowing **where** to look, **when** to look, and **how** to look is about 90% of the challenge in 'tuning in' these Intelsat transmissions on a typical CATV terminal 15 foot in diameter or larger. We'll address the where to look and touch briefly here on the how and when to look at this point in time. In a near future edition of his monthly column, Steve Birkill will address in more detail the how to look and when to look just to help you get off on the right foot.

First the basics of geo-stationary satellites. These (also called synchronous) satellites always remain at the same spot in the sky, for the earthbound observer who is stationary himself, because the satellite has been placed in a perfectly circular orbit over the equator. The altitude of the synchronous satellite is such that its orbital period around the earth exactly matches the rotation period of the earth itself; 24 hours. This altitude is approximately 22,245 miles above sea level at the equator.

If the location of the satellite is known (it is) and your own location is known (it is), then both locations can be reduced to a set of coordinates. Coordinates are merely numbers that divide the earth up into equal spheres; the location of the CATJ Lab, for example, is approximately 35 degrees 28 minutes north and 97 degrees 31 minutes west. North (or south depending upon where you are on the earth's surface) is always referenced to the equator. West (or again east, depending upon where you are located) is also referenced to a line that runs from the north pole to the south pole in a straight (so-called great circle) path through Greenwich, England. Thus the **longitude** for Greenwich **is 0 degrees;** and this particular line of longitude placed over the earth by mankind the surveyor is sometimes called the 'Prime

Meridian'. The geo-stationary satellites are always directly above the equator so their latitude (i.e. distance north or south of the equator) is essentially 'zero'.

Now how do you find it with your antenna?

Well, every TVRO antenna has two directional adjustments. One adjusts the antenna up and down (relative to the ground) and this is called the **elevation adjustment.** If your site was perfectly flat for as far as you could see and you manipulated the elevation adjustment so the TVRO antenna pointed exactly at your distant **horizon,** then your antenna would have a 'zero' **elevation angle.** By the same token if you were located exactly **on** the equator and you wanted to point your antenna **at** the satellite, it would be overhead. Your antenna elevation would then be 90 degrees or at right angles to your flat horizon. For most of us the angle lies someplace between these two extremes.

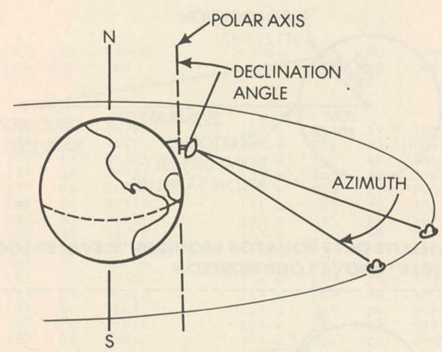
The second adjustment is called your **azimuth control,** and it allows you to swing the antenna left or right. Until the new circular-track antenna mounts came along (first from AFC/Microdyne and more recently from COMTECH/RF systems, Fort Worth Tower, and others) it was **essential** when putting your antenna mounting hardware in the ground that you knew **precisely where** true-north was so you could lay out a line on your ground at your antenna site that ran **true north by true south.** You did this to establish a 'reference' line for your antenna's azimuth adjustment; sort of like establishing your very own 'prime meridian'. If you had that true north-south line firmly marked and your antenna set in the ground so that it could initially be aligned true north and south, then you have a reference against which you can plot satellite locations that happen to fall either left (i.e. easterly) or right (i.e. westerly) of your own 'prime meridian'.

So to point your TVRO antenna at a known satellite location, you have to know (1) **where you are,** and (2) **where it is.** For most of us our hardware supplier hands us a set of 'coordinates' which tells us to point the antenna 'up' at an elevation of (say) 23 degrees and (right) 253 degrees to find (for example) SATCOM FI from Miami, Florida. What is this marvelous bit of information, typically generated by someone's computer, really telling us?

Up is obvious. The horizon in front of us, if our terrain is flat, is 0 degrees. Up 23 is obviously 23 degrees (on a 360 degree circle) **above** the horizon. We'll deal with how uncomplicated it is to measure that shortly. But this 253 azimuth degree business—what can that mean?

Remember when we put in our terminal we had to establish where true north was? Which by turning around "180 degrees" also told us where true south was. Well, for our purposes we consider true north to be 0 degrees on our 360 degree circular Boy Scout compass, true east to be 90 degrees, true south to be 180, and true west to be 270 degrees. If we know for a fact where north and south are, then our **starting point** for looking for a known satellite at a known location from the northern hemisphere will always be true south. Which on our compass is 180 degrees. Just to the 'right' of true south, if we are facing in that direction, is 181 degrees while just to the left is 179 degrees. In our Miami example then 253 degrees must be 180 (true south) **plus** 73 degrees. If you had laid out a set of taunt strings at your TVRO site that ran north and south (one set) and east and west (another set) you would have already marked 0,90,180,270 and 360(0). **Thus 253 must be someplace between 180 and 270,** and by simple arithmetic closer to 270 than 180. Finding precisely where 253 is becomes the job of the azimuth adjustment and your compass, transit or other device to carve up your 360 degree circle into 1 degree increments.

POLAR MOUNT MECHANICS

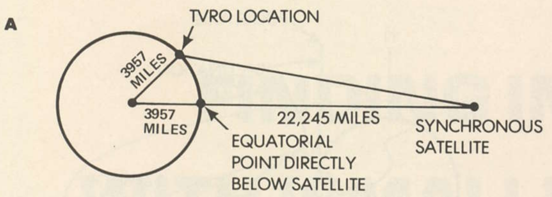


POLAR MOUNT ANTENNA IS INSTALLED WITH THE POLAR AXIS PARALLEL TO THE "TRUE" NORTH-SOUTH AXIS OF THE EARTH.

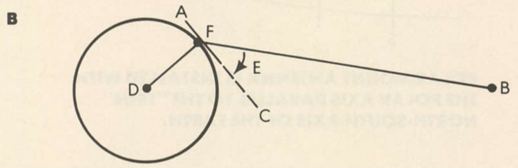
If you have either a polar mount antenna (see box material here) or one of the newer 'circular track mount' antennas, finding a satellite becomes quite simple if you simply know the proper elevation angle for your location. **How's that?** Well, if you can use and read a Boy Scout compass to say within +/− 5 degrees (allowing for the difference between magnetic north and true north *) and you have your antenna adjusted to the proper (calculated) elevation angle, you can then 'search' for the satellite signal (if you have either a spectrum analyzer to look at the full 500 MHz downlink band, or, have a TVRO receiver pretuned to a downlink transponder which you know to be active) by maintaining the pre-calculated elevation angle and slowly 'sweeping' left and right (azimuth) looking for signs of signal. As anyone who has ever done this previously can tell you, **once you find the signal,** the final tweeking proceeds usually with good speed and a light heart.

***—Magnetic compasses find magnetic north which differs from true north by several degrees in most areas. USGS 7.5 minute series maps, or the local airport control tower can advise you what the 'correction factor' is for your location to convert 'indicated** (magnetic) **north' to true-north.**

TVRO / GEO-STATIONARY SATELLITE RELATIONSHIPS, AND ELEVATION MECHANICS



SATELLITE OVER EQUATOR REQUIRES "ELEVATED LOOK ANGLE" ABOVE YOUR HORIZON



ELEVATION IS MEASURED AS AN ANGLE (E HERE) BETWEEN YOUR ANTENNA HEADING (I.E. WHERE FEED POINTS) AND LINE PERPENDICULAR (A-C) TO EARTH'S RADIUS FROM CORE (CENTER OF GRAVITY) AND YOUR LOCATION (D-F).

On the other hand if you have one of the azimuth over elevation (sometimes called **Az-El)** mounts then you have a bit more work ahead of you. With each adjustment of your azimuth you must also make a corresponding adjustment in your elevation. This is tedious and also quite slow and random sky searching for 'distant satellites' with an Az-El system is not recommended for the faint of heart or short of time person.

**—If you will provide your geographic coordinates (longitude in degrees and minutes, latitude in degrees and minutes) with a check for $3.00 made out to 'CATJ Wallchart' (Suite 106, 4209 N.W. 23rd, Oklahoma City, OK. 73107) plus your name and address, CATJ will have the full geosynchronous range satellite elevation and azimuth headings prepared for you on an IBM 360 computer in 1 degree increments. With this you will be able to determine what satellites are visible to your location and the exact elevation and azimuth adjustment settings to put your (TVRO) antenna in the proper spot for accessing the satellites available.

The impact of more northerly latitudes is evident when you take a cross section of North America and plot the 'visibility factor' from those locations to the 'distant satellites' available. Three examples follow:

Miami, Florida

1° west (IV-F7)	1 degree el	95 degree az
4° west (IV-F2)	4 degree el	96 degree az
15° west (SIRIC)	**14 degree el**	101 degree az
19° west (IVA-F3)	17 degree el	103 degree az
24° west (IV-F1)	22 degree el	106 degree az
29° west (IVA-F2)	27 degree el	109 degree az
34° west (IV-F3)	31 degree el	113 degree az

Oklahoma City, Oklahoma

19° west (IVA-F3)	1 degree el	97 degree az
24° west (IV-F1)	5 degree el	100 degree az
29° west (IVA-F2)	**9 degree el**	103 degree az
34° west (IV-F3)	13 degree el	106 degree az

Seattle, Washington

179° east (IV-F4)	**12 degree el**	246 degree az
174° east (IV-F8)	9 degree el	250 degree az

(It should also be noted that if you have a polar mount that was not precisely **installed on a true north south-**reference-**line that you may find as you wander out of the beaten track**—that area where the U.S. domestic satellite sit—**that you will lose tracking ability of the polar mount.** This means where you can easily, quickly and accurately move from say F1 through COMSTAR, WESTAR II, FII and even ANIK III you may not be able to make a major excursion to Intelsat IV-F3 at 34 degrees west without some **major** re-adjustments to your polar mount elevation).

Finding the elevation, then, is the first key fact you need to go 'satellite hunting'. It happens that there are several ways to do this. One of the easiest, if you are handy with a pocket calculator, is discussed in some (step by step) length in **QST Magazine** for March 1978 (page 23). For those willing to spend $3.00 there is an even easier method; it's called letting somebody else's IBM 360 computer do the work for you! As an illustration here shows, putting this relatively simple "calculation of a right spherical triangle" into a self-solving computer program is not much of a trick. A Radio Shack TRS-80 can do the job nicely (CATJ contributing editor Ray Daly, appearing in this issue with part two of his 'Computer Basics' series can probably be talked into putting together a program for TRS-80 users) but when you have the high speed plus hard copy print out ability of an IBM 360 available, it seems a shame not to use it. With the IBM 360 program one can feed into the computer the longitude and latitude of your proposed receiving site, and in seconds the computer prints out all of the following in one degree equatorial geo-stationary locations:

1) **The elevation angle** from your site to the bird
2) **The azimuth** for your antenna
3) **The geo-stationary assigned** longitudinal locations in one degree increments
4) **The 'slant range' distance** (in kilometers) from your site to the satellite's synchronous location.

If you are into informative wall charts this one is a dandy **(**)**. If you are thinking about looking for a soccer match from Argentina on Intelsat IVA-F3 this chart is a must.

CATJ has run approximately thirty such charts for various locations spread across the Northern Hemisphere. From such charts you can learn a great deal. . .not the least of which is you discover which satellites are 'above the horizon' for various locations. Above the horizon?

Remember that the earth is round. In fact if we forget the minor bumps and depressions, it has a radius of 3,957 miles at the equator. If you add the radius of the earth (i.e. the distance in miles from the exact center or core of the earth to the surface, or 3,957 miles) to the elevation **above the earth** of the geo-stationary satellites, we have an 'extended radius' of 26,202 miles. That is the 'length of the string' extending from the earth's center to the satellite; and the satellite is swinging around the earth's center on that string, keep-

GROUND STATION AT: TEXAS, HOUSTON 29 45N 95 22W

SYNCHRONOUS SATELLITE LONG. DEG	AZ DEG	EL DEG	RANGE KM	SYNCHRONOUS SATELLITE LONG. DEG	AZ DEG	EL DEG	RANGE KM	SYNCHRONOUS SATELLITE LONG. DEG	AZ DEG	EL DEG	RANGE KM	SYNCHRONOUS SATELLITE LONG. DEG	AZ DEG	EL DEG	RANGE KM
0 W	***	**	*****												
1 W	***	**	*****	46 W	113	27	38923	91 W	171	55	36794	136 W	240	34	38273
2 W	***	**	*****	47 W	114	28	38844	92 W	173	55	36786	137 W	241	33	38343
3 W	***	**	*****	48 W	115	28	38767	93 W	175	55	36781	138 W	242	32	38414
4 W	***	**	*****	49 W	115	29	38690	94 W	177	55	36777	139 W	243	32	38486
5 W	***	**	*****	50 W	116	30	38614	95 W	179	55	36775	140 W	243	31	38560
6 W	***	**	*****	51 W	117	31	38540	96 W	181	55	36776	141 W	244	30	38634
7 W	***	**	*****	52 W	118	32	38467	97 W	183	55	36778	142 W	245	29	38710
8 W	***	**	*****	53 W	119	33	38395	98 W	185	55	36782	143 W	246	28	38787
9 W	***	**	*****	54 W	119	33	38324	99 W	187	55	36788	144 W	246	27	38865
10 W	***	**	*****	55 W	120	34	38254	100 W	189	55	36796	145 W	247	26	38944
11 W	***	**	*****	56 W	121	35	38186	101 W	191	55	36806	146 W	248	26	39024
12 W	***	**	*****	57 W	122	36	38119	102 W	193	55	36818	147 W	249	25	39105
13 W	***	**	*****	58 W	123	37	38054	103 W	195	54	36831	148 W	249	24	39188
14 W	***	**	*****	59 W	124	37	37990	104 W	197	54	36847	149 W	250	23	39270
15 W	***	**	*****	60 W	125	38	37927	105 W	199	54	36864	150 W	251	22	39354
16 W	95	1	41624	61 W	126	39	37865	106 W	201	53	36884	151 W	251	21	39439
17 W	96	1	41528	62 W	127	40	37805	107 W	203	53	36905	152 W	252	20	39525
18 W	96	2	41432	63 W	128	41	37747	108 W	204	53	36928	153 W	253	20	39611
19 W	97	3	41337	64 W	129	41	37690	109 W	206	52	36953	154 W	253	19	39698
20 W	97	4	41241	65 W	130	42	37635	110 W	208	52	36980	155 W	254	18	39786
21 W	98	5	41146	66 W	131	43	37581	111 W	209	51	37009	156 W	254	17	39875
22 W	98	6	41051	67 W	133	44	37528	112 W	211	51	37039	157 W	255	16	39964
23 W	99	7	40956	68 W	134	44	37478	113 W	213	50	37072	158 W	256	15	40054
24 W	99	7	40861	69 W	135	45	37429	114 W	214	50	37106	159 W	256	14	40144
25 W	100	8	40767	70 W	136	46	37381	115 W	216	49	37142	160 W	257	13	40235
26 W	101	9	40673	71 W	138	46	37335	116 W	217	49	37179	161 W	257	13	40327
27 W	101	10	40580	72 W	139	47	37291	117 W	219	48	37219	162 W	258	12	40419
28 W	102	11	40487	73 W	140	48	37249	118 W	220	47	37260	163 W	258	11	40512
29 W	102	12	40394	74 W	142	48	37208	119 W	221	47	37303	164 W	259	10	40605
30 W	103	13	40302	75 W	143	49	37169	120 W	223	46	37348	165 W	260	9	40698
31 W	103	14	40211	76 W	145	49	37132	121 W	224	45	37394	166 W	260	8	40792
32 W	104	14	40120	77 W	146	50	37097	122 W	225	45	37442	167 W	261	7	40886
33 W	105	15	40030	78 W	148	50	37063	123 W	227	44	37491	168 W	261	6	40981
34 W	105	16	39940	79 W	149	51	37031	124 W	228	43	37542	169 W	262	6	41076
35 W	106	17	39851	80 W	151	51	37001	125 W	229	43	37595	170 W	262	5	41171
36 W	106	18	39762	81 W	153	52	36973	126 W	230	42	37649	171 W	263	4	41266
37 W	107	19	39675	82 W	154	52	36946	127 W	231	41	37705	172 W	263	3	41362
38 W	108	20	39588	83 W	156	53	36922	128 W	232	40	37762	173 W	264	2	41458
39 W	108	21	39502	84 W	158	53	36899	129 W	233	40	37821	174 W	264	1	41554
40 W	109	21	39416	85 W	160	53	36878	130 W	234	39	37882	175 W	265	0	41650
41 W	110	22	39332	86 W	162	54	36860	131 W	235	38	37943	176 W	***	**	*****
42 W	110	23	39248	87 W	163	54	36843	132 W	236	37	38007	177 W	***	**	*****
43 W	111	24	39166	88 W	165	54	36827	133 W	237	36	38071	178 W	***	**	*****
44 W	112	25	39084	89 W	167	55	36814	134 W	238	36	38137	179 W	***	**	*****
45 W	112	26	39003	90 W	169	55	36803	135 W	239	35	38204	180 W	***	**	*****

*** MEANS THAT A GEOSYNCHRONOUS SATELLITE AT THE GIVEN POSITION IS NOT VISIBLE FROM THIS GROUND STATION.

it taunt at all times, at the same apparent speed as the earth itself is rotating about that same mythical center.

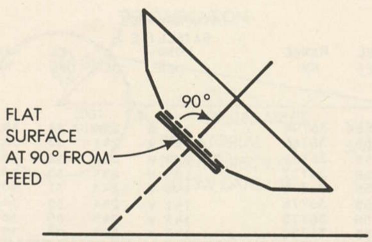
Which is another way of saying that for simplistic calculations of the 'coverage range' of the geo-stationary satellite **we can consider it to be** a television broadcasting tower **some 26,202 miles high** while our receiving site is a mere 3,957 miles high. And since the earth is assumed to be completely round, obviously like any 'broadcast line-of-sight signal' sooner or later as you back yourself far enough away from the satellite's location (i.e. 'tower' base) and along the earth's surface, the satellite will drop lower and lower towards the horizon until finally you take one too many steps backward and you lose line-of-sight to the bird. At any point within the line of sight range the bird is said to be 'above the horizon'. At any location beyond that point, it is 'below the horizon' and everyone knows that 4,000 MHz microwave signals don't bend over or around the horizon. Not very well anyhow.

Thus the satellite has a 'limited field of view', or coverage area. Because the earth is smooth (the variations in surface elevation above sea level for our mythical smoothed earth are so small as to be inconsequential in our calculations, **unless of course** the ground rises rapidly **directly in front of you** blocking part of your own horizon) and the earth is round, we have two different factors working on our coverage range from the satellite. Both relate to the 'ball' we call earth.

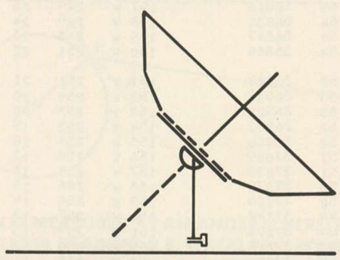
If the satellite is directly south of us (i.e. the azimuth is 180 degrees) the maximum distance you can go north (in the northern hemisphere) and still "see" the satellite is approximately to the 80th latitude parallel. Fortunately not too many people live north of that line anyhow so not much is lost there. If the north pole is the 90th parallel (it is, which makes it hardly a parallel at all but rather a small dot), then the geo-stationary satellite sitting 22,245 miles above the equator can 'see' 8/9th's of the distance to the 'top' of the world (or 'bottom' of the world for those of us biased against the southern hemisphere). But alas, when you go around the world east to west there are 360 different longitudinal man-created points; not 90 (or 180) as we commonly think of our north and south coordinates (reference the equator which is 0 degrees). If the satellite can 'see' 80 degrees north (or south—let's be fair to our readers in the southern hemisphere), **how far can it see east?** Or west? The answer should not surprise you; a maximum of 80 degrees in either direction, or a total of 160 degrees. Remember... the earth is (presumed to be) round.

If the world is 360 degrees 'around' and a single satellite can 'see' but 160 of these degrees...

HOW TO FIND "UP"



(A) MOST PARABOLIC ANTENNAS HAVE FLAT "DESIGN" SURFACE (PLATE, BAR, SUPPORT) AT RIGHT ANGLE TO FEED



(B) TAKE INEXPENSIVE PROTRACTOR, DRILL HOLE IN CENTER OF FLAT SIDE, INSERT PIECE OF STRING 3-4 FEET LONG WITH WEIGHT ON OPPOSITE END. PLACE FLAT EDGE OF PROTRACTOR AGAINST FLAT EDGE OF PARABOLIC ANTENNA.

then two could 'see' 320 degrees. Obviously to cover all of the world, less those portions north of 80 degrees latitude north and 80 degrees latitude south, requires not two but three properly placed geo-stationary satellites. And because of the geometric mechanics of the required height **above** the equator (22,245 miles) folks north of 80 degrees north and south of 80 degrees south are just going to have to learn to get along without HBO, SHOWTIME, FANFARE and the rest of the fare on FI and its descendents.

Another way to look at this is to calculate the so-called **'slant range'** or distance from the satellite to the **last point on earth** at which if you stand on the earth's surface and look just a tad above the horizon you can still 'see' the bird. Remember that the satellite is 22,245 miles (35,800 km) above the equator. Obviously if you go north or south of the equator even a few miles the distance **from the satellite to you** is going to **increase.** Directly above you, on the equator, the satellite is 90 degrees in elevation **and straight up.** Move north of the equator, say 100 miles, and the elevation is now less than 90 degrees (i.e. the angle to the satellite has moved from straight overhead to a lower 'slanted angle'). Now you have a triangle. The satellite sits at the top with the shortest distance to earth (directly down to the equator) one leg, the distance from the equator to you (along the earth's surface) another leg, and finally the distance from you to the satellite the third leg. Here we are back at a spherical triangle calculation once again.

Now move away from the equator to say the 80th parallel; pick the '80th' you like best near your favorite pole. Now the distance from you along the earth's surface to the equator, due south (north) of you, is considerable. So too has the distance from the satellite to you gotten greater. Where on the equator the distance was 22,245 miles, at the 80th parallel it is now 25,881 miles (or 41,650 km), give or take a few inconsequential unit digits.

The same numbers work if you head east (or west) along the equator until your 'elevation angle' drops to just a tad above zero. You will end up about 80 degrees east (or west) of where you started (when the satellite was directly overhead) and you will take one step too many and lose line-of-sight back to the bird. And the 'slant range' distance from you (on earth) backwards up to the bird will be 25,881 miles, give or take a few tenths of a mile.

All of this should tell you something. Namely that a circle is a circle no matter how you walk around it or over it. And that sooner or later, when your slant range reaches approximately 25,881 miles back to the satellite, you have just lost the ability to access the satellite.

The bottom line? From your location on earth you have a maximum distance you can be from the geo-stationary satellite. As long as you walk straight east or west along the equator, you can get 8/9ths **of 50%** of the way around the world before you run out of line-of-sight. But. . .and this is important for people who do **not** live on the equator. . .if you live north or south of the equator, your field of view narrows quite abit.

How's that?

Remember the earth is assumed to be a round ball—a perfect sphere. If you are due north of the satellite, the earth only bulges "in one plane" in front of you. It is sort of "uphill" all of the way. However, if you are looking at a satellite that is both south of you and say east (or west) of you. . . then the earth is bulging in two directions at once. Sort of 'uphill' and 'sideways' at the same time.

The earth field of view from Inuvik in the Canadian Northwest Territory is only from 162 degrees east longitude to 68 degrees west longitude; or 18 plus 112 which is **130 degrees total field of view.** In Oklahoma City the field of view is from 19 west to 176 west, or **157 degrees wide.** In San Juan (Puerto Rico) it is from 14 degrees east to 146 degrees west—a total of 160 degrees. San Juan is not exactly on the equator but the earth tends to flatten out (in the 'real world') at all three extremes, meaning both poles and in the equatorial region.

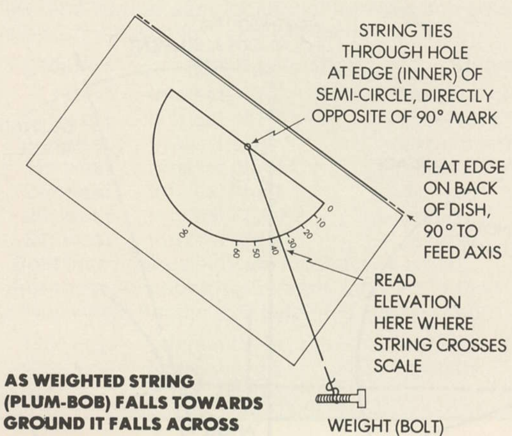
What is this east and west business? Well, for most users of longitude it is more convenient to think of our 360 degree round earth as **two 180 degree segments.** Recall that the 0 meridian runs through Greenwich, England. If you go west (that's towards us here in North America) the longitude gets measured as so many degrees **west of** Greenwich. If you head east (towards Russia) it is measured as so many degrees **east of** Greenwich. Obviously there is a counterpoint to Greenwich half way around the world from

England; that's where 180 degrees is. There is a 180 'east' and a 180 'west' but fortunately for us, they are the same place. **That is also where today becomes tomorrow** for those traveling through the area. . .which has absolutely nothing to do with this discussion. However 180 degrees (east or west. . .take your pick) unlike 0 degrees which runs through a pretty fair piece of countryside . . .runs through virtually nothing but blue Pacific. This is probably why mankind long ago decided to make **that point** the spot on earth where today becomes tomorrow. Very few people are inconvenienced that way since the date change doesn't run through the main street of anyone's town. Like we said. . .it has very little to do with this discussion except perhaps to help explain why rather than talking about 290 degrees west most people prefer to think of that particular spot as being 90 degrees east. If all of this bothers you don't fret too long about it. . .unless you are planning to talk via satellite to some chap in Guam at 9 AM on Tuesday. Because if you mean 9 AM your Tuesday it will already be Wednesday in Guam (and frightfully late at night!).

Back to our limited field of view. Obviously people in more temperature climes have an advantage when it comes to looking at satellites. They have a wider field of view which simply means they are more apt to be able to see more satellites than Rod Wheeler up in Whitehorse. That's because more of the 'geo-stationary orbit belt' is available to their line-of-sight view. All of this interplays on what you are apt to look for in the 'distant satellite' department.

If you line of sight horizon is truly 0 degrees (i.e. the earth is flat in front of you with no obstructions extending above the horizon) then can you not look for **'distant satellites'** all the way **down to the horizon?** Yes and no. Aside from the horizon blocking problem, the next problem you have at low 'elevation angles' is noise. Noise at 4 GHz comes from three sources one of which is independent of what the antenna elevation might be. Equipment noise (i.e. noise contributed to the receiving system by the LNA and receiver electronics) is or should be the same for any elevation angle. However two other forms of noise are elevation sensitive. **Terrestrial noise** is simply background noise **given off by the earth itself.** This is not manmade noise (we'll come to that shortly); it is simply created when objects are warm enough (or hot enough) for the atoms in the object to be moving about quite intensely. At most domestic bird **elevations** we can ignore the presence of terrestrial noise simply because our antenna pattern is such that we don't 'see' very much of it. However as we pull the elevation of the dish down, **closer to the horizon,** the minor or secondary antenna lobes (i.e. the antenna's side lobe patterns) start to fall close to the earth itself. That means that noise generated and radiated from the earth (and trees, buildings and other molecular objects) begins to be 'seen' by

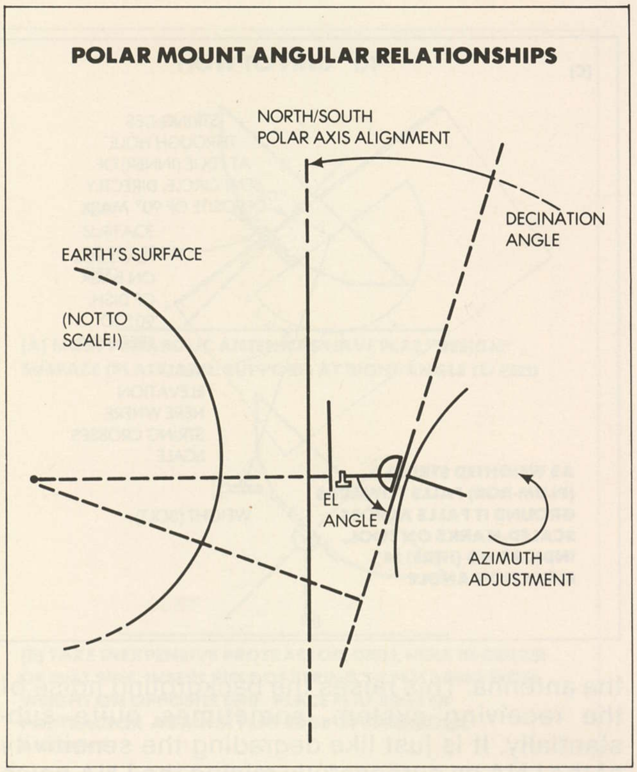
(C)



AS WEIGHTED STRING (PLUM-BOB) FALLS TOWARDS GROUND IT FALLS ACROSS SCALED-MARKS ON TOOL, INDICATING (HERE) 34° ELEVATION ANGLE

the antenna. This raises the background noise of the receiving system, sometimes quite substantially. It is just like degrading the sensitivity of the LNA by purposefully raising the LNA noise temperature. The effect is the same; the 'system threshold' goes up and the ability of the 'system' to receive weak signal levels goes down. **And then there is terrestrial signal interference.** Many share the view of Howard Hubbard at Antennas For Communications that FM signal interference is more apt to 'look like' noise interference than pure signal carrier interference. Remember that all satellite downlink signals in the TV service are FM (frequency modulated). Also remember than an FM receiver sees any discriminator (i.e. detector) signal voltage as a contributor to the total of the signal voltages present. A non-desired (i.e. interfering) frequency modulated signal falling into the antenna and detected by the discriminator is either coherent (i.e. it resolves into a picture and/or sound) or it is non-coherent (it is just a busy voltage bustling around the discriminator). A non-coherent bit of unwanted signal interacts with the desired signal and rather than producing a visible coherent picture or sound, it simply gets in the way of the desired signal's discriminator voltage. It looks like noise and it acts like noise because to the FM receiver **if** it is **not** a coherent signal, it **is noise.**

This says that when you are receiving a desired signal (from any satellite) that when there is also a non-desired signal present, the non-desired signal can have all of the **'appearance'** of simply random noise because to the discriminator it lacks coherency. When we move our antenna elevation angle down closer to the horizon we start seeing the odd bits of terrestrial 4 GHz signal that is present in almost all areas of the United States. The signal does not even have to come from the direction our antenna is pointing; 4 GHz microwave energy has the ability to re-



radiate (or reflect off of) just about anything big enough to see. That includes foilage, trees, buildings and hills.

Is that to say that as you approach the horizon with your elevation adjustment that there are limits as to how low you can go before the system is no longer useful? Yes, but there is no hard and fast rule as to just how low you can go. **If** there is a rule of thumb, it is that **the bigger the antenna aperture** (i.e. size) **the closer you can get to the horizon** before you start running into a combination of terrestrial noise and terrestrial interference that looks like noise in the video picture (and sounds like in the audio).

As an industry we are already 'experienced' in relatively low elevation angle signals, especially in New England where SATCOM FI elevation angles drop down to 9-11 degrees. Some systems are experiencing signal reception problems at these low angles, problems which were not apparent when all CATV services were through FII. It is not unlike a limbo contest; "how low can you go" depends largely on the antenna aperture plus a host of local variables. You don't (or won't) really know until you try.

Is ten degrees safe? Probably yes, with a 15 foot or larger terminal. Not guaranteed you understand, just good odds in favor of ten degrees and above. How about five degrees? Tony Bickel suggests that unless the antenna is at least 20 foot in aperture you are probably going to start running into serious terrestrial noise problems below say 8 degrees. To get down to 5 degrees while still maintaining reasonably good rejection of terrestrial noise sources probably requires an antenna 10 meters or larger.

Will the terrestrial noise **kill** you? Not by itself, but you have some other factors working against you; factors which Steve Birkill has largely solved and which through his 'Experimental Terminal Column' here in CATJ he will share with readers as the months go by. One of these is the EIRP levels of the Intelsat birds.

We are accustomed to making do in signal contours largely between 31 and 36 dBw. The present generation of Intelsat birds have three 'selectable' power levels available. There is the **'spot beam'** coverage, which is in the **33-34 dBw** region. Spot beams are typically available on just a few (such as 2 out of 12) of the total transponders on an Intelsat bird, and they are reserved for the lower angle transmissions. **Low angle** is a relative term that relates to the elevation angle **at the receive end** of the circuit, which means that for the birds clustered around 19 to 34 degrees west there is in fact at least one spot beam transponder available which does from time to time send signals towards North America in this (for Intelsat) high power configuration.

Then there is the **'hemispheric beam'** which is dedicated to covering (typically) a single hemisphere. Remember that the view from the bird is plus or minus 80 degrees (more or less) in **all** directions and with the hemispheric beam the bird then 'sees' say all of the northern hemisphere, or alternately all of the southern hemisphere. Or it could see everything 'east' on one beam (eastern hemisphere) and everything 'west' on another beam (western hemisphere). This is typically a **26 dBw** power level.

Finally there is the **'global beam'** which is the weakest of the three options, primarily because when in the global beam feed mode the bird is attempting to spray signal in **all** 360 degrees around it, for as far as it can see. This is typically a **22 dBw** signal level contour.

Steve Birkill has produced watchable pictures in both the 22 dBw global and the 26 dBw hemispheric modes with an 8 foot dish and an LNA in the 200 degree range. We re-mention this here to add encouragement to those who think you must have 34 or 35 or 36 dBw contours to do any good.

Most of what you will see, apparently, will be in the 'hemispheric' mode although North America is at a low elevation angle and should from time to time be blessed with spot beam coverage as well. If you should happen to catch a spot beam pattern from Intelsat the pictures could **approach** the levels you are accustomed to seeing from FI or any of the other domestic birds.

Then there is the 1/2 transponder format which Intelsat utilizes on a fairly regular basis. Because Intelsat is an international common carrier, they try to make the best and most efficient use of the transponders they have available. One way they do this is by cutting the transponders in half and leasing or renting 1/2 of one transponder to one customer and the other half to another customer. Often in the half transponder format there are **not** two signals in the transponder simultaneously however. For the 'standard 36 MHz wide IF' receiver (which may more often be 30 MHz wide) found in most CATV TVRO installations this is both a blessing and a new problem. The blessing is the advantage you can gain by tailoring the receiver to the half-transponder width (18 MHz), something done quite easily if you tack the Birkill phase lock loop demodulator onto your 70 MHz IF output (see **'S.J. Birkill On Experimental Terminals'**, October 1978 CATJ)—the problem is when you don't have a 70 MHz IF in your receiver. With the Birkill PLL demod you can also adjust the 'bandwidth' of the demod circuit to take advantage of a narrow passband. There is signal to noise gain here. . .but we'll save that for Steve Birkill's column in a future month.

The Intelsat birds are there and they are active. If you can manage to get your antenna down to say ten degrees (15 foot or larger), chances are good you have at least a couple of Intelsats within 'elevation view' of your site if you are located in the North American continental area. There are clusters of 4 GHz satellites in the 0 to 34 degrees west region and in the 45-60 degree east longitude region. A table here duplicating in 'short form' detailed data appearing in the CATJ Satellite Data (Wall) Chart pinpoints where some of the more 'interesting' targets are located.

INTERNATIONAL SATELLITE LOCATIONS

For those locations where 34 degrees west is within view, and further east locations, here are the satellites visible off the eastern coast of North America:

Location	Bird Designation	Status
1° west	Intelsat IV-F2	reserve
4° west	Intelsat IV-F7	reserve
15° west	SIRIC (Italy)	experimental
19° west	**Intelsat IV-A-F3**	secondary
24° west	**Intelsat IV-F1**	primary
29° west	Intelsat IV-A-F2	reserve
34° west	**Intelsat IV-F3**	reserve

Bold face listings indicate most active birds.

For those locations sufficiently far west in the U.S. or Canada where Pacific area satellites can be seen:

Location	Bird Designation	Status
179° east	Intelsat IV-F4	secondary
174° east	**Intelsat IV-F8**	primary

Save Money — Have Fun

MICROWAVE/SATELLITE ALIGNMENT MADE EASY

by
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One of the critical tasks that must be performed in engineering a microwave path or earth station site is to determine the heights of objects that may lie in the path of the beam. Because some of these objects are quite tall, a method of making the measurements easily from the ground is imperative. One method was described in a CATJ article on M/W field survey (see **CATJ**, May 1977, page 24).

The measuring technique is straight forward and uses a simple trigonometric principal **(see figure 1)** which states that **both sides of a 45° right triangle have the same length.** Using that fact and determining the location on the ground at which the angle between a straight line from the bottom of the object to an imaginary line to the top of the object is 45° defines one leg of the triangle. The distance from the base of the object and the located point is exactly the same as the height of the object.

The trick of course is to determine the proper location on the ground. Location of the point is determined with an instrument called an inclinometer. An inclinometer is a device used for measuring inclines or angles.

If making field surveys is your business, then the purchase of a quality commercial inclinometer is well worth the cost of $100, or more. If, however, you are only going to investigate a few paths for one microwave or earth station site, the investment may be easily avoided by building your own simple inclinometer for a cost of less than $5.00.

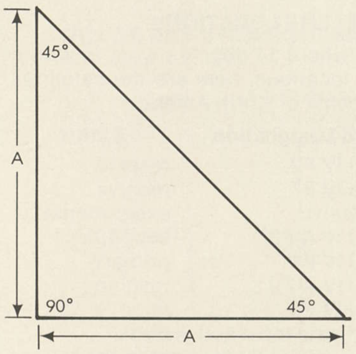


FIGURE ONE

Essentially **all that is needed is a way to determine a 45° angle and a method for keeping the 45° angle constant with respect to the surface of the earth** while the location of the proper point is determined **(figure 2).**

A simple 45° right triangle cut from a piece of wood will provide the correct angle while an inexpensive carpenters level or line level will aid in maintaining the proper angle during the measurement procedure.

The materials involved are a piece of 1/2" or 3/4" thick plywood, a short carpenters level (or line level) and a small pocket makeup mirror plus some silicone sealent or epoxy cement.

To assemble the inclinometer proceed as follows:

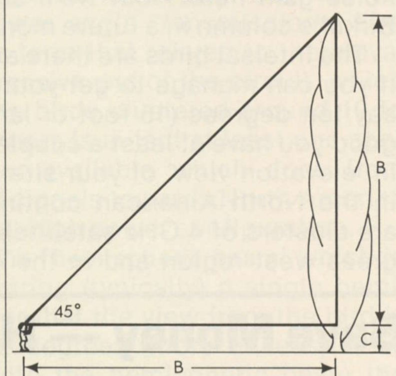
1. Using a 45° drafting triangle or a protractor trace a 45° right triangle on the plywood and cut out the pattern accurately with a saw. Truncate one point of the triangle for the sighting end.
2. Mount the carpenters level temporarily along the base of the triangle with a clamp.
3. Locate the mirror so that by sighting up the triangle from the blunt end an image of the level bubble can be seen.
4. Saw a slot in the plywood to accept the mirror.
5. With silicone seal or epoxy glue install the mirror and the level in their proper locations.

To use the inclinometer for determining object heights it should be held in the hand at eye level while sighting the top of the object along the 45° ramp. **Adjust your position relative to the object**—closer or farther away—**until the top of the object is even with the sighting plane while at the same time the bubble as seen by the mirror is in the center of the sight glass.**

Mark your location with a stake and using a tape measure, determine the distance from the bottom of the object to the stake. Since you are sighting the object in a standing position, add the distance from the ground to your eye level to the stake to object measurement **(figure 2).**

If the ground is not level you may also need to make corrections for the elevation change. Elevation correction may be

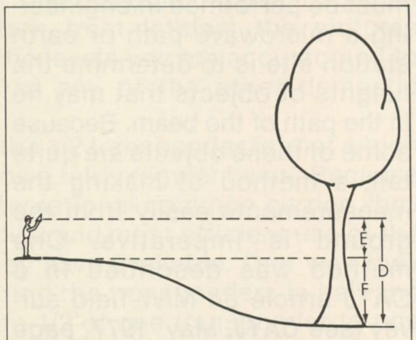
FIGURE TWO



TREE HEIGHT = B + C WHERE B IS THE DISTANCE FROM THE OBSERVER TO THE BASE OF THE TREE AND C IS THE EYELEVEL HEIGHT OF THE OBSERVER.

made by sighting along the bottom of the inclinometer (maintaining the bubble in the center) and having an associate mark the location on the object along the sighted line **(figure 3).**

After the first unit was constructed it was apparent that some simple refinements could be made to make the instrument more permanent and more cosmetically pleasing. The result of the improved device is shown in here. The refinements include encasing the mirror in wood to prevent accidental breakage, sanding



ELEVATION DIFFERENCE D IS F − E WHERE E IS THE EYELEVEL HEIGHT OF THE OBSERVER.

FIGURE THREE

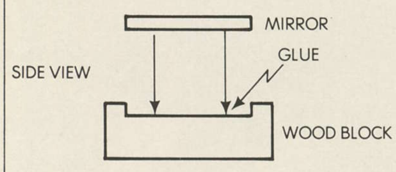


FIGURE FOUR

and painting the device and making the level moveable in 5° increments to increase the utility of the unit for **earth station** measurements.

Construction of the improved adjustable version is a little more complicated but costs about the same.

The only additional materials needed are a 2½ inch bolt, a wing nut, three washers, a piece of heavy paper and some paint.

To assemble the inclinometer proceed as follows:

1) Cut a block of wood slightly larger than the makeup mirror and rout or saw out enough material to insert the mirror **(figure 4).**
2) Glue the mirror to the block of wood.
3) Cut a 45° triangle from plywood to form the body of the inclinometer as before.
4) Install the line level in a piece of wood about 2" x 4" **(figure 5).**
5) Locate the level and the mirror so that pivoting the level over a 45° range will permit viewing the sight glass while sighting along the hypotenuse of the triangle (looking at the photo should help in positioning).
6) Drill a hole through the level and inclinometer form just large enough to accept the 2 inch bolt. (Be sure to drill the hole perfectly straight).
7) Install the wood framed mirror in the selected location.
8) Sand and paint both the level and the inclinometer frame.
9) When the paint is dry install the level using washers under the bolt head, between the level and inclinometer body and under the wing nut.
10) Glue the heavy paper or cardboard to the lower half of the body. This will be used for a calibration scale.

Calibration is done as follows:

a) Place the bottom of the body on a **level** surface. (Use a carpenters level to determine a suitable surface). Pivot the level attached to the inclinometer until the bubble is centered in the sight glass (the level will be horizontal).
b) Draw a line along the **bottom** of the adjustable level and label it 45°; i.e. the **incline of the sighting surface** will be 45° when the adjustable level is in the **marked** location and the bubble is **centered** in the sight glass.
c) With a protractor **centered** at the intersection between the two sides of the body, **pivot** the inclinometer on the 90° intersection until **the base intercepts** the 5° mark on the protractor. Holding this position move the adjustable level until the bubble is centered. Draw a line on the calibration card along the bottom of the level. Label this line 40° **(figure 6).**

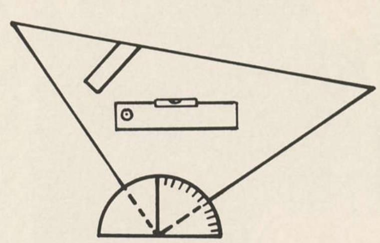


FIGURE SIX

d) **Continue** this procedure in 5° increments until the hypotenuse of the triangle is **horizontal.** The last position will be 0°.

To use the second generation adjustable unit for earth station measurements, adjust the level of the required angle by consulting the calculated antenna elevation angle for the satellite

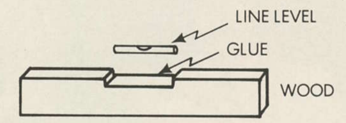
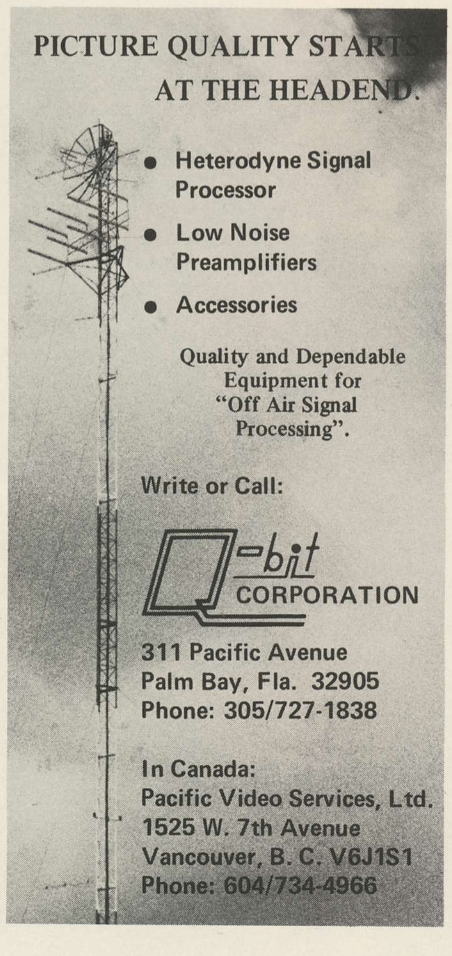


FIGURE FIVE

of interest at your longitude and latitude. **Sight along the hypotenuse of** the triangle **keeping the bubble centered** in the sight glass and determine if there is any object above the sight line. Be certain to make the measurement at the **lowest** point (i.e. bottom lip) at which the antenna will be located. (This point can be determined by checking the antenna manufacturers data for the elevation angle of the satellite). Allow for any additional **clearance over objects** as recommended by the antenna manufacturer.

Although the device described is crude by commercial standards it will perform the task for which it was designed and by careful manipulation the measurements will be accurate to within a few percent.



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You know us. We know you.

COMPUTERS ARE SURROUNDING YOU IN CATV OPERATIONS

by
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How many microcomputers will your system have in the next five to ten years? While this question may seem a bit ridiculous, consider what has happened with television. Most people never foresaw the need or desire for more than one TV per household. But now count the number of homes on your CATV system with more than one TV outlet. Just as it may be ridiculous to ask if someone owns a TV, so in ten years it will be the same with microcomputers in cable television.

One reason why it is difficult to describe or define a computer is that they can do so much. While one company may use a microcomputer to prepare and mail bills, the same model computer could be used in another company on an assembly line. However, some microcomputers are designed and built so that they can be used in very limited ways. For example, most electronic games, from hand held games to sophisticated video games to pinball machines, contain microcomputer parts. Because of their design, the devices are limited to game use. Another example is Warner Cable's QUBE home terminals. For CATV similarily limited microcomputers will appear (or have already appeared) as test instruments, character generators, pay-television scramblers, convertors, TVRO equipment, etc. In other words, microcomputers will often be disguised as a computerized, old-fashion gadget!

These limited microcomputers are like an audio tape player only capable of playing one tape permanently enclosed in the machine. If you could buy such a device, the program material would be designed into the product at the factory; in the same way the **program material** for the limited microcomputer is designed into the product at the factory, whether it be a TV game or cable television character generator. The only way to change this preprogrammed product would be to physically modify the device.

The general purpose microcomputer is not designed in this manner. Though some program material is usually incorporated into the product, it is designed so that it can be programmed by the user to do a wide variety of functions and connect to many different types of devices. For example, a **Radio Shack TRS-80** microcomputer could be used as a **character generator** on a cable television system. But when some math computations are needed, it could be disconnected from the cable and attached to a printer to give hard copy results to the problem. Though a limited microcomputer may be able to perform a specific function better than a more general purpose microcomputer, the important point is that **a microcomputer can do a wide variety of things.**

The vast potential of microcomputers has many people excited and seriously considering a microcomputer for their CATV operations. Selecting a microcomputer requires good business judgment. Such a decision is complicated because microcomputers are part of a new, rapidly changing industry. Though it may appear difficult, if a few points are understood then it is easy to avoid some of the pitfalls involved with microcomputers.

In purchasing any microcomputer, the natural instinct is to shop for the **best price.** However, this is often a costly mistake. When considering a computer system, the cost includes **both** the computer itself and the programs for the computer. Just as cable television service is an extra cost beyond the price of a television, so computer programs are usually an additional cost beyond the cost of the computer. In fact,

the **primary concern** in pricing a computer system **should be the computer programs,** not the system's equipment. A computer can be purchased at a comparatively bargain price, but it may be unable to do anything useful without a great expense in acquiring or writing programs. Computer programs, **or software,** as it is called in computer jargon, can cost more than the computer itself. In most leased systems, the software is the major selling point. **Unfortunately,** in looking at microcomputers, **the software cost is often overlooked.**

Computer programs are expensive for several reasons. First, there is a **lack of standardization** between computers. For example, a cassette tape which stores program from a Radio Shack TRS-80 microcomputer will not work on a Commadore PET computer. And the same is generally true for most computers, no matter how large or small. **Secondly,** computer software is traditionally written for customer use, for a particular customer, and not for general use. As such the vast amount of programs already written have little application to other users. **Third,** writing any computer program can be very time consuming and therefore expensive. This is also the case for professional programmers and why there is such a profession.

The key to reducing software expenses is to use a computer which meets some standards, whether they be formally recognized or not. Most large computer users follow this approach which is why many bought IBM computers. With microcomputers, the concept is to buy one which will have many programs available; not only from the manufacturer but from a variety of independent sources. Using this approach the high cost of custom made programs is avoided by purchasing **existing programs.** And if custom written programs or modifications to existing programs are necessary, this work can cost less when using a standard microcomputer. Often, the finished product can be marketed to other similar computer users to reduce such development costs.

Currently, in the microcomputer field most programs are sold or exchanged on common, audio, casettes; with "floppy disk" (program storage) becoming increasingly more popular. Though an attempt was made to standardize cassette formats, the resultant "Kansas City" standard is virtually ignored. The situation is even worse than video cassettes where the Betamax type tapes will not play on the VHS type machines. In microcomputers, the only standards are those "established" by the popularity of a **particular** microcomputer. To date this has resulted in a wide variety of programs distributed mainly for the **three** most popular microcomputers: the **Radio Shack** TRS-80, the **Com-**

Prior to the introduction of a new generation of microcomputers last year you could save a substantial amount of money building your own computer from a kit. This has all changed with the introduction of the Radio Shack TRS-80, the Commadore PET and the Apple II. For example, to build the equivalent S-100 buss-microcomputer to the TRS-80 which costs $599, would cost more than twice as much:

Intergrand mainframe	$200
Jade Computer Products Z80	135
Two Jade 8k Static Memory	250
Jade CRT Video Memory	100
Video Monitor	200
Keyboard Interface	125
Keyboard	75
Cassette Interface	100
Cassette Recorder	60
BASIC	80
Total	$1425

It is not necessary that you know what all those terms mean, but it is important that you see the difference between $599 and $1425. Yes, $826. And remember that this is in kit form; no warranties and not as easy to use as the Radio Shack TRS-80. Furthermore, you would probably have a custom built machine for which not much software would be available because most people don't build kits anymore.

***Note:** There are other less expensive kits available. But the S-100 buss type of computer is compared because it is the the most popular type of computer other than the new generation of microcomputers.

madore PET 2001, and the Apple II by **Apple Computer, Inc.** Another article will review these computers.

Instead of buying one of these assembled and completely operational microcomputers, one might suspect that it would be less expensive to 'home-brew' a microcomputer. Prior to 1975 the only reasonable way to have a low cost computer was to build one from scratch. When the first kit was introduced in 1975, thousands of home computers were built at a substantial savings over the assembled units. But today, home-built computers are too expensive because of the mass production techniques employed in building the more popular microcomputers. Recently, the home built computer has gone the way of the home built radio and television; today, to build from kits a home brew computer would easily cost more than twice as much as the simplest Radio Shack TRS-80 (see box). The **only reason** to **build** home-brew computers is for **custom** applications or to learn about microcomputer electronics. Otherwise, the home brew approach to computers is simply impractical.

Though the home-brew computer is uneconomical, the home-brew approach to computing can be very worthwhile. Though programs can be purchased for business and engineering use, you can program a computer yourself. Even if you have never used a computer before and have had no advanced math, you can easily learn how to write computer programs with self-teaching books. There are even **several computer program packages** which teach this skill **using the computer.** This is not to say that home brew computing is always inexpensive, because writing some programs can take a considerable amount of time. But money can be saved doing it yourself.

Can a low cost, popular computer be **adequate** for business use? There may be some particular applications which require a more powerful microcomputer, but in most cases this type of microcomputer will be sufficient for small business use. In fact, many firms offering **computer services** use similar microcomputers. The low cost computers are extremely powerful, equivalent to very expensive computers of just a few years ago. Their price makes an initial investment into this field affordable with minimum dollars risked. The "hands-on" experience alone may justify the initial investment considering the rapid advancement of microprocessors and digital electronics into all phases of the cable television business. It is probably a wise business decision for many CATV operators.

When selecting a computer system for any business operation there are several ramifications to consider. For example, will it be used to deal directly with the customer? It is important to consider customer reactions to computerized materials. You should ask yourself: Do the benefits of the computer system outweigh the risk of depersonalization? Will the customers be alienated, or will they enjoy better services? **The customer can never be ignored.**

Next, the time required to first implement and then use a new system must not be overlooked. How long it will take to initiate the conversion to a computer system must be considered. When a computer system is first used, it is often run side-by-side with the manual system which cross-checks operation. Additionally, the amount of time required to use the system on a day-to-day basis should not be ignored. While a computerized system will generally save time for business operations, **it is possible** to start a computerized system which takes more time and effort than it is worth. The solution can sometimes be worse than the problem. Computer software should be evaluated in this light.

Purchasing a microcomputer is not the only option either. The manual system can be maintained and it is often preferred because of its familiarity. On the other hand, a computer system with a complete, cable television software package can be leased or purchased from several companies. This "turnkey approach" has many advantages, as many cable television operators have discovered. If you are considering this approach, it would probably be advantageous to talk to one or more of these operators.

With this background, business decisions can be reached in looking at microcomputer systems. Once it is understood that there is much more involved than just buying the computer, a standardized computer system can reduce the total cost of using microcomputers. In the next article in this series we will review and compare the three most popular, low cost microcomputers to see which would be most valuable in cable television operations.

TECHNICAL TOPICS

Response To Switzer

"I wish to take this opportunity to reply to some of the comments and criticisms contained in Mr. I. Switzer's letter to you (see **Technical Topics, October CATJ**) regarding our Inter City Broadband Network. The technical criticisms advanced by Mr. Switzer will best be answered by certified test results for the 130 mile Winnipeg-Brandon I CBN system when they are available in late October. Repeated tests of the 30 mile Winnipeg-Selkirk system which has been running since February, have met or exceeded expectations.

"The design and operation of the M.T.S. ICBN system reflects a balanced systems engineering approach to the delivery of television signals for CATV distribution. Rather than use a very high quality (65 dB SNR) intercity facility such as microwave, designed for 4000 mile transmission with 35 dB fade margins, to deliver moderate quality received signals (35-50 dB SNR) to local distribution plant capable of 45 dB SNR performance, the Manitoba system has been designed such that the minimum noise and distortion performance of the inter-city transmission facility will not materially degrade the subscriber's signal below that established by the community's Local Broadband Network (LBN), which generally is the weakest performance link in the entire system. All MTS LBN's are hubbed on our central offices such that the local plant cascades are short and offer relatively high performance (typically SNR exceeds 45 dB).

"Mr. Switzer is certainly aware that CATV operators, at least in Canada, have continually complained that **common carrier inter-city microwave facilities are overdesigned** with respect to CATV requirements. In terms of SNR performance, propagation, reliability, and system availability. (Reference—"Microwave for Cable Television"—study done for Canadian Cable Television Association by K.J. Easton, P. Eng., dated March, 1973).

"Back in the 60's, many common carriers in Canada prophesied that the viewing public would soon revolt against the 'inferior technical standards' of the CATV industry and clamour for better signal quality. The fact that this never happened is clearly reflected in the standards recommended for CATV inter city signal distribution in recent professional references such as:

(a) **High quality trunk SNR = 46 dB.** Bell Northern Research Prairie Provinces Rural Distribution Study—Activity 12 and 15. "Rural Distribution of Video Services on Coax"

(b) **SNR for Hypothetical Reference Circuit** (H.R.C.) **is 47 dB.** Trans Canada Telephone System Guideline—"Television System Transmission Parameters for CATV and Broadcaster Applications"

(c) Canada Wire and Cable—Multi Channel Fibre Optic CATV Trunk proposal to MTS—March 1977 SNR = 50 dB (peak white to blanking to RMS noise).

"These references, and others indicate a **relaxation** in the standards recommended for inter-city CATV signal delivery, presumably because of overall system engineering considerations.

"In comparison on the Winnipeg-Brandon System, the predicted, CCIR-weighted baseband SNR will exceed 49 dB., using standard NTSC—format AM vestigial sideband transmission.

"The ICBN system, by virtue of its bandwidth, provides considerable flexibility in terms of transmission performance. While Mr. Switzer characterizes the Winnipeg-Brandon system (49 dB SNR) as "mediocre", is should be clearly understood that use of FM transmission, (eg. Catel FMS-2000 system) or (theoretically) some of the new Digital Noise Reduction Units could boost the system SNR over 60 dB to meet or exceed applicable network television standards.

"While we have not experimented with any of the available Digital Noise Reduction Units yet (loan of one was promised in October), the glowing reports of some units' effectiveness received from professional users, do not include any complaints concerning "motion smearing", unless extreme levels of noise reduction are attempted i.e. 12-15 dB. **Modest SNR improvements** of 6-9 dB have met with excellent success **with no perceptible distortion,** even to broadcast quality standards for transmission. We are very anxious to test this concept as it has obvious immense potential for all forms of television transmission.

"Use of suppressed carrier or, harmonically-related carrier techniques for improving transmission performance is possible on ICBN. The flexibility and bandwidth of the system allow the user to select the quality required for his individual application, with broadcast quality transmission being mixed with industrial grade and/or channels optimized per CATV signal delivery on a common, multi-user **'electronic highway'.**

"Having designed and built the original elaborate Winnipeg head end in 1967, which used three 80' x 270' parabolic dishes in a maximal-ratio diversity combiner configuration to squeeze every microvolt of signal out of U.S. signal paths up to 184 miles, **my interest** was stimulated when relaxation of Canadian government policy resulted in application for construction by the Winnipeg operators of a distant head end on the North Dakota border, some 65 miles closer to the U.S. network transmitters in 1974.

"However it became quickly apparent that the proposed 400' tower facility would not improve U.S. signal reception to a degree consistent with the importance of **this head end,** which **is presently licensed to provide service to CATV systems in Saskatchewan and Manitoba.** The Government of

Manitoba presented an engineering brief to the CRTC in May 1974 and again in February 1976, with a request that a more suitable facility, using a 1400 foot tower be constructed.

"This brief, which was based on detailed path calculations using two separate computer programs, with particular attention to co-channel interference, predicted 99% received SNR's of more than 31 dB and 50% SNR's of more than 44 dB for the distant U.S. channels using the 400 foot facility. My viewing experience tends to support the professional predictions and I cannot agree with Mr. Switzer's conjecture that the input signals to the Manitoba Network are in the low 50's S/N.

"As of this date 87 stations on the Brandon system have been turned up—a system length of some 95 miles, with a measured response spread (peak to valley) of 0.3 dB. Experience on the 30 mile Selkirk system and laboratory tests from −32°C to +55°C, indicate that this level of equalization will be maintained.

"Return loss and K-factor effects have been carefully analyzed theoretically for worst-case (regular spacing) Winnipeg-Brandon conditions. In the forward direction, at the low band edge, the cumulative echo rating exceeds the level of perception (General System Practice 871-010-901 BC) by some 23 dB. At the high band edge, the margin is over 29 dB. **In the return direction,** a problem is possible on the lower sub band channels. **This suggests that return video should be placed high on the return signal band,** with data and telephone signals habitating the low end. Alternately FM modulation techniques may offer some advantages on the low sub band channels.

"The fused disc cable has proven to be excellent quality, meeting a 30 dB. SRL limit easily, typically better than 35 dB. and, **most importantly** with **no consistent frequency pattern** to the SRL spikes between reels received, below 300 MHz.

"We are therefore not anticipating any echo, smearing, or K-factor problems with the Brandon system. None are present on the Selkirk system, where measurements of these parameters equate to terminal mod-demod/values.

"It is very interesting to evaluate theoretically, the echo possibilities in a three or four amplifier distribution cascade with standard multitaps spaced at lot lines. The margin over the limit of echo perceptability is low, and under practical conditions, it is likely that some visible edge effects are being produced, particularly if unterminated tap spiggots are present. **The source of cumulative smearing,** ringing and ghosting effects **is hence predominantly the local distribution plant itself.**

"While I'm not sure readers are interested in having CATJ's technical atmosphere disturbed with political arguments regarding a highly complex Canadian situation, I can hardly let some of Mr. Switzer's non-technical comments go unchallenged.

"It should be clearly understood that the initial customers for the MTS Provincial Broadband Network are the newly licensed rural CATV operators, not those in Winnipeg, and that the network under construction has been developed to meet the rural operators expressed requirements for U.S. signal delivery **and distribution of Manitoba originated television and FM radio services for which they are licensed.**

"To illustrate this important latter point, the licensee for 20 of the communities shown on the map, Figure 4 of Page 23 of the **August CATJ**, is licensed to provide **live delivery** of two regional channels (ETV, Community programming) **from Brandon to the other 19 outlying communities,** plus delivery Winnipeg FM stations, received at Portage La Prairie to Brandon and thence distribute these signals, plus the local Brandon FM stations, throughout his area (which at present has little or no FM broadcast service). These requirements, among others, cannot be met by the Telesat satellite **'study'**.

"The Winnipeg CATV operators, for whom Mr. Switzer is a consultant, appear to have two motives in pushing for satellite delivery of U.S. signals to Manitoba, irrespective of its higher costs and other service deficiencies:

(a) To achieve a position of strong advantage over other interests in the provision of the long-awaited Pay TV service (**when our federal govermnent approves its initiation**) by establishing their own ground receive stations in Winnipeg.

(b) Perhaps more importantly, to remove themselves from the need to provide an inter-city delivery **subsidy** to the rural operators, for provision of the U.S. network signals. The CRTC licensed **all 28 rural communities** in 1977 on the basis that **there would be a consortium formed to cost share the delivery of these signals.** Cost sharing arrangements like this, while certainly foreign to the United States, exist in other parts of Canada (Saskatchewan, Alberta, British Columbia, Atlantic Provinces for example) such that accidents of geography (living removed from U.S. border television stations) can receive some degree of equalization.

"The Telesat **'study'** equalizes satellite delivery costs spread between all users at a rate of 90 cents per sub per month. **However,** the ground station, civil works and associated costs are not cost shared, nor have the Winnipeg operators offered to participate in such a plan. Using the lowest possible, current costs for receive facilities, the new operators would face a "tab" of almost **$2.4M.** A representative rural

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town like Gladstone (334 potential households) would have to pay over $11.00 per month, at a 50% subscription level, for the satellite reception service alone **plus** costs to cover the local head end for off-air signals **plus** the normal monthly CATV service charges, which would likely approach $8-$9.

"At best, if the Winnipeg operators agreed to share in the costs of **all** Manitoba ground stations, the cost would be in the neighborhood of **$1.30 per sub per month** for the Telesat service **versus $0.65 for delivery of the four U.S. networks via the MTS network.** Placed in the perspective of the 172,000 existing Winnipeg CATV subscribers, why should the Winnipeg operators pay 90¢ per sub per month (plus ground station costs) for the four U.S. networks from Detroit, when they now get these networks from neighboring North Dakota for less than 3.8¢ per month?

"While the M.T.S. annual commitment to the financial support of Telesat may be small, percentage-wise, as suggested by Mr. Switzer, that commitment represents a substantial sum, and the provision of new services using satellite is of great interest to us. If Manitoba's licensed CATV operators are willing to commit to use of satellite facilities, with the apparent higher costs and requirements for rural licensees to change their CRTC licenses, (with attendant delays in provision of service) and can provide reasonable assurances of total user growth to meet Telesat's 1.5M subscriber base required, M.T.S. would be pleased to assist in the provision of this service."

W.E. Evans, P. Eng.,
Broadband Industry Operations Manager
Manitoba Telephone System
Winnipeg, Manitoba
R3C 3V6

Richey Needs A Keeper?

"My wife and I really enjoyed CCOS 78. I got alot of help and ideas from the event. Especially enjoyed meeting so many people such as Kyle Moore, Oliver Swan, Bob Richardson and so on; great guys, all of them. Also met the 'infamous' Steve Richey. Why doesn't he hire twenty sharp guys to run along behind him and execute his brain childs that seem to ebb and flow out of his noggin?. Great ideas, great technician but he can't begin to find a big enough day to do what he has to do to keep people happy and out of his hair. He needs help. Can't somebody fill the gap between him and his brainstorms so at least 10% of his ideas get to be reality? Wow."

Dyn Zirzow
Sights and Sounds Cablevision
Alma, Wisconsin 54610

For someone who just met Richey, and at that spent but a short time with him, you have amazing insight Dyn. One of our favorite 'Richey stories' comes to mind. Years ago Steve was Chief Engineer of CADCO. Some several months prior to a major trade show he agreed to develop a 'revolutionary' heterodyne processor for CADCO. He then, in the best Richey tradition, diddled and piddled around on the project until about five days before the major event where it was scheduled to be first shown. Then he went to work. At D-Day minus six hours he was still seven hours from completion. So Richey, a load of test equipment, and a box of parts were loaded into the back of a station wagon. For six hours driving time Richey sat hunched over in the back of the wagon soldering and cutting, cursing and moaning as each highway bump sent his test gear flying and his parts tray scattering. As the wagon pulled up to the convention site just moments before the show he shouted 'Eureka' and as the back door opened out crawled a double-bent-over Richey bushy eyed and drawn but smiling. Under his arm was the still warm processor only minutes before unplugged from the DC/AC converter hurridly wired into the station wagon for the trip. It was rushed to the show floor and displayed, where it performed flawlessly. Richey crawled into the nearest motel bed and collapsed for two days.

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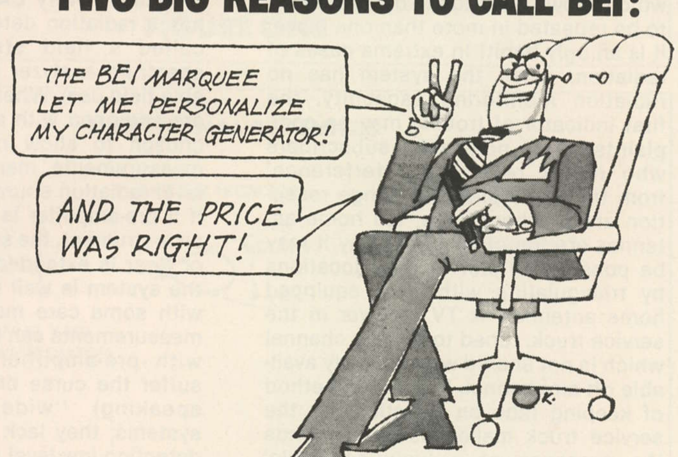

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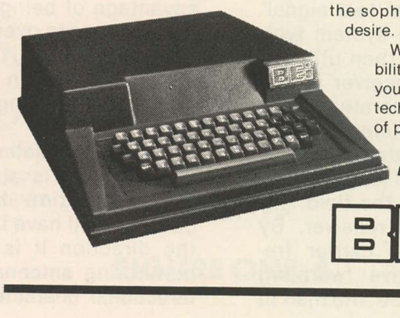

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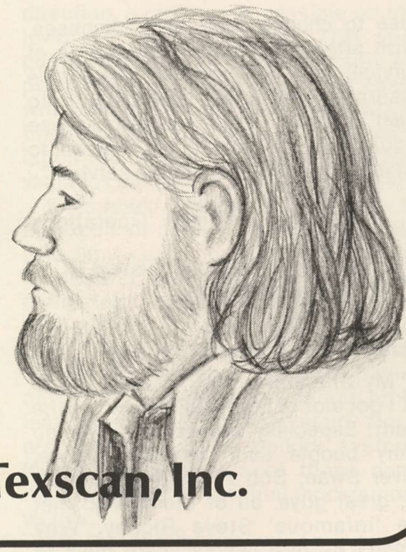


Raleigh B. Stelle - Texscan, Inc.

Finding/Measuring Radiation

In parts one and two of this series we looked at the hazards of radiating signals from our cable plants into the 'ether' (atmosphere) and pinpointed several ways that radiation can and does occur. Now we are going to attempt to locate sources of radiation, and then measure those sources for radiated signal level.

The cable system which radiates will usually do so at multiple locations. This is another way of saying that the error in construction or maintenance which allows radiation to occur is likely to be repeated in more than one place; it is an ugly habit! In extreme cases of radiation, when the system has no radiation monitoring capability, the first indicator of trouble may be complaints from non-cable subscribers who report receiving 'interference' from the cable plant. In 'fringe reception areas' where large, tall home antennas are the order of the day it may be possible to plot leakage locations by triangulating with rotor equipped home antennas. A TV receiver in the service truck, tuned to a cable channel which is not shared with a locally available off-air channel, is another method of keeping tabs on radiation. As the service truck makes its daily rounds the presence of a 'unique-to-cable' channel signal will be an instant indicator of problems.

There are, at this writing, several dedicated leakage detection systems available in the marketplace. These systems inject a descrete 'test signal' or 'carrier' into the cable system typically at the headend and then utilize a (remote) transportable receiver in the field, tuned to that descrete carrier frequency. One such system utilizes a frequency in or immediately adjacent to the FM broadcast band (88-108 MHz) and the receiver used in the field is a portable FM (broadcast) receiver. By modulating the descrete carrier frequency with a distinctive 'warbling tone' stepped in 'amplitude' the man in the field has both a quick identification for the descrete test carrier and a method of determining whether he is getting closer to or farther from the radiation source.

Another approach places a choice of (different) frequencies in the midband and/or superband spectrum. The receiver in this 'system' is a dedicated instrument supplied with antennas useful for both general surveillance and specific pinpointing of actual radiation sources.

Virtually every CATV system already has a radiation detection device; it is called a field strength meter (or spectrum analyzer equipped for portable field use). When such instruments are equipped with a suitable antenna, chosen to allow radiation detection measurements, many medium to high level radiation sources can be located. If a pre-amplifier is utilized with such an instrument, the sensitivity threshold or floor is extended even lower and if the system is well designed and used with some care moderately low level measurements can be made. Still, even with pre-amplifiers, such systems suffer the curse of all (comparatively speaking) "wideband" receiving systems; they lack real sensitivity for detecting low level signals. The hands-down winner for low (radiation) level detection is a dedicated system designed around a "narrow band" receiving instrument. However the tried and true FSM/SLM or analyzer has the advantage of being capable of making measurements over a wide band of frequencies (i.e. the whole CATV spectrum) and in making calibrated (relatively speaking) measurements at that.

Locating radiation or leakage to a single source is at best a tricky task. When radiation is first found the operator will have little or no hint as to the direction it is coming from. The monitoring **antenna** typically **has poor directional characteristics;** and if they are known in advance they are typically not predictable under field conditions. This is especially true when the detection antenna is mounted on a vehicle; the presence of the vehicle metal body plus the near by proximity of numerous other metallic objects (other vehicles, utility lines, buildings, etc.) will distort if not destroy the 'ideal' directional characteristics of the monitoring antenna. In short, what you believe to be 'front' may well turn out to be 'back' or side!

To determine the true source of radiation, and its direction from the point where you first notice the signal, may well require switching to a directional antenna with relatively stable directional characteristics. A few are shown in figure 1 with typical 'patterns'. A word of caution here in case the 'truth' of figure 1 is not evident to you:

If you are using a 'loop' or 'dipole' antenna for direction finding, calibrate against the 'null' of the antenna. The null tends to be much sharper (i.e. more clearly defined) **than the peak** (which tends to be quite broad). **However, if you are utilizing a yagi** (or log) **antenna just the opposite is true; the peak is relatively sharp and much better defined than the 'null'(s); which tend to be 'multi-pointed' with minor-antenna lobe patterns.**

When the radiation is tracked close to its suspected location you need to reduce the amount of antenna gain, and switch to a small-capture area antenna with a good null indication. This suggests breaking out a small, hand held capacitively loaded loop antenna (see **figure 2** for a generalized loop construction **technique**). If there is sufficient interest from readers we will detail construction of both standard loops and 'loaded loops' in a future issue of CATJ.

There have been numerous articles published relating steps to take to measure radiation. **Some of that information is at best erroneous.** Remember there are two separate and distinct levels of radiation detection: (1) **To spot** any source which may be harmful in any way to either your system or to users of the 'ether', and, (2) **To determine** with a high degree of accuracy **the absolute radiated signal levels** present when normal corrective measures have been taken to insure that every possible step has been taken to either eliminate or reduce to a bare minimum and radiation found. To determine the absolute value of a radiated signal (reference the levels permissible under Part 76 rules) requires both precision measurement equipment and precision measurement techniques.

There are two common mistakes made by many measurement 'experts'. One is the care (or lack of) given to the design and construction of the radiation detection/measurement **antenna,** and, the other is the care in selecting and specing a preamplifier to be used in the radiation measurement system. Many people apparently believe "an antenna is an antenna. . .is an antenna". Or more aptly, "a dipole is a dipole. . .is a dipole". **Not so.**

Take a look at figure 3. Here are three ways to build a dipole/radiation detection antenna. **All are wrong.** All have appeared in print as "the way" to do it. None of these will get you into the proper ballpark, not to speak of onto the base path. About the only proper instructions in figure 3 is the notation that the (dipole) antenna needs to be 1/2 wavelength long.

A dipole (straight dipole, not folded dipole) has a characteristic impedance of 73 ohms. **Figure 3 (A)** is obviously in error; the 'dipole' is being fed with a section of 300 ohm line. The very bad mis-match between the dipole 'impedance' and the 300 ohm line is obvious. However this particular combination might respond, it won't be like a dipole. All of the desirable characteristics of a dipole (broad side pattern, steep null off ends) will most probably be destroyed by the mis-match. In **figure 3 (B)** we have an improvement but there is still a problem. The 'balanced dipole' is fed directly with 'unbalanced' line (75 ohm coax). When you connect an unbalanced line to a balanced antenna the shield of the coax becomes a part of the antenna itself and this distorts the antenna's pattern. I know, many 'ham radio' publications describe antennas that are fed in this manner and for certain applications (especially when the non-antenna end of the line is connected to a good ground) it will work. However for our radiation measurement purposes this is not an acceptable antenna; allowing the shield of the coax to become part of the antenna is not good practice.

In **figure 3 (C)** we have an attempt to achieve a balanced antenna to unbalanced line match, without resorting to trifilar windings. Of the three choices, this is the best of the lot, but it is still not correct. None of this is to say that these antenna lash-ups will not **detect** radiation; they will. However, **they cannot be calibrated** and for this reason they are not useful when making hard number measurements of radiation levels, nor at proof time.

Figure 4 shows three ways to 'do it right' and have a system that will not only detect radiation, but will also allow you to make real-world (hard type) measurements of the levels detected. **Figure 4 (A)** is a folded dipole constructed from twin lead. The dipole is cut to length, the two ends of the twin lead soldered together to make a 'loop' and the bottom side of the 'loop' is split exactly in the middle where a 4:1 balun (matching transformer) is attached (300 ohm side to 300 ohm line). Out of the 75 ohm side comes the 75 ohm (unbalanced) feed. Such a dipole can be built and installed on a piece of 1 x 2 or plastic to hold it rigid.

Figure 4 (B) shows a method of removing the 'shield currents' from the coaxial tranmission line. The 73 ohm dipole (balanced) is connected to the 75 ohm coax line (unbalanced) and a 1/4

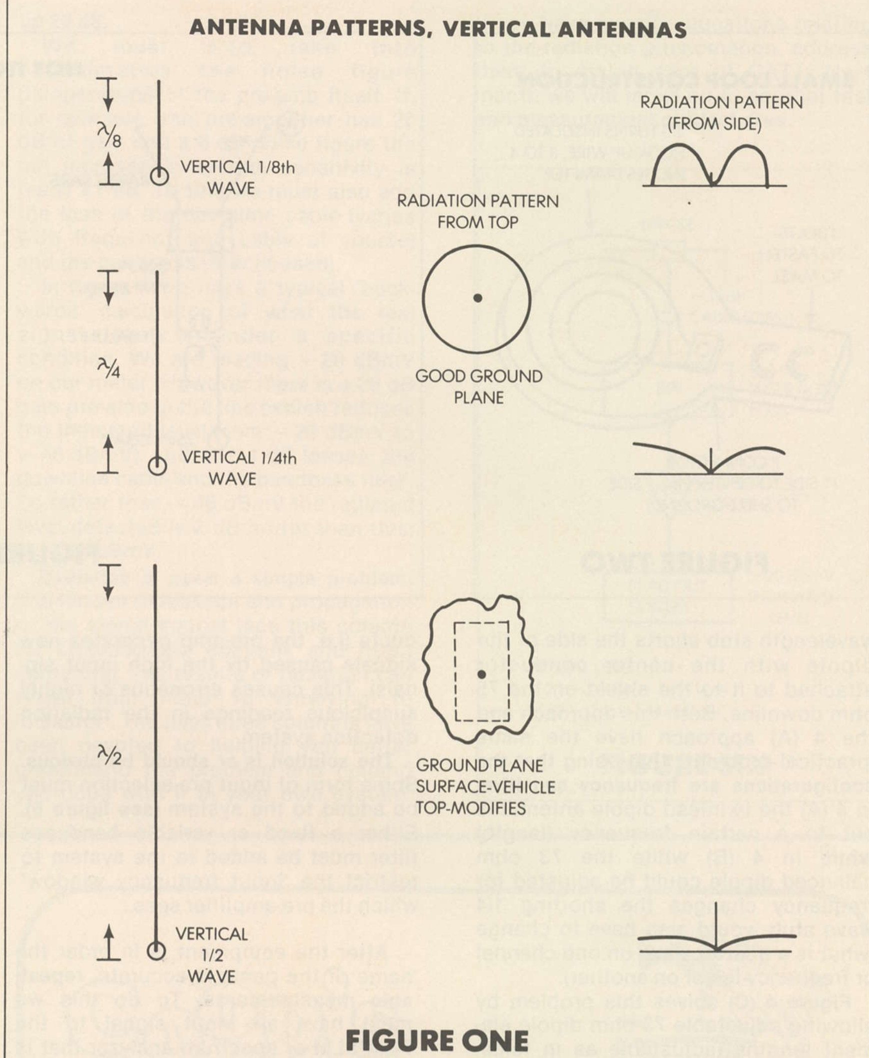


FIGURE ONE

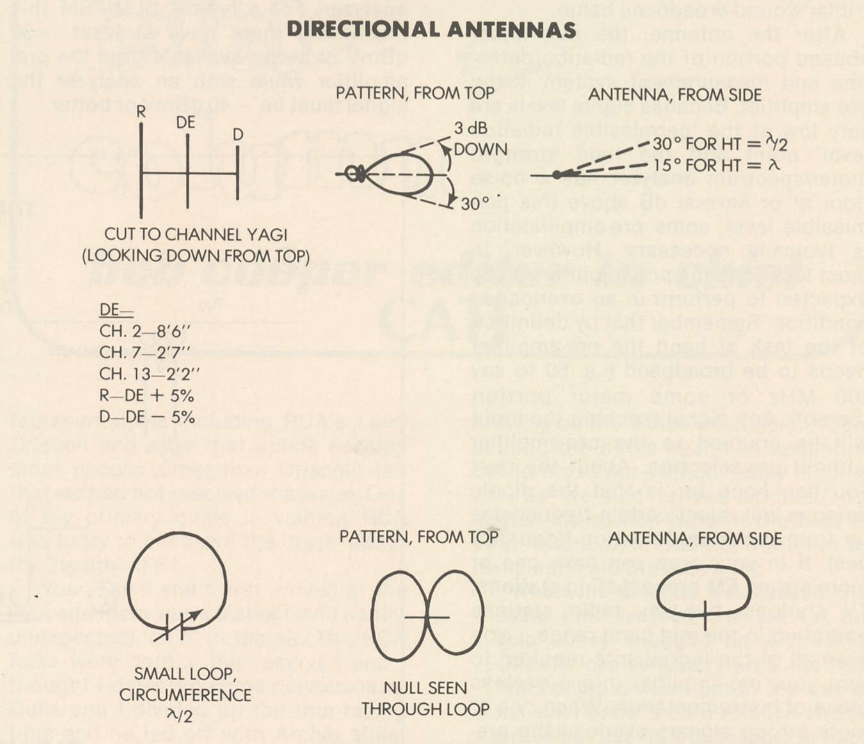


FIGURE ONE-A

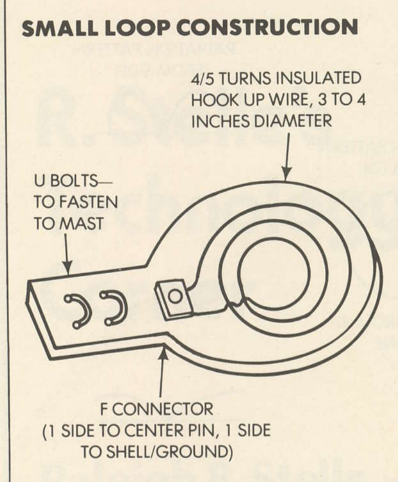


FIGURE TWO

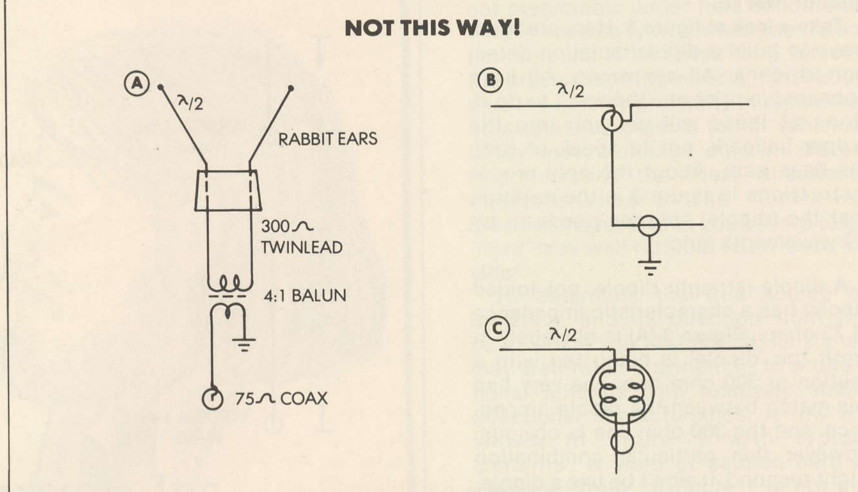


FIGURE THREE

wavelength stub shorts the side of the dipole with the center conductor attached to it to the shield on the 75 ohm downline. Both this approach and the 4 (A) approach have the same 'practical problem'; that being that **the configurations are frequency sensitive.** In 4 (A) the twinlead dipole antenna is cut to a certain frequency (length) while in 4 (B) while the 73 ohm balanced dipole could be adjusted for frequency changes the shorting 1/4 wave stub would also have to change (what is a quarter wave on one channel or frequency is not on another).

Figure 4 (C) solves this problem by allowing adjustable 73 ohm dipole element lengths (adjustable as in telescopic rods) to couple to a 75 ohm unbalanced transmission line through a trifilar wound broadband balun.

After the antenna, the next most abused portion of the radiation detection and measurement system is the pre-amplifier. Because signal levels are very low at the 'permissible radiation level' point and the field strength meter/spectrum analyzer has a noise floor at or several dB above this permissible level, some pre-amplification is typically necessary. However, in most locations the pre-amplifier will be expected to perform in an overloaded condition. Remember that by definition of the task at hand the pre-amplifier needs to be broadband (i.e. 50 to say 300 MHz or some major portion thereof). Any signal reaching the input will be coupled to the pre-amplifier without pre-selection. About the best you can hope for is that the dipole antenna will reject certain frequencies far from radiation detection frequency (ies). If in your area you have one or more strong FM broadcasting stations, TV stations, two-way radio stations operating in the mid band range. . .you have all of the ingredients required to turn your pre-amplifier into a useless piece of instrumentation. When one or more strong signals overload the pre-amp, the device goes into compression which causes intermodulation products (i.e. the pre-amp generates new signals caused by the high input signals). This causes erroneous or highly suspicious readings in the radiation detection system.

The solution is or should be obvious. Some form of input pre-selection must be added to the system **(see figure 5).** Either a fixed or variable bandpass filter must be added to the system to restrict the 'input frequency window' which the pre-amplifier sees.

After the equipment is in order the name of the game is accurate, **repeatable** measurements. To do this we must have an input signal to the FSM/SLM or spectrum analyzer that is at least 8 to 10 dB stronger (or higher) than the noise floor of the meter/analyzer. For a typical SLM/FSM this means we must have at least −30 dBmV or better available from the pre-amplifier while with an analyzer the signal must be −40 dBmV or better.

Let's look at just what type of 'measured levels' the FCC will tolerate under 76.605 (a) (12) so we have a handle on what type of levels we must measure accurately:

Channel/ Frequency	dBmV
2	−36 dBmV
3	−37 dBmV
4	−38 dBmV
74 MHz	−39 dBmV
5	−39 dBmV
6	−40 dBmV
100 MHz	−41 dBmV
108 MHz	−42 dBmV
165 MHz	−46 dBmV
7	−46 dBmV
8	−46 dBmV
9	−47 dBmV
10	−47 dBmV
11	−48 dBmV
12	−48 dBmV
13	−49 dBmV

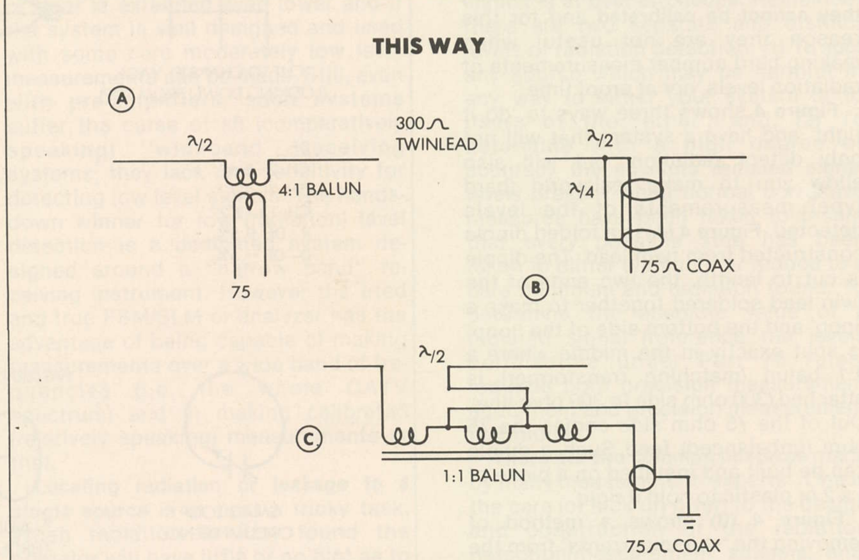


FIGURE FOUR

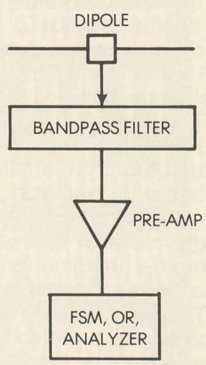


FIGURE FIVE

Seemingly if you are detecting a −49 dBmV signal with your test dipole, and you add a 26 dB gain pre-amplifier to the system you will now be able to read the radiation level at the −49 dBmV / +26 dBg or −13 dBmV point on your meter. Unfortunately this is not quite true. The addition of a (26 dB gain) pre-amp does not **necessarily** mean that your system sensitivity **goes up 26 dB.**

We must also take into consideration the noise figure (temperature) of the pre-amp itself. If, for example, the pre-amplifier has 26 dB of gain and a 6 dB noise figure the net increase in system sensitivity is really 21 dB. To this we must also add the loss of the downline cable (varies with frequency and cable of course) and the bandpass filter (if used).

In figure 6 we have a typical 'backwards' calculation of what the real signal level is under a specific condition. We are reading −20 dBmV on our meter. However there is a 26 dB gain pre-amp in the line (which reduces the indicated level from −20 dBmV to −46 dBmV), and, two 1 dB losses; the downline cable and the bandpass filter. So rather than −46 dBmV the radiated level detected is 2 dB hotter than this; or −44 dBmV.

Radiation is never a simple problem. The modes of leakage and propagation of the signal source (see this column for October) are complex and often confusing. The results of radiation can result from 'none' to 'annoying' to 'disaster'. The past three columns have been devoted to helping you better understand the problem and helping you cope with it in your own system.

If you have specific questions relating to the radiation phenomenon, address them to me in care of CATJ. Next month we will move on to another test and measurement subject area.

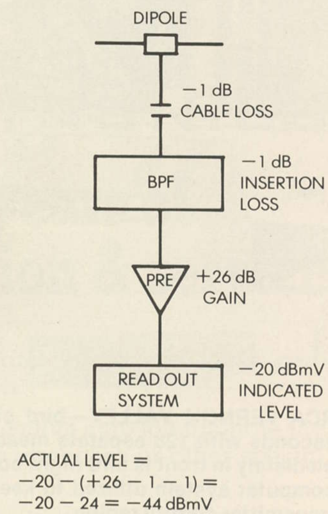
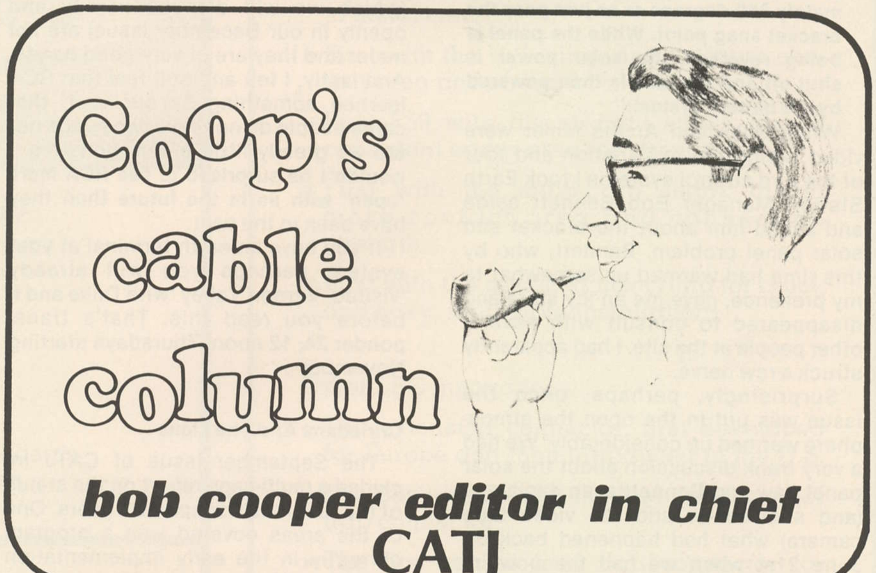


FIGURE SIX



Visit To Vernon Valley

On October 3rd I flew east to Newark to converge with Microwave Associate's **J. Duke Brown** for a one day visit to the RCA main command, control and video uplink site at Vernon Valley. This was my first visit to VV and I went with some trepidation since I'm the so and so that had called their F1 bird 'sick' a few issues back. Duke and I spent the evening of the 3rd going over my interview questions and after 30 minutes of this Duke forecast we'd both be thrown out bodily by 10:30 AM. We were due there at 9:30.

RCA was approached for approval of the visit early in September. I had suggested that a 'tour' of the facility with a color video camera, tape recorder and all of the usual roving video-journalist paraphenalia might be a good idea since I could then bring back to Oklahome enough video tape to create a 'program' or two for our new Thursday (transponder **24, 12** noon **eastern**) 'Satellite Magazine' program. I felt that if they would give us a first class tour then we could share that tour with the hundreds of cable system terminals and their personnel via the bird itself. RCA not only agreed, they provided one of the fancy RCA TK-76 Minicam's and a fantastically talented Carl Hensen (Manager of the RCA Video Equipment Tech-Alert group) to run the camera and assorted other gear.

As most readers are aware, I've been concerned (perhaps even convinced) for months **that something was indeed wrong** with 'our' bird. We spent the last uplink session of CCOS-78 talking about this with various industry representatives including RCA's Larry Driscoll and after that uplink session most people (other than Driscoll) felt that we had not resolved the issue. One of my primary goals in visiting RCA was to try to pin down the 'truth' about the 'health' of F1.

When Duke and I first arrived at the RCA site there was a distinct (and hardly unexpected) 'chill' in the air. The RCA folks were cordial but reserved and I thought I detected some nervousness. Duke and I divided up the tour-taping time and he led off with Archie Miller who is responsible for 'flying the bird'. Duke had been briefed by me the prior evening on the latest 'intelligence' concerning the bird's health. A telephone call to me at our Vernon Valley lodging site as we had arrived updated my 'facts'. My source (who in the best of First Amendment traditions will not be revealed!) said the following:

"When the satellite was launched a cable that secured one arm of the solar array snagged on a bracket. Once in geo-stationary orbit the malfunctioning bracket got in the way of the solar panel's daily rotation and as a result of this RCA is not able to track the sun through the full daily 360 degree rotation with the solar panel.

RCA VERNON VALLEY—bird status monitors (upper) are updated every 2 seconds with 128 separate measurement points of data from F1 and F2. Immediately in front is bird flight control console while far right is portion of dual computer system utilized to keep tab on bird. Back, left, is video and uplink transmitter control region.

When the panel(s) reach that high-torque spot in the rotation field RCA must ground command the panel to stop, and then they 'fast reverse' the panel backwards around approximately 350 degrees or so just pass the bracket snag point. While the panel is being reversed the solar power is shut off and the bird is then powered by the battery system."

While Duke and Archie Miller were video taping the explanation and tour of the bird control systems I took Earth Station Manager Bob Bennett aside and asked him about the bracket and solar panel problem. Bennett, who by this time had warmed up somewhat to my presence, gave me an icy stare and disappeared to consult with several other people at the site. I had apparently struck a raw nerve.

Surprisingly, perhaps, once the issue was out in the open the atmosphere warmed up considerably. We had a very frank discussion about the solar panel flaw and Bennett even explained (and showed us and the video tape camera) what had happened back on June 21st when we had the now infamous bird shutdown.

Before we finally left the VV site (well after 6 PM that evening) I had managed to get on videotape **a full explanation of the SATCOM bird problems** along with a fascinating tour of the full facility including the tape services portion where a young lady named Linda Sample says she is grooming herself for RCA Americom President Andy Inglis's job.

The Vernon Valley visit convinced me of several things. First of all, **RCA Americom is a very professional outfit.** I've been exposed to fancy electronic equipment for 25 years or more but nothing I have ever seen comes close to this array of assembled parts. Secondly, while there are some malfunctions with the SATCOM family of birds **both Duke and I left Vernon Valley convinced that we as an industry should quit worrying about something over which we have no control.** The problems (which we will discuss frankly and openly in our December issue) are **not** major and they are in very good hands. And lastly, I felt and still feel that RCA learned something by our visit; that cable people do not have two heads nor are we greedy little green monsters. **I wouldn't be surprised to see RCA more 'open' with us in the future** than they have been in the past.

If you have an earth terminal at your system perhaps you will already 'visited' Vernon Valley 'with Duke and I' before you read this. That's transponder 24, 12 noon, Thursdays starting November .

Christians And The Lions

The September issue of CATJ included a multi-page report on the status of the religious transponder users. One of the areas covered was a program currently in the early implementation (but late planning) stages by a group known as **Full Gospel Businessmen's Fellowship International.** They have a deal working with PTL to carry the PTL satellite feed (transponder 2) across the United States and into American homes. **The last leg will be through 100 watt output UHF translators.**

Head honcho for this effort is a chap named Shakarian. Steve Shakarian to be exact. Shakarian is the second generation Shakarian involved with Full Gospel. Poppa Demos started the group 25 years ago.

When the September issue hit the streets the Full Gospel program was little known in the industry. One supplier, Stormy Weather's USTC, had been involved in the planning from day one. Stormy is a proud member of Full Gospel, and has in fact donated a six meter terminal to Full Gospel's Irvine, California headquarters. To Stormy, the Full Gospel program was an opportunity of a lifetime to serve God. He is deeply religious, believes strongly in the work Full Gospel does, and saw this project coming along as it has in his last years before retirement as the fulfillment of his life long work.

Because of the key role Stormy had played in the program's development and his 'inside involvement' most people who knew about the concept figured USTC was a shoe-in for the job. There will be several hundred terminals initially; perhaps more than 1,000 ultimately. I traveled with Stormy, as a friend and a mostly quiet 'observer' to NASA to meet with one George Metcalf, the technical expert for Full Gospel's project, back early in June. **I heard Metcalf repeatedly tell Stormy that a contract between Full Gospel and USTC would be let 'shortly'.**

But the contract did not come. June turned into July and then July into August. During July, Stormy, on his own nickle, donated a couple of weeks of his time and thousands of his small firm's dollars to provide an operating terminal for the Full Gospel 25th annual international convention in California; so the Full Gospel breathern could actually see and touch satellite distribution of God's word and work.

Then in August a meeting was held in Dallas, at the offices of Compucon, over a weekend; a meeting to bring all participants up to date on where the various elements were in the project. Participants included Doc St. Clair from translator manufacturer Television Technology Corporation, Stormy Weathers, George Metcalf from NASA, Steve Shakarian and Claude Wehmeyer from Full Gospel, and the hosts from Compucon. Among other things accomplished at this meeting was a ritual opening of bids received to date for the equipment. The only **complete turnkey bid** came from USTC; completely installed packages from the 6 meter TVRO input antenna through to the UHF translator transmit antenna. It provided a basic system for under $40,000. A bid from Scientific Atlanta offered only the TVRO portion (dish, LNA, receiver). On an item-for-item basis the SA bid was lower than USTC's bid for similar gear (although USTC bid a six meter antenna and SA a five meter).

Several weeks later the September CATJ 'hit the streets' and when several dozen more suppliers read about the Full Gospel program the phone rang off the hook at Full Gospel. Everyone wanted 'a piece' of the action; each caller offering his own particular part (receiver, LNA, antenna, etc.) for bargain basement pricing in the 100-600 lot quantities. USTC remained the only full-system (turnkey) bid; which by the way was how NASA's Metcalf insisted the project should be handled. The September issue also produced another type of response; from

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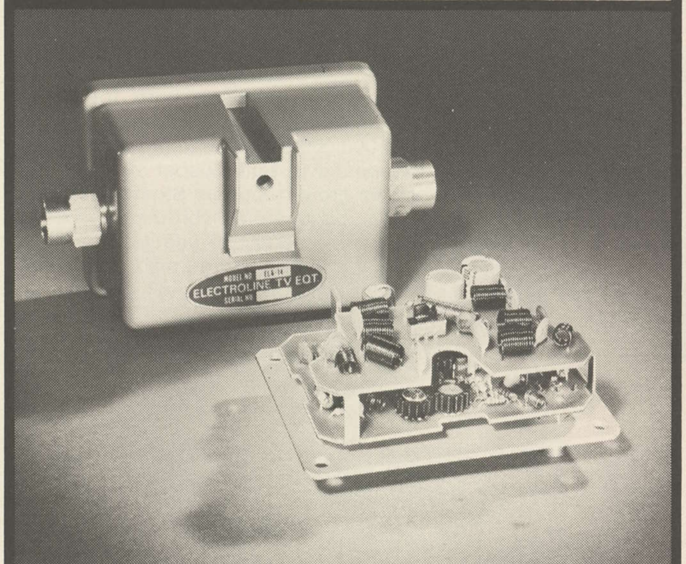

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Shakarian. We are told he was exceedingly upset by the 'tone' of the September report **(we reported that STC's Pete Warren and Alex Blomerth were charging Sharkarian's group with profitering;** to the tune of as much as $15,000 per terminal/translator). Around the middle of September we learned that Shakarian was holding Stormy Weathers responsible for the 'bad press' he received from CATJ. The word out was that Stormy would be lucky to get an order for anything.

Now if the charges by Warren and Blomerth, as reported in the September CATJ, proved accurate Shakarian obviously had egg on his face. When **we attended** the Full Gospel meeting in Anaheim in July **we knew** that Stormy's bid was in the under $40,000 area. Yet when Metcalf and Shakarian led the July 6th afternoon plenary session that resulted in 335 Full Gospel chapters signing up for translators **the price had climbed** to the $60,000 range. That was not the only 'unusual information' we heard at the session. Full Gospel had rounded up several 'experts' to testify to the group about how the Full Gospel/PTL satellite interconnection would work. One chap from Canada told the group that the Canadian chapters would be able to take PTL off of SATCOM FI and **re-broadcast the U.S. signals inside Canada** via privately owned translators. Another chap who claimed he was from General Electric explained that satellite terminals had to be located on mountain tops (to 'get a strong signal' we suppose). After 90 minutes of this type of hypped mis-information we quietly got up while the lights were off and another 'expert' was showing some 1968 vintage space system slides (which he represented as current) and left the premises. Our impression of the project at that point was zero or worse. Frankly it looked to us like the suede shoe Bible salesmen had taken command. Had we not seen it with our own eyes and heard it with our own ears we never would have believed it.

Through some mysterious Shakarian concocted connection **he blames Stormy Weathers** for the CATJ article. To properly 'discipline' Stormy for having 'authorized' the CATJ report, Shakarian has decided to go out for bids from **everyone.** Stormy had no for-knowledge of the article of course, and since the report tarnishes some of the Full Gospel glow (or Shakarian's glow if you want to cast stones at the administration of Full Gospel) obviously Stormy would have been some kind of nut to have 'allowed' any negative publicity of the project.

Currently Full Gospel continues flailing about in the marketplace. They have Cliff Gardiner and others jumping through hoops dangling that 100-600 (plus) terminal order in quiet public view. Shakarian is after "the best price around" and we understand a contract signed with Compucon on October 3rd will finally set into motion the wheels of preliminary licensing study. In mid-October the 'group' was to have made a sojourn to Washington to meet with the FCC and various influential members of Congress (including Senator Ernest Hollings of the Senate Communications Subcommittee). To date there has been virtually no contact between Full Gospel and Washington.

There is a lesson here for those gladiators still in the race for the big $21,000,000 prize. Remember what has happened to Full Gospel member and ardent group supporter Stormy Weathers as you negotiate with brother Shakarian. Perhaps after 2,000 years the Christians have finally figured out how to maul the lions; and a few fellow Christians in the process.

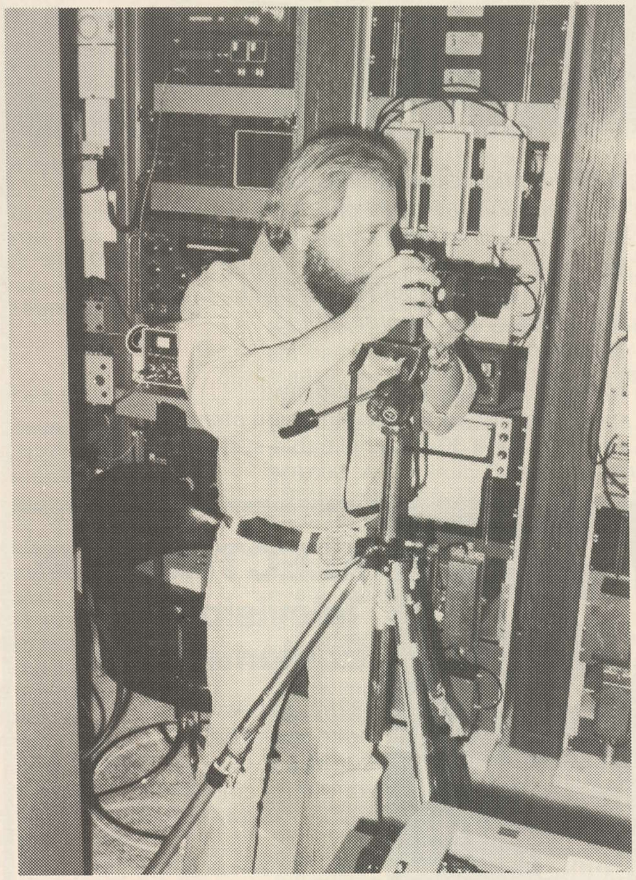
How The Big Boys Do It

Those who regularly read nationally circulated **TV GUIDE** (in either Canada or the U.S.) possibly noticed in a recent issue an article by this journalist detailing backyard satellite reception.

You might be interested how such things happen. More than a year ago I discussed producing a feature article on backyard terminals with Art Salsberg, Editorial Director at **Popular Electronics.** Salsberg liked the idea and I put it together. I also put together a related piece on do-it-yourself video microwave at the same time. Salsbert took the two 50-page-plus typed manuscripts and after holding onto them for 90 days decided he understood the low cost microwave but not the satellites. **"Satellites are a thing of the future. . .too much blue sky"** he said, returning the backyard terminal piece to me. **"But we'll publish the video GunnPlexer piece".** It turned out Salsberg (who apparently is a good digital man but is not as fluent in RF systems) mis-understood what satellites and low cost microwave were all about. Until **he** got the 50-page-plus manuscripts **he thought** a person could take a $95 GunnPlexer with the 17 dB gain horn antenna and **'point it into the sky';** and 'the BBC would pop out of the spigot'. Oh well, we can't all be brilliant.

So I discussed the backyard terminal piece with some other editors and found several interested. **TV GUIDE** was one and while I recognized that their general circulation audience was not very technical I agreed to have a shot at that because I felt the 17,000,000 U.S. circulation (plus several million in the Canadian editions) would be good for cable's use of satellites. On a 'rush schedule' I wrote the piece in June. In July they accepted it and late in July they sent to Oklahoma City on a hot Saturday a chap named Shelley Katz; a first rate professional photographer who 'strings' for Time/Life, and a host of international publications. You will often see the 'Shelley Katz' credit line in **PEOPLE** magazine photos for example. Shelley turned out to be a peach of a guy and I was ready for him, I thought. I had gone through the birds a bird at a time the day previously and with my Betamax format 1/2 inch machine taped bits

Continued on Page 40



TV GUIDE's Shelley Katz, in the CATJ Lab, shooting off-screen reception photos for the feature article on private earth terminals appearing in the 17,000,000 circulation publication.

The shopping cart on the left contains a Hughes AML receiver. It's all you need for a typical 12-channel microwave system. The carts on the right hold the equipment needed at *each receive site* for a conventional 12-channel FM system: 12 FM receivers and 12 modulators. The reduction in pieces of equipment means significantly better reliability and lower maintenance costs, in addition to the dramatically lower initial cost of Hughes AML receivers. What's more, you can hang Hughes AML outdoor receivers on a telephone pole. And you can expand your system up to 40 channels per receiver without ever climbing that pole or spending another penny at the receive site.

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Continued from Page 38

and pieces of this sporting event and that station or program logo. I knew he'd be rushed and I didn't relish moving the big twenty foot dish from SATCOM F1 all the way across to WESTAR I a step at a time in 105 degree F temperatures. Shelley set himself and his expensive cameras up in the lab (see photo) and started shooting off-screen photos. After reviewing all that F1 had to offer between 1 and 2 on a Saturday afternoon we dug into the tapes. And by 3 PM he had me out in the sun with nine year old Kevin tugging and pulling on the dish controls to move around to FII, WESTAR II and ANIK III. Shelley quickly adapted to running the Microdyne receiver controls and while Kevin and I stayed in the hot sunshine he sat down in the air conditioned Lab and switched channels, snapped pictures and communicated with us on an intercom line between the Lab and the antenna. After a heavy dose of switching and shooting we settled down to something cold to drink and reviewing some of the classic tapes such as HBO's Casino De Paris and Redd Foxx.

As we headed back to the Oklahoma City airport to send Shelley off on another assignment (he noted he is home around four days a month) he asked if we could put him in touch with someone to install a terminal in his backyard. **''For four days a month?''** I asked. **''From what I've seen, it would be worth it. . .every penny. Besides I've got a couple of Betamax machines of my own to catch things when I'm out of town''.**

By mid-August **TV GUIDE** was back in touch. **''Perhaps it will run in September''** said they. By September it became October and then finally it did run. **TV GUIDE** in Canada opted to exercise their option to run U.S. issue material, on this piece, early in September and we put them in touch with the Yukon's Rod Wheeler so they could work in some additional Canadian flavor. And by some coincidence it ran there at about the same time.

Oh yes. . . Susan (my wife) now insists that we build a six foot fence around our country place to keep the curious from depriving us of the small amount of privacy that we have remaining **(we recently changed our unlisted telephone number** for the third time in two years. . .**just in case** you think you have it filed away someplace!). You know what they say about fame and fortune. . .well, I'm still waiting for the fortune. And we could do with a little less fame right now.

TUNE IN CATJ'S SATELLITE MAGAZINE

If everything goes according to schedule the first edition of the new (weekly) CATJ Satellite Magazine ''uplink program'' will be telecast at 12 noon eastern on transponder 24 on SATCOM F1, November 16th. For the balance of the fall and into mid-January we will run each program two times; on an 'inaugural week' and then again (typically) in the following week as well. These 're-runs' are required by the present ability to produce a new show each week at the University of Oklahoma School of Broadcast Journalism where the program is prepared by CATJ Editor in Chief Bob Cooper.

The program runs 1 hour, features interviews with cable people, how to do it tips and suggestions from cable engineers and technicians, and a bit of 'hard news'. The November 16th first show begins a two part series that takes you to the RCA Vernon Valley uplink site where we get a first class look at how the birds are flown, controlled, fed and monitored. A fascinating look 'behind the scenes' and it includes several frank discussions on bird life, bird health and bird capacity. This show will repeat November 30th.

The second show premieres December 7th (if you are at the Western Show, get yourself in front of a satellite receiver at 9 AM Pacific time) and repeates on December 14th. This program features a very honest appraisal of the current situation on F2 and F1 by knowledgeable RCA personnel as well as a description of 'what happened' on June 21st when all signals were erratic for several hours.

THANK YOU, TERRY JOHNSON!

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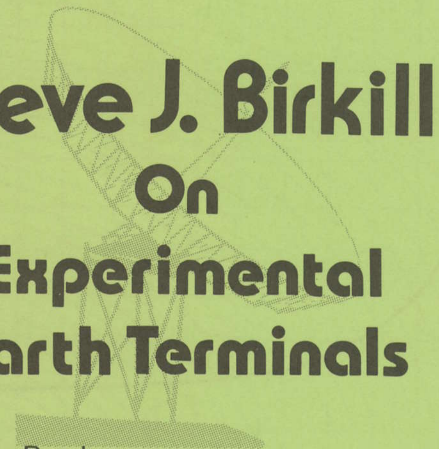

Steve J. Birkill On Experimental Earth Terminals

Steve J. Birkill
128 Cross House Road,
Grenoside, Sheffield S30 3RX England

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Let's start this month with some fundamental realities of the satellite circuit. We shall consider in some detail the down-link equation, and see just what we require to deliver adequate performance, having chosen our satellite. Firstly the spacecraft. Whatever service we wish to receive, the chances are (at 4 GHz) that its transponder will employ a travelling wave tube of between 5 and 13 watts saturated output power, or expressed in dB above one watt, +7 to +11 dBw. This power, rather than being radiated isotropically (i.e. equally in **all** directions) is fed via a low loss waveguide system to one of the spacecraft's parabolic antennas, designed to illuminate a specific region of the Earth's surface from its allocated orbital station. **The gain of this antenna, plus transponder power** (but less waveguide losses) results in the familiar 'footprint' of **e**ffective **i**sotropic **r**adiated **p**ower **(EIRP)** contours, each contour being a line joining all points on the Earth's surface towards which the satellite radiates a particular value of EIRP; this value being **the power** which would need to be radiated **from an isotropic source** to deliver **the same signal flux** at its contour as is achieved by the satellite's (parabolic) transmitting antenna. A typical beam **centre** EIRP from a satellite transponder might be 36 dBw, with the **edge** of the useful coverage area being defined by the 32 dBw contour. These will be **minimum values,** including allowances for transponder end-of-life deterioration, plus (satellite) pointing errors. Of course the EIRP will continue to fall increasingly rapidly outside this (32 dBw) line as the first null in the antenna radiation pattern is approached.

Reference to the published footprint map will tell us within (perhaps) ± 1 dB the EIRP to be **expected** at our location. In order to translate this EIRP value to carrier/noise ratio at our demodulator (receiver) we must next consider what happens to the transmitted power on its way to our receive antenna. Well, being concentrated into a beam of finite width, it spreads out! This 'spreading' can be considered as a, **free space path loss,** although very little is actually 'lost'; it just can't be intercepted by our antenna. This attenuation is dependent on the wavelength (λ) and path length (d) and is equivalent to:

$$(4\pi d/\lambda)^2$$

Path length from the geostationary orbit varies from approximately 35,786 km to 41,646 km over the 'visible' Earth surface. However receiving locations in the U.S. are typically **within** 40,900 km of the target 'bird'. Taking a mid-band frequency of 3,950 MHz (λ = 7.595 cm) gives is a free-space attenuation of 196.6 dB. To this figure we must add the losses suffered by the signal in its passage through the atmosphere. **Fortunately,** for more than **99 percent** of the time at 4,000 MHz **this loss** factor (term) **can be neglected.**

So we must now equip our headend (or back yard) with an antenna capable of delivering what we shall define as adequate signal power to our receiver (here our LNA) input port. A circular aperture (antenna) with a diameter of D will exhibit a gain of:

$$\pi^2 \eta (D/\lambda)^2$$

above an isotropic source where λ is the operating wavelength expressed in the same (measurement) units as D and η is the aperture efficiency; typically a maximum of 0.66 for a good dish (parabolic) antenna. Armed with the worst case values of **receiving antenna gain** (G_R expressed in dB), EIRP, and **path attenuation (L),** assuming zero feed line loss between the antenna and the LNA, we arrive at a minimum signal power of:

$$EIRP - L + G_R$$

at the LNA input. For an antenna installation using a 4.5 meter dish **(gain of 44**

TABLE ONE

System assumptions: **EIRP** = 33 dBw
IF noise bandwidth = 27 MHz
Path loss = 196.6 dB
C/N = 10 dB
G/T = 19.3 dB/K

Antenna Diameter							
Feet	6	8	10	12	15	20	30
Meters	1.8	2.4	3.0	3.7	4.5	6.0	9.0
Antenna Gain (dB, at 66% efficiency)	36	38	40	42	44	46	49
Antenna Noise Temperature (7° elevation, °K)	70	58	50	44	40	38	35
LNA noise temperature required (°K, maximum)		16	67	142	255	430	898
Equivalent Noise Figure (dB)		0.2	0.9	1.7	2.7	3.9	6.1

TABLE TWO

System assumptions: **EIRP** = 36 dBw
IF noise bandwidth = 27 MHz
Path Loss = 196.0 dB
C/N = 10 dB
G/T = 15.7 dB/K

Antenna Diameter							
Feet	6	8	10	12	15	20	30
Meters	1.8	2.4	3.0	3.7	4.5	6.0	9.0
Antenna Gain (dB, at 66% efficieny)	36	38	40	42	44	46	49
Antenna Noise Temperature (30° elevation, °K)	36	32	29	26	24	22	20
LNA noise temperature required (°K, maximum)	71	138	240	401	652	1050	2118
Equivalent Noise Figure (dB)	1.0	1.7	2.6	3.8	5.1	6.6	9.2

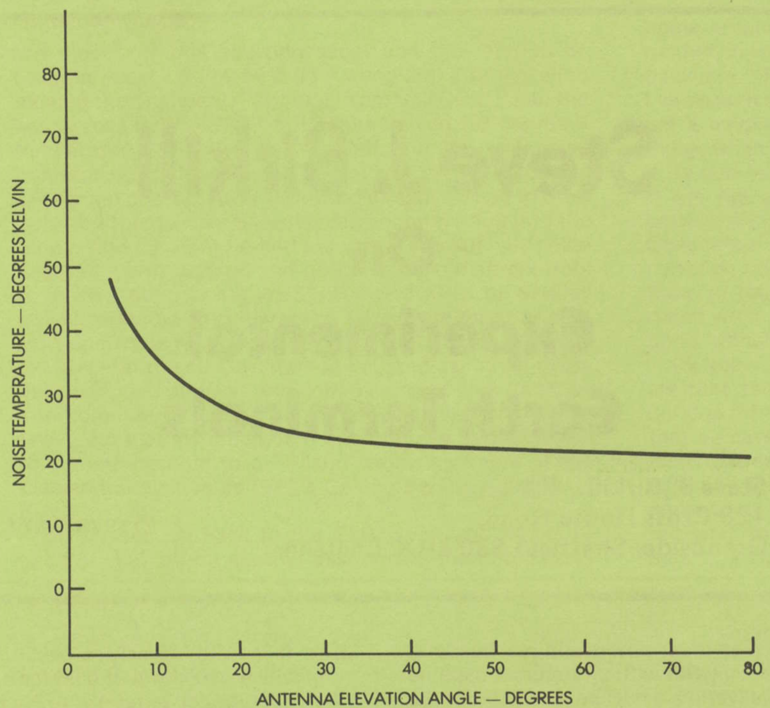


DIAGRAM ONE

dBi) and situated **on** the 33 dBw EIRP contour, with **a range distance of 40,900 km** (this corresponds to being some distance from the sub-satellite point and an elevation angle of only 7 degrees), we arrive at **a signal input** to the LNA **of:**

$$33 - 196.6 + 44$$
$$= -119.6 \text{ dBw.}$$

In order **to work out** what **carrier-to-noise ratio** we can expect we must now consider **sources of noise** at our receiver input. In a given bandwidth **(B)** noise power can conveniently be expressed as the absolute temperature **(T)** in degrees Kelvin **(K)**. For our noise power reference we assume a resistive impedance matched to the equipment with

$$P_N = kTB$$

and **k** is Boltzmann's constant (−228.6 dB/°K Hz). The antenna itself will have a noise temperature **(T_A)** which is a function of its aperture, elevation angle, side lobe pattern and the part of the sky 'seen' within the beam (width). This could vary from perhaps 50°K at 5 degrees elevation (with the 'hot' ground close to the main antenna lobe) to 20°K above 60 degrees elevation **(see diagram 1).** However for **most** applications and sites the single largest contributor of noise is the LNA. This segment of the terminal will have sufficient gain to dominate other sources of receiver noise and its own equivalent noise temperature **(T_R)** must be added to the antenna noise temperature **(T_A)** to calculate the overall system noise temperature **(T_S)**. Again we are assuming zero 'feed line' loss between the antenna and the LNA.

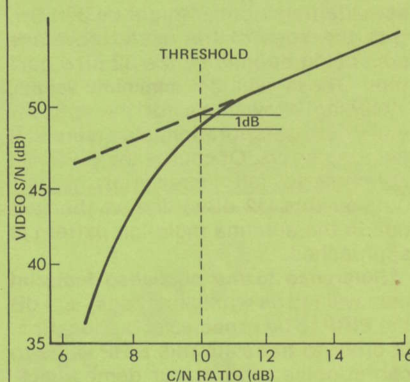
From P_N = kTB and a knowledge of our system noise temperature (which we shall express in dB°K) and noise bandwidth (in dB Hz) we can now calculate equivalent noise power at the LNA input port. Let's stay with our hypothetical system, give it a 100°K LNA and an antenna temperature of 40°K (T_S = 140°K or 21.5 dB°K), and assume we have chosen a receiver with **a 27 MHz noise bandwidth** (a parameter dependent upon **receiver** IF, or pre-demodulation, **bandwidth** and not normally variable); which is 74.3 dB ('power' ratio above 1 Hz). This yields a value for P_N of:

$$-228.6 + 21.5 + 74.3$$
$$= -132.8 \text{ dBw.}$$

So **our carrier to noise ratio is simply the difference in dB between our carrier power and our noise power at the receiver** (i.e LNA) input, or:

$$-119.6 - (132.8)$$
$$= 13.2 \text{ dB.}$$

Assuming our demodulator (TVRO receiver) has its FM threshold at a C/N of 10 dB this finds us 3.2 dB 'in the



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clear' on the downlink (13.2 dB C/N — 10.0 dB threshold), in the absence of terrestrial interference. This is a healthy margin on a satellite circuit and with **an experimental terminal** we can afford to lose 3 dB (of that margin) performance by designing our system around a smaller aperture dish or a less expensive (i.e. higher noise temperature) LNA.

A useful figure of merit for judging the sensitivity of a satellite receive terminal is its G/T (pronounced "G over T"). **G/T** is the **antenna gain** (in dBi) **less** the **system noise temperature** (dB°K). In the example given:

G/T = 44 − 21.5
= 22.5 dB/°K.

Just for comparison an **Intelsat** specification **'A'** earth station **must** achieve a G/T of 40.7 dB/°K.

G/T Trade Offs

To explore the options open to us on the RF side, assume now that we accept working at a C/N of 10 dB which, with most receivers, will allow **no margin** for deterioration from whatever cause. **If** the **other parameters** in our example **remain the same,** the G/T required of the system (for a 10 dB C/N) falls to 19.3 dB/°K. Clearly this figure could be achieved with a wide range of related values of G and T. For instance with an 11 meter dish such as at CCOS '78 for the uplink and with an LNA of 32.1 dB°K noise temperature (that is 1,600 K, a noise figure of 8 dB!) could be used, or, if we had access to a 77°K parametric LNA, it could be teamed with a 10 foot dish antenna and deliver the same C/N, all other things being equal.

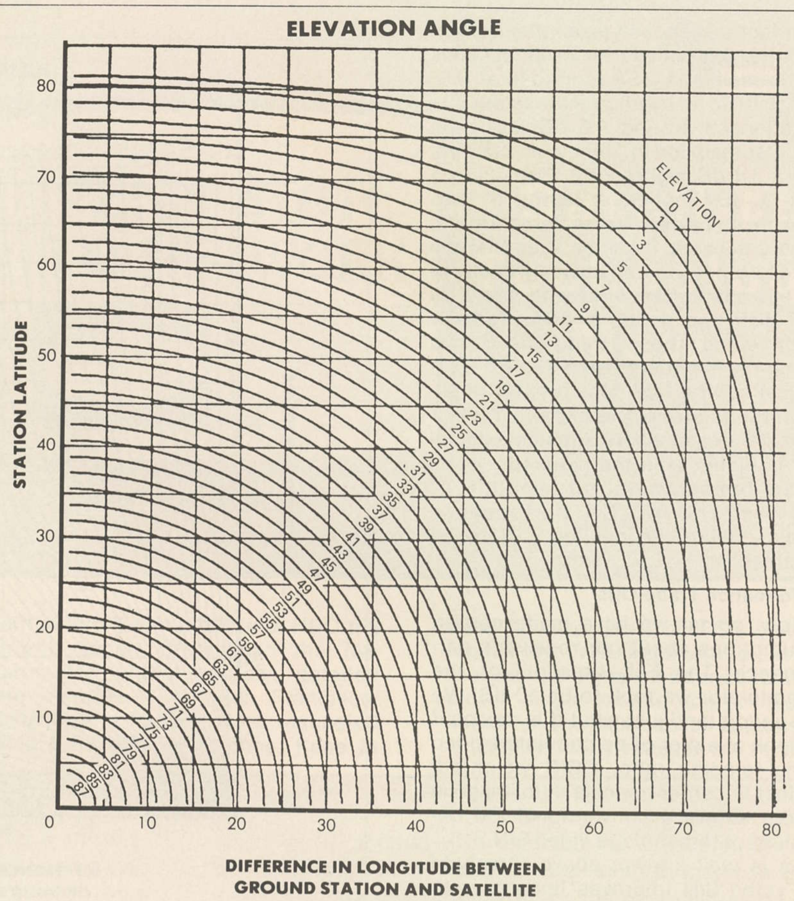

DIAGRAM THREE

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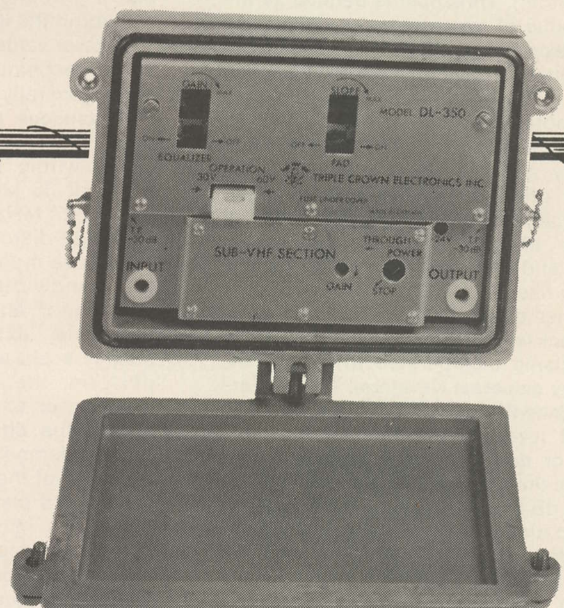

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Telephone (416) 743-1481

In fact our chosen (example) system is rather **pessimistic** for **most locations** in the mainland USA (continental U.S. or CONUS); an average **midwestern site** experiences around 0.6 dB **less path loss** ('spread loss') than our example and a 3-4 dB **higher EIRP.** Considering that 3 dB implies a factor of two change in system noise temperature, or antenna area, it can be seen that **the more fortunate** among us **could get by** at or just above threshold **with** say **a 10 foot dish and a 300 K LNA.** Table 1 summarizes these trade-offs for a 'worst-case' situation and **Table 2** for a typical central USA location; for popular antenna sizes. The gaps in **Table 1** indicate a case where **antenna noise itself is higher than the required system noise temperature;** no amount of improvement in LNA performance would enable the desired C/N to be obtained.

Performance Trade-Offs

Now, so far we have made certain assumptions about our receiver's performance. The FM threshold of the demodulator we took to be 10 dB. We can understand just what this means if we look at a plot of demodulated video signal-to-noise ratio, CCIR weighted, against IF carrier-to-noise ratio. **Diagram 2** here shows a conventional FM demodulator threshold vs video S/N.

As is well known, above threshold the video S/N improves linearily with C/N, and at the same rate; i.e. for each 1 dB increase in C/N, S/N also increases by 1 dB. The actual values are related by the FM improvement factor (a subject to be discussed in this column for December). **Threshold is defined as the C/N value at which signal-to-noise ratio has departed by 1 dB from this linear relationship.** If we **observe** the demodulated **video** as C/N is reduced below threshold, we see the amount of noise on the picture begin to increase more rapidly, and also that **the quality of the noise changes.** Impulse noise predominates over the general level of 'snow', showing **white impulses in dark areas** and **black impulses in light areas,** giving rise to the description **'sparklies'.** Another effect begins to show: **noise on black level affects the operation of the line clamp incorporated to remove the energy dispersal waveform.** This results in **adjacent lines being clamped to different levels** giving rise to **flickering light or dark horizontal lines or bands across the picture.** This will occur some 3 or 4 dB **below threshold,** but since pre-clamp signal-to-noise ratio **will already have fallen** to around 30 dB **in the video band** there is no possibility of the video being **(commercially)** useable so far below threshold.

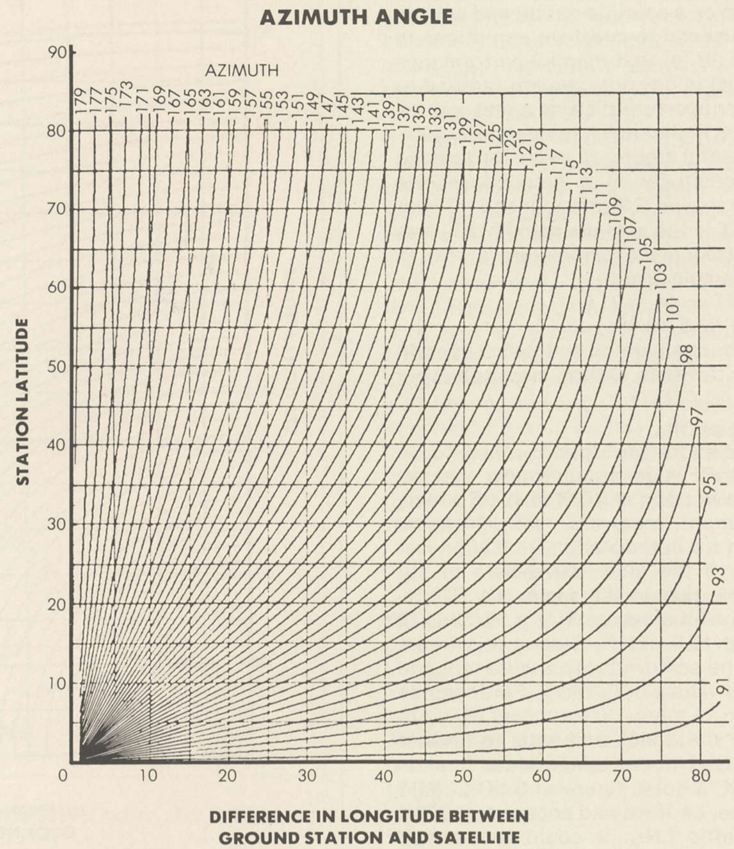


DIAGRAM FOUR

Though we cannot operate much below threshold, there are ways of extending the linear portion of diagram 2 to lower values of carrier/noise ratio. These techniques of **'threshold extension'** generally work by **reducing the instantaneous noise bandwidth of the demodulator** while tracking the FM signal within the full channel bandwidth of 36 MHz, or such restriction (say to 27 MHz) as is consistent with adequate distortion performance. (We shall have more to say next month on the bandwidth required for transmission of an FM TV signal.) Most **threshold extension demodulators employ a phase locked loop,** either to perform the actual demodulation process, **or** to sweep a tracking filter across the channel bandwidth at IF prior to demodulation, **or** to reduce the deviation of the signal at IF by tracking the second conversion local oscillator frequency in synchronism with the baseband video signal.

The other possibility open is to compromise the quality of the demodulated signal by reducing the IF bandwidth below the 27 MHz (or so) **necessary to recover CATV**—or broadcast—**quality video.** As noted last month, the gain in carrier/noise ratio is often worth the loss of picture quality (usually first observed with the appearance of in-band intermodulation products and chrome linearity degradation, i.e. differential gain and phase distortions) up to a point. . . In December CATJ we shall explore bandwidth optimisation in greater depth.

AZIMUTH AND ELEVATION ANGLES TO A GEOSTATIONARY SATELLITE

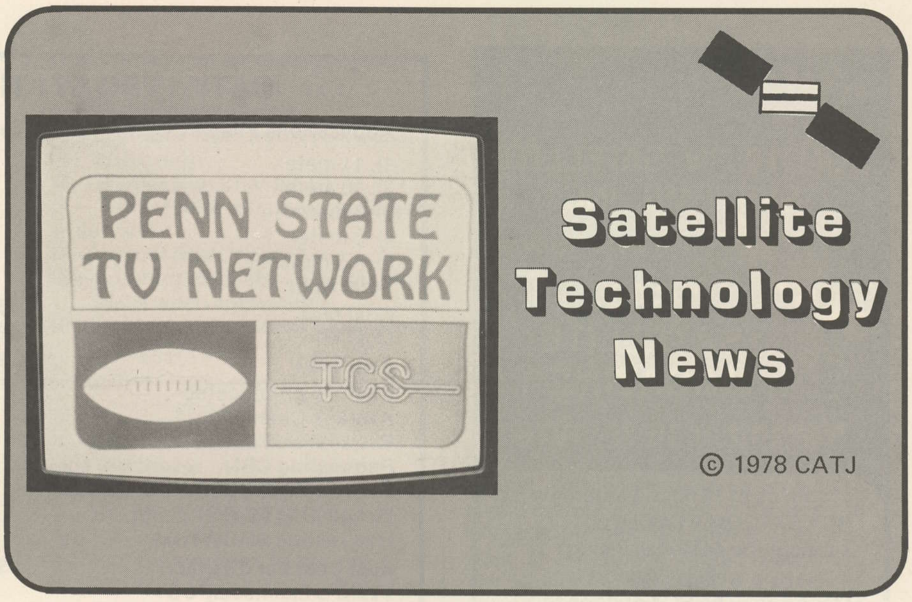
As promised last month, diagrams 3 and 4 provide the necessary data to **aim an earth terminal antenna to within 1 degree** of a target satellite (near enough to peak the antenna on signal), **knowing the satellite longitude and the earth coordinates of the terminal.** These computer-produced curves eliminate the need for trigonometric calculations, and are most convenient for those with az/el or inaccurately aligned polar mounts, who wish to 'satellite-hop' along the geostationary orbit.

CATJ SATELLITE MAGAZINE SCHEDULE

November 16th (12 noon eastern, transponder 24): Part one of **"Visit To RCA Vernon Valley"**, a tour of the uplink facility and discussion of how the RCA birds are 'flown'; featuring J. Duke Brown as moderator. Also, a look at the SHOWTIME production facilities at Vernon Valley with RCA Americom Services Linda Sample. This program will repeat on Thursday, November 30th. (Thanksgiving day, the 24th of November is a 'vacation date'.)

December 7th (12 noon eastern, transponder 24): Part two of the **"RCA Vernon Valley Visit"** with RCA explanations of recent bird problems, discussions of how RCA is expanding to accommodate additional CATV service signals. This segment explains the infamous June 21st signal outage and discusses solar panel problems with the RCA SATCOM bird (F2).

Note: Scheduling on transponder 24 is on an **as-available basis;** in the event that transponder 24 is otherwise occupied at that time, **the program will be fed on transponder 20.**



November Stats

A gradual, perhaps seasonal trend suggests that the 'big summer of '78' is about over for the TVRO suppliers and the FCC's license processing staff. Virtually all measurement areas indicate a dip from prior month highs. This, coupled with the early-warning indication concerning TVRO sites being submitted for frequency coordination (see separate report here) may well point to cable television systems as users of new TVRO terminals heading down the back side of the growth cycle.

Equipment shipments continued through mid-October to be on the slow side although there are scattered indications equipment shipments will begin to catch up to demand in at least some areas during November and December. Receivers, in particular, were just starting to look better although this may be a short lived phenomenon as new services take to the bird 'enmasse' on or around January first (see separate report here).

The three top leaders in signal sources mentioned by applicants (CBN, HBO and WTCG) continue to dominate the field although there was a shift in the leadership position during the most recent complete measurement month (September) with HBO the current leader. Other than the five 'barometer' signal sources detailed here monthly KTVU (San Francisco/Oakland) and Fanfare were requested twice each and WGN once. Keep in mind however that the FCC does **not require** the TVRO applicant to list **all** of the satellite signals it intends to utilize; only a single service source need be listed for the purpose of establishing 'eligibility' for a license in the service.

NOVEMBER 1978 REVISED TRANSPONDER USE CHART

With recent changes in transponder loading for both WESTAR and SATCOM (FI) birds, the chart appearing on pages 28 and 29 for the September CATJ must be revised. There are two primary reasons for this updating: (1) WESTAR I and II are refining their transponder loading for the next six month period while Western Union prepares to launch WESTAR III; and, (2) RCA common carrier customers on the CATV-dedicated bird (FI) have recently increased by a factor of six with virtually all of the new customers intending to inaugerate service **on or prior to** the 1st of January (1979).

WESTAR I (99.0 W)

Trans.	Service / User
1 ---	occasional **video** (load shedding)
2 ---	occasional **video,** WU system testing
3 ---	AMSAT traffic
4 ---	SCPC (Western Union)
5 ---	AMSAT traffic
6 ---	occasional **video**
7 ---	AMSAT traffic
8 ---	PBS **video**
9 ---	PBS **video**
10 ---	WU testing, occ. **video** (load shedding)
11 ---	PBS **video**
12 ---	occ. **video,** PBS 'hot standby **video**'

WESTAR II (128.5 W)

Trans.	Service / User
1 ---	occasional **video** (load shedding)
2 ---	Glenwood (N.J.) message traffic
3 ---	Seattle / Phoenix message traffic
4 ---	occasional **video** (often Chicago)
5 ---	Glenwood (N.J.) message traffic
6 ---	Sky Valley (S.F.) message traffic
7 ---	SIN **video,** occasional **video**
8 ---	Cedar Hill (Tx.) message traffic
9 ---	Steele Valley (LA) message traffic
10 ---	Atlanta (area) message traffic
11 ---	Lake Geneva (Chicago) message traffic
12 ---	occasional **video** (load shedding)

SATCOM FI (135.0 W)

Trans.	Service / User
1 ---	Southern Sat. Sys. **(probably KTVU),** HTN (after 1-1-79)
2 ---	**PTL**
3 ---	United Video **(WGN)**
4 ---	not in service
5 ---	**Warner Star Channel** (probably west)
6 ---	**WTCG**
7 ---	**ESP** (New England regional)
8 ---	**CBN**
9 ---	**Madison Square Garden, C-SPAN**
10 ---	**SHOWTIME** (west)
11 ---	**Warner Star Channel** (probably east)
12 ---	**SHOWTIME** (east)
13 ---	Southern Sat. Sys. **(probably WGN)**
14 ---	**Trinity** (KTBN)
15 ---	RCA message traffic
16 ---	**Fanfare**
17 ---	RCA message traffic
18 ---	**Reuters** news service (HTN until 1-1-79)
19 ---	RCA message traffic
20 ---	**TCS,** occ. video, HBO 'spare'
21 ---	RCA message traffic
22 ---	**HBO** (west)
23 ---	**HBO** family viewing second service level
24 ---	**HBO** (east)

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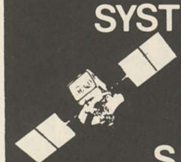

"CATJ SATELLITE MAGAZINE"

November 16,30; 1978

Join us at 12 noon Eastern on RCA SATCOM F1 as we co-sponsor the cable television industry's weekly 'Video Magazine'. The RCA announced transponder is 24 and the dates are November 16 and 30th (note: should we be pre-empted on transponder 24, look for us on either 22 or 20.)

In the November 16 and 30th shows the **CATJ Satellite Magazine** takes you on a tour of the famous RCA Vernon Valley uplink facility; a fascinating visit to the place where it all happens. RCA's Archie Miller explains how SATCOM is flown and controlled, monitored and maintained.

Additionally, RCA's Linda Sample conducts us on a tour of the video production center at Vernon Valley where SHOWTIME and other video productions are brought together for satellite airing.

Then on December 7th and 14th catch CATJ Editor Bob Cooper as he pins down RCA people on the now famous June 21st signal 'outage', and the rumors about the health of F1. A very frank, and we believe honest discussion of just what problems there are with SATCOM birds.

Make it a point on Thursdays at 12 noon eastern to 'tune-in' the world's first satellite distributed weekly all industry news and feature show. Proudly co-sponsored by the folks at SSS!

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CATV TVRO STATISTICS—NOV. 1978

Applications Filed/FCC	July 1978	Aug 1978	Sept. 1978
1) 11 meter	0	0	0
2) 10 meter	1	0	1
3) 6 meter	12	6	5
4) 5 meter	36	41	42
5) 4.5 meter	24	21	19
Total Apps	**73**	**68**	**67**
Cost Max.	$87,412	$62,000	$109,000
Cost Min.	$19,900	$12,600	$12,600
Avg. Cost	**$35,686**	**$34,424**	**$34,662**
Channels Requested	237	214	136
Average Channels	3.25	3.15	2.06
Requesting WTCG	43	44	35
Requesting CBN	29	42	35
Requesting HBO	48	36	44
Requesting MSGE	12	19	13
Requesting SHOWTIME	11	10	5
Avg. Cost Per Channel	**$10,980**	**$10,928**	**$16,826***
TVRO's Licensed/FCC	**61**	**118**	**73**

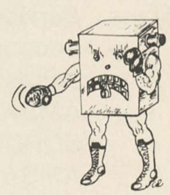
Notes: *—may no longer be valid measurement stick due to method applicants now file with FCC. Data compiled from FCC sources, advances ahead one month with each issue of CATJ.

RCA's Revenge / Part Two

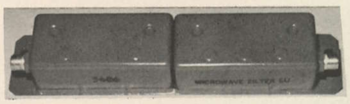
In our Coop's Cable Column for October CATJ reported that RCA had established a date late in September as a 'cut off date' by which new applicants for satellite transponder time were required to have their 'best offers' into the RCA office.

Our best 'guess-timate' of who would end up with the additional transponders missed slightly. Here is what happened. RCA found it had more 'serious applicants' for transponders than transponders. Furthermore it found it was going to have to delay until late summer of 1979 clearing 'all' of the F1 transponders for CATV use; at least four would remain separate from CATV (for RCA message traffic)

The CATV Filter CHAMPIONS Have Done it Again!



The "MID-BAND TWINS"



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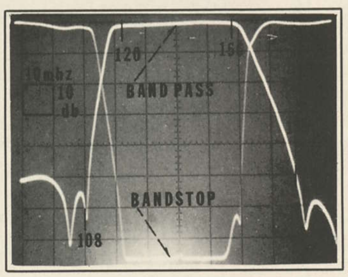
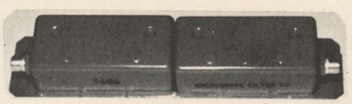
Suppression 0-108/175-300





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Suppresses 120-156 mhz with 50db
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until additional ground receive terminal equipment could be engineered and installed at RCA owned receive terminals. This meant that transponders 15, 17, 19 and 21 (all on the vertical side) would be kept 'out of the running' for 8-10 months time.

When the 'bids' were opened RCA determined (based upon bid-willingness to start new services and/or payments to RCA at the **earliest** possible date) that the following new common carrier services will get the balance of the presently available transponders:

1—Southern Satellite Systems (for KTVU when approved)
3—United Video (for WGN when approved)
5—Warner Star Channel (*)
7—'ESP' (New England regional service)
11—Warner Star Channel
13—Southern Satellite Systems (for WGN when approved)
18—Reuters (new format slow scan news service)
23—HBO (level two, family entertainment)

*—So what happened to **VISTAR?** This service began testing on transponder 5 during September, maintained its announced 'test schedule' through the end of September. However, when the bids were opened and transponders assigned VISTAR (which **had been** scheduled to begin regular, daily, ten hour service on October 1st) was not among the 'winners'. Ap-

CLASSY-CAT advertising is handled as a no-charge membership service of and by CATA. The rules are as follows:

1) **Any member of CATA** (member-system, Associate member, individual member) qualifies for CLASSY-CAT advertising space free of any charge (limit 50 words/-numbers per issue);
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4) **Deadlines** are the 15th of each month for the following month's issue.
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Young, growing MSO wishes to hire experienced manager for system in North Carolina. Construction and marketing background preferred. For more information, call Gil Clark at (616-347-4352)

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Small system operator seeks individual qualified in system maintenance and construction to supervise installers in several small systems.
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For Sale: Jerrold DPM Strip Amplifier for the following channels: 4, 5, 6, 7, 9, 11, 13. Also have two RPS300N Jerrold Power Supplies for these strips. Additionally have Jerrold 450 U Xtal Controlled Oscillator with 4534 UHF Cavity Converter Head for the following Conversions: Ch. 18 to 8, Ch. 21 to 6, Ch. 33 to 10. Contact John Nowak, Bellaire Tele Cable Co. Phone (614) 676-7911.

MANAGEMENT POSITION

A challenging management position is now available with an established consulting firm. We are looking for a person with in-depth, hands-on cable system operations and administrative experience who is currently employed by one of the top 50 MSO's. Salary commensurate with experience. Generous fringe benefits. All replies will be held in strict confidence. Please submit detailed resume to: CATJ, Box 10978.

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Operations Manager,
TK Cablevision,
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parently what happened was this. VISTAR and RCA differed as to the interpretation of the RCA contract for transponder service. RCA insisted that VISTAR had the right to cancel service and pay approximately $185,000 as a cancellation penalty **only after two years had elapsed** on the contract. VISTAR maintained that they could cancel at anytime, before the two years were up. When they could not work out that 'detail' VISTAR was left out of the running. VISTAR folks have been looking for alternate ways to get back onto the bird and there is the **possibility** that they **may** sub-let transponder 20 time from HBO (HBO maintains transponder twenty as a standby transponder).

Not everyone was 'pleased' with the channel assignment; primarily because of the way transponder 18 finally was assigned. Southern Satellite Systems' Ed Taylor has for more than a year been counting on having transponder 18 for KTVU. No formal contract was ever signed with RCA (primarily because when you sign a contract you start paying money immediately) but Taylor felt 'comfortable' (he said) with the **'understanding'** he **had** with RCA. When the new transponder assignments were released SSS lost 18 to Reuters which plans a new format slow scan video news service there.

All of the new 'assignees' began paying transponder rent for their new transponders as of October first. This means that from $40 to $60,000 per month is now going to RCA for these additional transponders, from would-be users who to date have not begun to use the transponders. Southern Satellite's transponders 1 and 13, and United Video's transponder 3 cannot begin service until the FCC acts on

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AmeriCom Satellite Network, Inc., 6350 LBJ Freeway, Suite 148, Dallas, TX (**S4**) 214—341-4502
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Applied Data Research, Inc., Route 206 Center CN-8, Princeton, NJ 08540 (**M9**) 609—921-8550
Avantek, Inc., 3175 Bowers Avenue, Santa Clara, CA 95051 (**M8**) 408—249-0700
Belden Corp., Electronic Division, P.O. Box 1327, Richmond, IN 47374 (**M3**) 317—966-6661
BESTON ELECTRONICS, INC., 903 South Kansas Ave., Olathe, KS 66061 (**M9 Character Generators**) 913—764-764-1900
Bestvision Home Cinema, Inc., 5540 W. Glendale Ave., Suite C-106, Glendale, Az. 85301 (**S9 Pay-TV programming and marketing**) 602—931-9157
BLONDER-TONGUE LABORATORIES, One Jake Brown Rd., Old Bridge, N.J. 08857 (**M1, M2, M4, M5, M6, M7**) 201—679-4000
BROADBAND ENGINEERING, INC., 1525 Cypress Dr., Jupiter, FL 33458 (**D9, replacement parts**) 1-800-327-6690
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CCS HATFIELD/CATV DIV., 5707 W. Buckeye Rd., Phoenix, AZ. 85063 (**M3**) 201—272-3850
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COLLINS COMMERCIAL TELECOMMUNICATIONS, MP-402-101, Dallas, TX 75207 (**M9, Microwave**) 214—690-5954
COMM/SCOPE COMPANY, Rt. 1, Box 199A, Catawba, NC 28609 (**M3**) 704—241-3142
COMMUNICATIONS EQUITY ASSOCIATES, 651 Lincoln Center, 5401 W. Kennedy Blvd., Tampa, FL 33609 (**S3**) 813—877-8844
COMPUTER VIDEO SYSTEMS, INC., Suite E, 6290 McDonough D., Norcross, GA 30093 (**M9**) 404—449-3800
Comsearch, Inc., 2936 Chain Bridge Rd., Oakton, VA 22124 (**S8, S9 earth station placement frequency coordination**) 703—281-5550
ComSoncis, Inc., P.O. Box 1106, Harrisonburg, VA 22801 (**M8, M9, S8, S9**) 703—434-5965
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Custom Building Products, Inc., P.O. Box 32231, Okla. City, OK 73132, (**S9, Underground Boring Equip.**) 405—495-1935
Daniels & Associates, 2930 E. 3rd Ave., Denver, Colo. 80206 (**S3, S9 Brokerage**) 303—321-7550
DAVCO, INC., P.O. Box 861, Batesville, AR 72501 (**D1, S1, S2, S8**) 501—793-3816
DF Countryman Co., 1821 University Ave., St. Paul, MN 55104 (**D1, S1, S8**) 612—645-9153
Durnell Engineering, Inc., Hwy. 4 So., Emmetsburg, Iowa 50536, (**M9**) 712—852-2611
EAGLE COM-TRONICS, INC., P.O. Box 93, Phoenix, NY 13135 (**M9 Pay TV Delivery Systems & Products**) 315—695-5406
EALES COMM. & ANTENNA SERV., 2904 N.W. 23rd, Oklahoma City, OK 73107 (**D1,2,3,4,5,6,7,S1,2,S7,8**) 405—946-3788
FANFARE TELEVISION, 10 Greenway Plaza, Houston, TX 77046 (**S4**) 713—960-8731
FARINON ELECTRIC, 1691 Bayport, San Carlos, CA 94070 (**M9, S9**) 415—592-4120
FERGUSON COMMUNICATIONS CORP., P.O. Drawer 871, Henderson, TX 75652 (**S1, S2, S7, S8, S9**) 214—854-2405
Gardiner Communications Corp., 2000 S. Post Oak Rd., Suite 1490, Houston, TX 77056 (**M9 TVRO Packages, S1, S2, S8**) 713—961-7348
GILBERT ENGINEERING CO., P.O. Box 14149, Phoenix, AZ 85063 (**M7**) 602—272-6871
Heller-Oak Communications Finance Corp., 105 W. Adams St., Chicago, IL 60603 (**S3**) 312—621-7661
HOME BOX OFFICE, INC., 7839 Churchill Way—Suite 133, Box 63, Dallas, TX 75251 (**S4**) 214—387-8557
HUGHES MICROWAVE COMMUNICATIONS PRODUCTS, 3060 W. Lomita Blvd., Torrance, CA 90505 (**M9**) 213—534-2146
Ind. Co. Cable TV Inc., P.O. Box 3799, Batesville, AR 72501 (**D1, S1, S2, S8**) 501—793-5872
International Microwave Corporation, 33 River Road, Cos Cob, CT 06807, (**M1, M4**) 203—661-6277
ITT SPACE COMMUNICATIONS, INC., 69 Spring St., Ramsey, NJ 07446 (**M9**) 201—825-1600
JERROLD Electronics Corp., P.O. Box 487, Byberry Rd. & PA. Turnpike, Hatboro, PA 19040, (**M1, M2, M4, M5, M6, M7, D3, D8, S1, S2, S3, S8**) 215—674-4800
JERRY CONN ASSOCIATES, INC., P.O. Box 444, Chambersburg, PA 17201 (**D3, D4, D5, D6, D7, D8**) 717—263-8258
Klungness Electronic Supply, P.O. Box 547, 107 Kent Street, Iron Mountain, MI 49801 (D1, D8, S2, S8) 906—774-1755
LARSON ELECTRONICS, 311 S. Locust St., Denton, TX 76201 (**M9 Standby Power**) 817—387-0002
LRC Electronics, Inc., 901 South Ave., Horseheads, N.Y. 14845 (**M7**) 607—739-3844
Magnavox CATV Division, 133 West Seneca St., Manlius, N.Y. 13104 (**M1**) 315—682-9105
MICRODYNE CORPORATION, P.O. Box 1527, 627 Lofstrand La., Rockville, MD 20850, (**M9 Satellite TV Recs.**) 301—762-8500
MICROWAVE ASSOCIATES, INC., 777 S. Central Expwy., Suite 4-C, Richardson, TX 75080 (**M9 Microwave Radio Systems**) 816—891-8895
Microwave Filter Co., 6743 Kinne St., Box 103, E. Syracuse, N.Y. 10357 (**M5 Bandpass Filters**) 315—437-4529

pending common carrier applications. Warner Star Channel transponders (5 and 11) will possibly utilize the new Ed Taylor owned and operated Atlanta uplink when it begins service at the end of December. Ultimately it is likely that Warner will build its own uplink and locate it in the Columbus, Ohio area. ESP and HBO (level two service) are expected to begin service around 1 January. Reuters also is talking about a 1 January start date.

The two WGN services would originate at the Lake Geneva (Wisconsin) uplink site of RCA. KTVU would originate at the San Francisco uplink site for RCA (at least temporarily). These three uplinks **could be** in service within days or weeks of FCC approval. The pair of Warner uplinks, if they originate via Southern Satellite's new Atlanta uplink terminal, cannot be up until at least December 27th. If they originate at the RCA Vernon Valley site instead of Atlanta, they (like ESP which is also expected to originate there along with Reuters) will have to wait until mid to late December while RCA upgrades and expands its uplink transmitter capability at the Vernon Valley site.

Because of the recent changes a revised transponder use chart appears here this month.

Trend Setter?

For many-many months now the volume of business at the nation's principal suppliers of satellite receive site frequency coordination has been running along at a combined total of perhaps 120-150 sites per month. By most estimates, approximately 1,500 (CATV) sites have now been processed in this preliminary application area.

Obviously there is a top limit as to how many CATV terminals will eventually be built for cable and an even earlier limit as to how many will be built in the first 'gold rush'.

Because applications for frequency coordination run 30-120 days ahead of FCC applications for actual licensing, there is a purpose to be served in monitoring such applications at this preliminary level. Our sources indicate that for whatever reason there has been a rather 'abrupt' pullup in applications received in recent weeks with some sources indicating the drop off has been as much as 50%.

Bob Shannon of Compucon voices the opinion that the drop off may be a combination of 'several factors' including normal seasonal variations (installation of TVRO terminals in more northern locations is hardly winter sport). For what it is worth, the curve is now sliding the other way.

Another Religious Transponder?

Faith Center, a religious television broadcaster operating television stations WHCT (Hartford, Ct. - channel 18), KHOF (San Bernadino/Los Angeles - channel 30) and KVOF (San Francisco - channel 38) is reportedly eyeing satellite distribution of its programming. This religious broadcast group, headquartered in Glendale, California, has been through some tough financial times recently but is apparently now out of the woods and actively looking for new 'affiliates'. The station recently signed up channel 66 in Manassas, Virginia as a new 'affiliate'. Expected start date for satellite signal delivery is mid-1979.

MID STATE Communication, Inc., P.O. Box 203, Beech Grove, IN 46107 (**M8**) 317–787-9426
Modern Cable Programs Division of Modern Talking Picture Service, Inc., 2323 New Hyde Park Road, New Hyde Park, NY 11042 (**S4**) (516) 437-6300
MSI TELEVISION, 4788 South State St., Salt Lake City, UT 84107 (**M9 Digital Video Equip.**) 801–262-8475
NORTHERN CATV DISTRIBUTORS, INC., 8016 Chatham Dr., Manlius, NY 13104 (**D1**) 315–682-2670
OAK INDUSTRIES INC./CATV DIV., Crystal Lake, IL 60014 (**M1, M9 Converters, S3**) 815–459-5000
PRODELIN, INC., 1350 Duane Avenue, Santa Clara, CA 95050 (**M2, M3, M7, S2**) 408–244-4720
Q-BIT Corporation, P.O. Box 2208, Melbourne, FL 32901 (**M4**) 305–727-1838
RADIO MECHANICAL STRUCTURES, INC., P.O. Box 1277, Kilgore, TX 75662 (**M2, M9, S2**) 214–984-0555
R F SYSTEMS, INC., P.O. Box 428, St. Cloud, FL 32769, (**M2, M6**) 305–892-6111
RICHEY DEVELOPMENT CORP., 6920 Melrose, Oklahoma City, OK 73127 (**M1, M4, M8, S8**) 405–495-3953
RMS CATV Division, 50 Antin Place, Bronx, NY 10462 (**M5, M7**) 212–892-1000
Sadelco, Inc., 299 Park Avenue, Weehawken, NJ 07087 (**M8**) 201–866-0912
Scientific Atlanta Inc., 3845 Pleasantdale Rd., Atlanta, GA 30340 (**M1, M2, M4, M8, S1, S2, S3, S8**) 404–449-2000
SCIENTIFIC COMMUNICATIONS, INC., 3425 Kingsley Rd., Garland, TX 75041. (**M4 Low Noise & Parametric**) 214–271-3685
Showtime Entertainment, Inc., 1211 Ave. of the Americas, New York, NY 10036 (**S4**) 212–575-5175
Southern Satellite Systems, Inc., P.O. Box 45684, Tulsa, OK 74145 (**S9**) 918–664-4812
Systems Wire and Cable, Inc., P.O. Box 21007, Phoenix, AZ 85036 (**M3**) 602–268-8744
TERRACOM, 9020 Balboa Ave., San Diego, CA 92123 (**M9 Microwave Earth Stations**) 714–278-4100
TEXSCAN Corp., 2446 N. Shadeland Ave., Indianapolis, IN 46219 (**M8 Bandpass Filters**) 317–357-8781
The Associated Press, 50 Rockefeller Plaza, New York, NY 10020 (**S4**) 303–825-6046
Theta-Com CATV, Division of Texscan Corporation, 2960 Grand Avenue, Phoenix, AZ. 85061, (M1, M4, M5, M7, M8) 602–252-5021
TIMES WIRE & CABLE CO., 358 Hall Avenue, Wallingford, CT 06492 (**M3**) 203–265-2361
Tocom, Inc., P.O. Box 47066, Dallas, TX 75247 (**M1, M4, M5, Converters**) 214–438-7691
TOMCO COMMUNICATIONS, INC., 1077 Independence Ave., Mtn. View, CA 94043 (**M4, M5, M9**) 415–969-3042
Toner Cable Equipment, Inc., 418 Caredean Drive, Horsham, PA 19044 (**D2, D3, D4, D5, D6, D7**) 215–675-2053
Trenco Inc., P.O. Box N, 385 South 300 West, Salem, UT 84653 (**S1, S2, S7, S8, S9 Consulting**) 801–798-8633
Triple Crown Electronics Inc., 42 Racine Rd., Rexdale, Ontario, Canada M9W2Z3 (**M4, M8**) 416–743-1481
TURNER COMMUNICATIONS CORP., (WTCG-TV), P.O. Box 4064, Atlanta Stadium, Atlanta, GA (**S9**) 404–522-7250
UNITED PRESS INTERNATIONAL, 220 East 42nd St., New York, NY 10017, (**S9 Automated News Svc.**) 212–682-0400
UNITED STATES TOWER & FAB. CO., P.O. Drawer "S", Afton, OK 74331 (**M2, M9**) 918–257-4257
United Video, Inc., 5200 S. Harvard, Suite 4-D, Tulsa, OK 74135 (**S9**) 918–749-8811
Van Ladder, Inc., P.O. Box 709, Spencer, Iowa 51301 (**M9, Automated Ladder Equipment**) 712–262-5810
VIDEO DATA SYSTEMS, 40 Oser Avenue, Hauppauge, NY 11787 (**M9**) 516–231-4400
VITEK ELECTRONICS, INC., 200 Wood Ave., Middlesex, NJ 201–469-9400
WAVETEK Indiana, 66 N. First Ave., Beech Grove, IN 46107 (**M8**) 317–783-3221
WEATHERSCAN, Loop 132, Throckmorton Hwy., Olney, TX 76374 (**D9, Sony Equip. Dist., M9 Weather Channel Displays**) 817–564-5688
Western Communication Service, Box 347, San Angelo, TX 76901 (**M2, Towers**) 915–655-6262/653-3363
Winegard Company, 3000 Kirkwood Street, Burlington, Iowa 52601 (**M2, M3, M4, M5, M7**) 319–753-0121

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M3—CATV cable
M4—CATV amplifiers
M5—CATV passives
M6—CATV hardware
M7—CATV connectors
M8—CATV test equipment
M9—Other

Service Firms:
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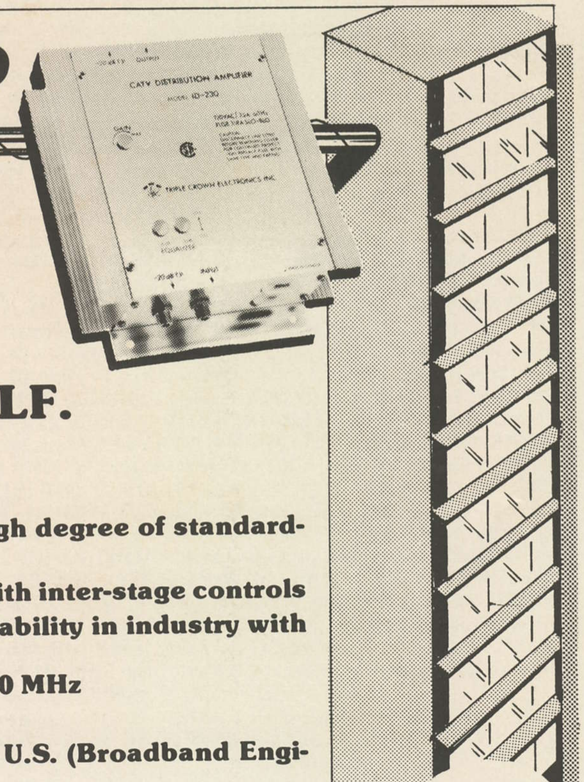

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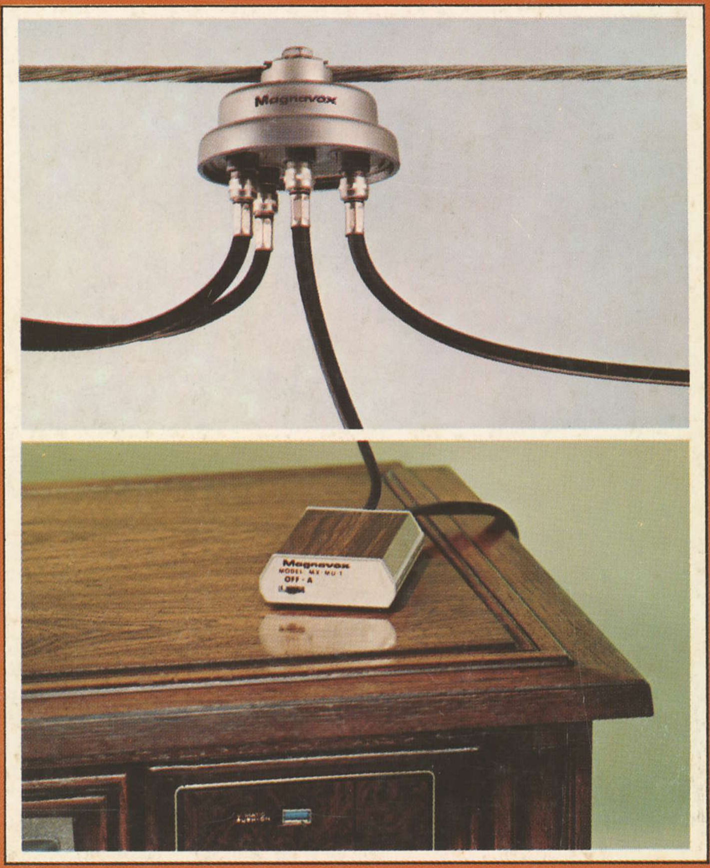

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